PINNACLE
ACTUARIAL RESOURCES, INC.

3109 Cornelius Drive
Bloomington, IL 61704
309.807.2300
pinnacleactuaries.com
Roosevelt C. Mosley, Jr., FCAS, MAAA
rmosley@pinnacleactuaries.com
Direct: 309.807.2330

November 12, 2019

The Honorable Brian D. Montgomery
Assistant Secretary for Housing – Federal Housing Commissioner
U.S. Department of Housing and Urban Development
451 Seventh Street, S.W., Room 9100
Washington, D.C. 20410

Dear Mr. Montgomery:

Pinnacle Actuarial Resources, Inc. (Pinnacle) has completed the final report for the Fiscal Year 2019 Independent Actuarial Review of the Mutual Mortgage Insurance Fund Forward Loans. The attached report details our estimate of the Cash Flow Net Present Value for fiscal year 2019 as of September 30, 2019.

Roosevelt C. Mosley, Jr., FCAS, MAAA is responsible for the content and conclusions set forth in the report. I am a Fellow of the Casualty Actuarial Society and a member of the American Academy of Actuaries, and am qualified to render the actuarial opinion contained herein.

It has been a pleasure working with you and your team to complete this study. I am available for any questions or comments you have regarding the report and its conclusions.

Respectfully Submitted,

Roosevelt Mosley

Roosevelt C. Mosley, Jr., FCAS, MAAA
Principal and Consulting Actuary

Fiscal Year 2019 Independent Actuarial Review of the Mutual Mortgage Insurance Fund: Economic Net Worth of Forward Mortgage Insurance-In-Force

November 12, 2019

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Commitment Beyond Numbers

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Summary of Findings

This report presents the results of Pinnacle Actuarial Resources, Inc.'s (Pinnacle's) independent actuarial review of the Economic Value associated with forward mortgages insured by the Mutual Mortgage Insurance Fund (MMIF or Fund) for fiscal year 2019. The Economic Value associated with Home Equity Conversion Mortgages (HECMs) are analyzed separately and are excluded from this report. In the remainder of this report, the term MMIF refers to forward mortgages and excludes HECMs.

Below we summarize the findings associated with each of the required deliverables.

Deliverable 1: Produce a written Actuarial Study for Forward that provides actuarial central estimates of MMIF economic net worth as of the end of fiscal year 2019 and assesses HUD's estimates of economic net worth.

The Economic Net Worth is defined as cash available to the Fund plus the Net Present Value (NPV) of all future cash outflows and inflows that are expected to result from the mortgages currently insured by the MMIF.

As of the end of Fiscal Year 2019, Pinnacle's Actuarial Central Estimate (ACE) of the MMIF Forward Cash Flow NPV is $18.643 billion.

The total capital resources as reported in FHA's audited financial statement are $54.600 billion at the end of Fiscal Year 2019. Thus, the ACE of the economic net worth of the MMIF is $73.243 billion.

Deliverable 2: Include a review of the risk characteristics of existing MMI loans including commentary on how such characteristics have changed in recent years.

A review of the risk characteristics of existing MMIF loans, and a commentary on how these risk characteristics have changed is included in Section 4.

Deliverable 3: Apply the final Forward actuarial model to the existing portfolio to produce conditional (and cumulative) claim, prepayment, and loss-given-default rates at various levels of aggregation across loans, and for individual policy years and policy year-quarter. Cash-flow summaries should also be provided for major categories (e.g., premium revenues, claim expenses and recoveries or net loss due to claim, with affected loan counts and balances).

Appendix G shows the interim and final claim rates, non-claim termination rates and loss severities by cohort. Each of these elements is calculated for each year of developed experience, and final projections are also included. Cash flow summaries by major category and credit subsidy cohort are shown below and discussed in more detail in Sections 2 and 3.

Table 1: Cash Flow Summaries

Cash Flow Category	Net Present Value of Cash Flow
Mortgage Insurance Premium	51,019,345,411
Loss Incurred	26,257,697,158
Loss Mitigation Expense	538,969,423
HAMP Expense	17,116,393,003
HAMP Recovery	11,536,492,194

Deliverable 4: To promote transparency of the Studies' assessments, the Studies should identify methodological vulnerabilities that may occur in its actuarial models or in HUD's analyses of economic net worth. This discussion should evaluate the scope and scale of such vulnerabilities in creating possible forecast risk and suggest possible lines of research in these areas. The Studies should assess and comment upon HUD's own models that estimate economic net worth for methodological vulnerabilities and compare HUD's methodologies with those in the Studies.

The assumptions and judgments on which the Cash Flow NPV estimates are based are summarized in Section 5 of this report. Appendix B shows the specifications and assumptions related to the transition models. Appendix C details the loss severity models. Section 3 describes the economic assumptions incorporated into the Cash Flow NPV estimates and the sensitivity of the estimates to alternative economic scenarios. Lastly, Section 5 and Appendix E summarize the assumptions associated with the cash flow analysis.

Section 3 provides a discussion of the economic conditions that could result in material adverse change to the Cash Flow NPV.

Appendix F provides a discussion of the HUD methodologies for estimating economic net worth, a comparison of HUD modeling methodology to those used in this study, and methodological vulnerabilities of the HUD models.

Deliverable 5: The Studies should include historical data on changes in program terms as well as relevant loan and borrower characteristics (e.g., credit scores, loan-to-value ratios) by cohort and other sub-populations. Loan performance data (claim rates, prepayment rates, severity and recovery rates) both historical and projected should be presented in the "finger-table" formats (arrayed by cohort and policy years for different loan products).

A review of the risk characteristics of existing MMIF loans, and a commentary of how these risk characteristics have changed is included in Section 4. Appendix G shows the interim and final claim rates, non-claim termination rates and loss severities by cohort. Each of these elements is calculated for each year of developed experience, and final projections are also included.

Deliverable 6: The Contractor should use the President's Economic Assumptions (provided by ORMRA) for the actuarial central estimates of the Studies. However, in addition to the central single path economic forecast, the Studies should test alternative economic forecasts for stress-testing and sensitivity analysis to estimate

ranges of reasonableness.

Pinnacle's ACE of Cash Flow NPV is based on the Economic Assumption for the 2020 Mid-Session Review from the Office of Management and Budget (OMB Economic Assumptions). Pinnacle also estimated Cash Flow NPV outcomes based on economic scenarios from Moody's Analytics (Moody's). The Cash Flow NPV results based on these scenarios are shown in Table 2.

Table 2: Range of Cash Flow NPV Outcomes Based on OMB & Moody's Scenarios

Economic Scenario	Fiscal Year 2019 Cash Flow NPV
Pinnacle ACE	18,642,778,021
Moody's Baseline	14,922,052,292
Moody's Exceptionally Strong Growth	22,674,040,769
Moody's Stronger Near-Term Rebound	17,615,671,583
Slower Near Term Growth	9,179,188,845
Moderate Recession	(7,409,866,362)
Protracted Slump	(20,722,269,452)
Below-Trend Long-Term Growth	7,579,187,543
Stagflation	7,717,331,307
Next Cycle Recession	12,607,557,514
Low Oil Price	13,493,371,888

The range of results based on the Moody's estimates is negative $20.722 billion to positive $22.674 billion.

In addition, Pinnacle has estimated a range of outcomes based on 100 randomly generated stochastic simulations of key economic variables. Based on these simulations, the range of Cash Flow NPV estimates is negative $41.910 billion to positive $26.753 billion. The largest negative Cash Flow NPV result is $16 billion lower than the next lowest outcome. Excluding this outlier, the range of Cash Flow NPV estimates is negative $25.647 billion to positive $26.753 billion.

The Cash Flow NPV estimate provided by the Federal Housing Administration (FHA) to be used in the FHA's Annual Report to Congress is positive $12.014 billion. Based on Pinnacle's Actuarial Central Estimate and range of reasonable estimates, we conclude that the FHA estimate of Cash Flow NPV to be used in the FHA's Annual Report to Congress is reasonable.

Pinnacle's Cash Flow NPV by cohort is shown below for the second largest negative outcome and the largest positive outcome based on the stochastic simulation results.

Table 3: Range of Cash Flow NPV Estimates - Forward Portfolio

Cohort	Largest Negative	Largest Positive	Pinnacle ACE
1992	-1,250,503	-743,426	-964,379
1993	-2,509,984	-1,533,373	-1,505,856
1994	-5,389,117	-2,939,749	-3,691,587
1995	-5,121,601	-1,631,418	-2,217,322
1996	-10,809,360	-3,785,126	-4,824,385
1997	-13,533,195	-3,313,678	-4,399,747
1998	-41,041,124	-12,467,652	-16,465,047
1999	-57,837,914	-11,242,102	-21,252,503
2000	-56,285,864	-15,158,785	-20,059,952
2001	-160,495,875	-70,111,132	-80,064,092
2002	-279,458,284	-126,361,544	-145,655,283
2003	-470,780,457	-195,903,973	-254,746,816
2004	-715,890,733	-292,107,549	-388,164,088
2005	-760,431,866	-339,169,341	-408,055,227
2006	-697,499,354	-312,860,116	-385,717,452
2007	-979,986,856	-458,897,177	-549,275,326
2008	-2,573,850,455	-1,245,290,635	-1,522,433,723
2009	-4,553,910,558	-1,860,505,679	-2,212,273,315
2010	-3,497,438,285	-1,485,451,347	-1,772,613,482
2011	-1,915,781,179	-760,117,226	-892,387,658
2012	-2,206,485,943	-858,069,591	-679,992,580
2013	-2,245,622,958	-427,072,427	-132,736,288
2014	514,751,510	2,510,048,460	2,148,162,157
2015	-257,550,265	4,361,683,330	3,801,723,984
2016	-2,155,132,300	6,407,204,130	5,511,602,471
2017	-923,775,613	8,300,381,661	6,506,912,896
2018	-588,398,350	6,769,990,189	4,903,707,739
2019	-985,016,220	6,888,415,728	5,270,164,879
Total	-25,646,532,701	26,752,990,453	18,642,778,021

Deliverable 7: To provide comparability to HUD estimates of economic net worth, the Contractor shall use Federal Credit Reform Act discounting assumptions and procedures.

Pinnacle has developed estimates of economic net worth using the Fair Credit Reform Act discounting assumptions.

Deliverable 8: These Studies should use stochastic or Monte Carlo simulations of future economic conditions including for interest rates and house price appreciation. The objective of these requirements is to illustrate the sensitivity of forecasts to economic uncertainty and other forms of forecast error.

As described in the results for Deliverable 6, additional economic assumptions were generated using Monte

Carlo simulations and Moody's economic scenarios. These results are discussed in further detail in Section 3.

Deliverable 9: Provide econometric appendices to the Studies that include variable specifications and statistical output from all regressions in the Studies. Individual estimation equations may not be combined for reporting.

Appendix B shows the predictive model parameters and goodness of fit measures for the Transition models. Appendix C shows the parameters and goodness of fit measures for the Loss Severity models. See the Binomial Model Results and Model Validation sections in Appendix B and the Model Parameters and Model Validation sections in Appendix C.

Executive Summary

The 1990 Cranston-Gonzalez National Affordable Housing Act (NAHA) requires an independent actuarial analysis of the economic value of the FHA and Department of Housing and Urban Development's (HUD's) MMIF. Enacted on July 30, 2008, the Housing and Economic Recovery Act of 2008 (HERA) moved the requirement for an independent actuarial review into 12 USC 1708(a)-(4).

HERA also moved several additional programs into the MMIF. One of them, HECMs, which are reverse mortgages, is analyzed separately and is excluded from this report. In the remainder of this report, the term MMIF refers to forward mortgages and excludes HECMs.

The primary purpose of this actuarial analysis is to estimate the Economic Net Worth of the current book of business. The economic net worth is defined as cash available to the Fund plus the NPV of all future cash outflows and inflows that are expected to result from the mortgages currently insured by the MMIF.

We have calculated a range of estimates using economic projections from the OMB Economic Assumptions for Fiscal Year 2020, ten economic projection scenarios from Moody's and a stochastic simulation approach to test variation from the base economic scenario.

Based on our analysis, we estimate that the Cash Flow NPV as of the end of fiscal year 2019 is $18.643 billion. We also estimate that the range of Cash Flow NPV based on randomly generated economic scenarios is between negative $25.647 billion and positive $26.753 billion.

The total capital resource as reported in FHA's audited financial statement is $54.600 billion at the end of Fiscal Year 2019. Thus, the estimated economic net worth of the MMIF is $73.243 billion.

Impact of Economic Forecasts

The Cash Flow NPV of the MMIF depends on many factors. One of the most important set of factors is the prevailing economic conditions over the next 30 years, and most critically during the next 10 years. We incorporate the most significant factors in the U.S. economy affecting the performance of the mortgages insured by the MMIF through the use of the following variables in our models:

- 30-year fixed-rate home mortgage effective rates
- 10-year Constant Maturity Treasury (CMT) rates
- 3-year CMT rates
- 1-year CMT rates
- Housing price index (HPI)
- Unemployment rates

The projected Cash Flow NPV of FHA's books of business is affected by changes in these economic variables. The ACE in this report is derived from using the OMB Economic Assumptions.

We have also estimated the Cash Flow NPV of the MMIF under ten economic scenarios from Moody's. These scenarios are:

1. Baseline
2. Exceptionally Strong Growth
3. Stronger Near-Term Rebound
4. Slower Near-Term Growth
5. Moderate Recession
6. Protracted Slump
7. Below-Trend Long-Term Growth
8. Stagflation
9. Next-Cycle Recession
10. Low Oil Price

These scenarios do not represent the full range of possible future economic paths, but represent a considerable variation of economic conditions. Therefore they provide insights into the projected Cash Flow NPV of the MMIF under a range of economic environments.

We have also developed an estimate of the Cash Flow NPV using HUD data aggregated at the origination year level.

The summary of the estimated Cash Flow NPV resulting from each scenario is shown in Table 4.

Table 4: Projected Forward Cash Flow NPV Using Alternative Economic Scenarios

Economic Scenario	Fiscal Year 2019 Cash Flow NPV
Pinnacle ACE	18,642,778,021
Moody's Baseline	14,922,052,292
Moody's Exceptionally Strong Growth	22,674,040,769
Moody's Stronger Near-Term Rebound	17,615,671,583
Slower Near Term Growth	9,179,188,845
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Protracted Slump	(20,722,269,452)
Below-Trend Long-Term Growth	7,579,187,543
Stagflation	7,717,331,307
Next Cycle Recession	12,607,557,514
Low Oil Price	13,493,371,888

We also randomly generated 100 stochastic simulations of key economic variables. Based on these simulations, the range of Cash Flow NPV estimates is negative $41.910 billion to positive $26.753 billion. The largest negative Cash Flow NPV result is $16 billion lower than the next lowest outcome. Excluding this outlier, the range of Cash Flow NPV estimates is negative $25.647 billion to positive $26.753 billion.

Distribution and Use

This report is being provided to FHA for its use and the use of makers of public policy in evaluating the Economic Net Worth of the MMIF. Permission is hereby granted for its distribution on the condition that the entire report, including the exhibits and appendices, is distributed rather than any excerpt. Pinnacle also acknowledges that this report will be included in the FHA's Annual Report to Congress, and permission is granted for this purpose as well. We are available to answer any questions that may arise regarding this report.

Any third parties receiving the report should recognize that the furnishing of this report is not a substitute for their own due diligence and should place no reliance on this report or the data contained herein that would result in the creation of any duty or liability by Pinnacle to the third party.

Our conclusions are predicated on a number of assumptions as to future conditions and events. These assumptions, which are documented in subsequent sections of the report, must be understood in order to place our conclusions in their appropriate context. In addition, our work is subject to inherent limitations, which are also discussed in this report.

Reliances and Limitations

Listed in Section 5 are the data sources Pinnacle has relied upon in our analysis. We have relied on the accuracy of these data sources in our calculations. If it is subsequently discovered that the underlying data or information is erroneous, then our calculations would need to be revised accordingly.

We have relied on a significant amount of data and information from external sources without audit or verification. This includes economic data projected over the next 30 years from Moody's and OMB. However, we did review as many elements of the data and information as practical for reasonableness and consistency with our knowledge of the mortgage insurance industry. It is possible that the historical data used to develop our estimates may not be predictive of future default and claim experience. We have not anticipated any extraordinary changes to the legal, social or economic environment which might affect the number or cost of mortgage defaults beyond those contemplated in the economic scenarios described in this report. To the extent that the realized economic conditions deviate significantly from these assumptions, the Economic Net Worth projections may differ, perhaps significantly, from actual results.

The predictive models used in this analysis are based on a theoretical framework and certain assumptions. This model structure predicts the rates of default, claim, loss and prepayment based on a number of individual mortgage characteristics and economic variables. The models are built using predictive modeling techniques, analyzing data from actual historical experience of FHA-insured mortgages. The parameters of the predictive models are estimated over a wide variety of mortgages originated since 1975 and their performance under the range of economic conditions and mortgage market environments experienced during the past 44 years. The predictive models are combined with assumptions about future behavior of current mortgage endorsements and certain key economic assumptions to produce future projections of the performance of the existing mortgages insured by the MMIF.

Pinnacle is not qualified to provide formal legal interpretation of federal legislation or FHA policies and procedures. The elements of this report that require legal interpretation should be recognized as reasonable interpretations of the available statutes, regulations and administrative rules.

Section 1: Introduction

Scope

HUD and FHA have engaged Pinnacle to perform the annual independent actuarial study of the MMIF. This study is required by 12 USC 1708(a)-(4) and must be completed in compliance with the Federal Credit Reform Act as implemented and all applicable Actuarial Standards of Practice (ASOPs). This study provides an analysis of the financial position of MMIF as of September 30, 2019, using data through September 30, 2019.

The MMIF is a group of accounts of the federal government which records transactions associated with the FHA's guarantee programs for single family mortgages. Currently, the FHA insures approximately 8.04 million forward mortgages under the MMIF and 353,000 reverse mortgages under the HECM program.

Per 12 USC 1711-(f), the FHA must endeavor to ensure that the MMIF maintains a capital ratio of not less than 2.0%. The capital ratio is defined as the ratio of capital to the MMIF obligations on outstanding mortgages (IIF). Capital is defined as cash available to the Fund plus the NPV of all future cash outflows and inflows that are expected to result from the mortgages currently insured by the MMIF.

The deliverables included in this study, as defined by the Statement of Work, are as follows:

1. Produce a written Actuarial Study for Forward that provides actuarial central estimates of MMI economic net worth as of the end of fiscal year 2019 and assesses HUD's estimates of economic net worth.

2. Include a review of the risk characteristics of existing MMI loans including commentary on how such characteristics have changed in recent years.

3. Apply the final Forward actuarial model to the existing portfolio to produce conditional (and cumulative) claim, prepayment, and loss-given-default rates at various levels of aggregation across loans, and for individual policy years and policy year-quarter. Cash-flow summaries should also be provided for major categories (e.g., premium revenues, claim expenses and recoveries or net loss due to claim, with affected loan counts and balances).

4. To promote transparency of the Studies' assessments, the Studies should identify methodological vulnerabilities that may occur in its actuarial models or in HUD's analyses of economic net worth. This discussion should evaluate the scope and scale of such vulnerabilities in creating possible forecast risk and suggest possible lines of research in these areas. The Studies should assess and comment upon HUD's own models that estimate economic net worth for methodological vulnerabilities and compare HUD's methodologies with those in the Studies.

5. The Studies should include historical data on changes in program terms as well as relevant loan and borrower characteristics (e.g., credit scores, loan-to-value ratios) by cohort and other sub-populations. Loan performance data (claim rates, prepayment rates, severity and recovery rates) both historical and projected should be presented in the “finger-table” formats (arrayed by cohort and policy years for different loan products).

6. The Contractor should use the President’s Economic Assumptions (provided by ORMRA) for the actuarial central estimates of the Studies. However, in addition to the central single path economic forecast, the Studies should test alternative economic forecasts for stress-testing and sensitivity analysis to estimate ranges of reasonableness.

7. To provide comparability to HUD estimates of economic net worth, the Contractor shall use Federal Credit Reform Act discounting assumptions and procedures.

8. The Studies should use stochastic or Monte Carlo simulations of future economic conditions including for interest rates and house price appreciation. The objective of these requirements is to illustrate the sensitivity of forecasts to economic uncertainty and other forms of forecast error.

9. Provide econometric appendices to the Studies that include variable specifications and statistical output from all regressions in the Studies. Individual estimation equations may not be combined for reporting.

Background

HUD was established in 1937 by the U.S. Housing Act of 1937. The current mission of HUD is:

> *…to create strong, sustainable, inclusive communities and quality affordable homes for all. HUD is working to strengthen the housing market to bolster the economy and protect consumers; meet the need for quality affordable rental homes; utilize housing as a platform for improving quality of life; build inclusive and sustainable communities free from discrimination, and transform the way HUD does business.*[1]

Congress created FHA in 1934. The FHA “provides mortgage insurance on loans made by FHA-approved lenders throughout the United States and its territories. FHA insures mortgages on single family and multifamily homes, including manufactured homes and hospitals. It is the largest insurer of mortgages in the world, insuring over 34 million properties since its inception in 1934.”[2] The mortgage insurance provided was done so through the establishment of the MMIF.

NAHA, enacted in 1990, introduced a minimum capital requirement for the MMIF[3]. By 1992, the capital ratio was to be at least 1.25%, and by 2000 the capital ratio was to be no less than 2.0%. The capital ratio is defined

[1] https://portal.hud.gov/hudportal/HUD?src=/about/mission
[2] https://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/fhahistory
[3] Public Law 101-625, 101st Congress, November 28, 1990, Section 332.

by NAHA as the ratio of capital to unamortized IIF. NAHA also implemented the requirement that an independent actuarial study of the MMIF be completed annually. HERA amended 12 USC 1708(a)-(4) to include the requirement for the annual actuarial study.

Given the purpose of HUD and FHA, availability of mortgages to a broad segment of the home-buying market is important to promote and strengthen the U.S. housing market. However, the capital requirements established by NAHA can potentially be in conflict with the desire for widespread availability of mortgage insurance. Since the implementation of NAHA, many of the steps taken by HUD have attempted to balance broader availability of mortgage insurance and the financial stability of the MMIF.

Mortgage Insurance Premiums

Adequate mortgage insurance premium (MIP) is key in maintaining the economic strength of the MMIF, but the level of MIP can also impact the ability of potential home buyers to afford a home. A summary of the adjustments in MIP since 1991 is shown below:

- In 1991, it was established that MIP would be determined as the combination of an upfront MIP and a yearly premium which was a percentage of the remaining outstanding mortgage balance each year.[4] Overall, this represented an increase in MIP, which was needed to help meet the new capital requirement established by NAHA.

- In 1994, the upfront MIP was decreased by 75 basis points to 2.25%.[5] This was in response to improved financial experience of the MMIF.

- In 1996, the upfront MIP was decreased by 25 basis points to 2.00% for first-time homebuyers that received mortgage counseling prior to purchasing their home.[6] This was implemented based on the success of a pilot program which showed that first-time homebuyers who received this counseling had better default experience.

- In 1997, the upfront MIP was decreased by an additional 25 basis points to 1.75% for first-time homebuyers that received mortgage counseling prior to purchasing their home. In total, the upfront MIP was 50 basis points lower than it would be for a homebuyer who did not receive counseling.[7]

- In 2000, in recognition of the improved experience of the MMIF, several changes were implemented. First, the upfront MIP was reduced by 75 basis points to 1.50%. Second, the upfront MIP refund

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[4] Mortgagee Letter 91-26, May 30, 1991: Single Family Insurance Processing for Risk Based Insurance Premiums.
[5] Mortgagee Letter 94-14, March 31, 1994: Single Family Loan Production – Reduced Upfront Mortgage Insurance Premium (UFMIP).
[6] Mortgagee Letter 96-48, August 28, 1996: Single Family Production – Reduction in Up-Front Mortgage Insurance Premiums (UFMIP) for First-Time Homebuyers Who Receive Housing Counseling.
[7] Mortgagee Letter 97-37, August 13, 1997: Single Family Production – Further Reduction in Up-Front Mortgage Insurance Premiums (UFMIP) for First-Time Homebuyers Who Receive Housing Counseling.

schedule was shortened to five years instead of seven years. Third, a provision to cancel the annual MIP once the loan-to-value (LTV) ratio was 78% or less was implemented. Also, the discount in the upfront MIP for first-time homebuyers that received counseling was canceled.[8]

- In April of 2010, upfront MIP was increased by 75 basis points to 2.25%.[9] This increase in premium was in response to the housing and economic crisis of 2008, and was the first in a series of increases over the next three years.

- In October of 2010, upfront MIP was decreased but annual MIP was increased significantly.[10] Overall, this resulted in an increase in MIP.

- In 2011, the annual MIP was increased by 25 basis points.[11]

- In 2012, the annual MIP was increased by 10 basis points.[12]

- In 2013, several changes were implemented related to annual MIP. First, the term for collection of MIP was extended to 11 years for mortgages with an initial LTV ratio of 90% or less, and for 30 years for mortgages with an initial LTV ratio of greater than 90%. Second, mortgages with terms of 15 years or less and LTV ratio of 78% or less at the time of origination, which were exempt from MIP, would no longer be exempt. Lastly, the annual MIP was increased by 5 to 10 basis points for mortgages with terms of 15 years or less and LTV ratios of 78% or less at origination.[13]

- As a result of improved financial experience, in 2015 annual MIP rates were decreased by 50 basis points for loans with terms greater than 15 years.[14]

- In 2017, a decrease was proposed for annual MIP rates[15], but this decrease was suspended later in the

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[8] Mortgagee Letter 2000-38, October 27, 2000: Single Family Loan Production – Further Reduction in Upfront Mortgage Insurance Premiums and Other Mortgage Insurance Premium Changes.
[9] Mortgagee Letter 2010-02, January 21, 2010: Increase in Upfront Premiums for FHA Mortgage Insurance.
[10] Mortgagee Letter 2010-28, September 1, 2010: Changes to FHA Mortgage Insurance Premiums.
[11] Mortgagee Letter 2011-10, February 14, 2011: Annual Mortgage Insurance Premium Changes and Guidance on Case Numbers.
[12] Mortgagee Letter 2012-04, March 6, 2012: Single Family Mortgage Insurance: Annual and Up-Front Mortgage Insurance Premium – Changes.
[13] Mortgagee Letter 2013-04, January 31, 2013: Revision of Federal Housing Administration (FHA) policies concerning cancellation of the annual Mortgage Insurance Premium (MIP) and increase to the annual MIP.
[14] Mortgagee Letter 2015-01, January 9, 2015: Reduction of Federal Housing Administration (FHA) annual Mortgage Insurance Premium (MIP) rates and Temporary Case Cancellation Authority.
[15] Mortgagee Letter 2017-01, January 9, 2017: Reduction of Federal Housing Administration (FHA) Annual Mortgage Insurance Premium (MIP) Rates.

year.[16]

Down Payment and Closing Costs

The source of funds for down payment and closing costs has been a significant issue for HUD. There are limitations on closing costs and down payment assistance that can be provided by sources other than the borrower or family, and there have been several mortgagee letters addressing this issue. Allowing assistance with down payments and closing costs increases the opportunity for more people to achieve homeownership. Historically, however, mortgages for which a larger percentage of the down payment and closing costs were provided by sources other than the borrowers own funds have demonstrated poorer performance. A summary of mortgagee letters addressing this is provided below:

- Prior to 1992, closing costs could not be financed in the loan. In 1992, the limitation on financing of closing costs was removed, but mortgages were still subject to LTV ratio limits.[17] This provision was implemented to make it easier for homebuyers to meet the down payment requirements.

- In 1996, HUD allowed family members to lend the borrower 100% of the down payment.[18] This also was intended to make it easier for borrowers to achieve homeownership.

- Two provisions were implemented in 1998. First, it was prohibited for the seller or any other party to pay mortgage interest for the buyer. In addition, any interest rate buydown could not result in a reduction in the interest rate of more than 2% below the note rate. These changes were implemented to avoid a significant increase in the payment amount once the seller-paid mortgage interest funds were depleted or the interest rate buydown term was complete.[19]

- In 2000, guidance was provided by HUD to mortgagees to ensure that the source of the gifts to buyers is documented, and the person giving the gift must certify that the funds did not come from someone with an interest in the transaction. This was implemented to combat a practice of the sellers providing funds to family members of the buyer that would then be used for the down payment.[20]

- In 2019, guidance by HUD was provided to clarify the rules associated with funds being provided by a governmental source for down payment assistance. The Mortgagee Letter requires the Mortgagee to

[16] Mortgagee Letter 2017-07, January 20, 2017: Suspension of Mortgagee Letter 2017-01 – Reduction of Federal Housing Administration (FHA) Annual Mortgage Insurance Premium (MIP) Rates.
[17] Mortgagee Letter 92-39, October 16, 1992: Single Family Loan Production - Elimination of Limit on Financing Closing Costs.
[18] Mortgagee Letter 96-58, October 23, 1996: Single Family Loan Production - Secondary Financing from Family Members.
[19] Mortgagee Letter 98-1, January 2, 1998: Single Family Loan Production - Underwriting Adjustable Rate Mortgages, Interest Buydowns, Homeownership Counseling and Other Credit Policy Issues
[20] Mortgagee Letter 2000-28, August 7, 2000: Gift Documentation, Mortgage Forms and other Credit Policy and Appraisal Issues.

> verify that the funds provided by the government agency were transferred to the Borrower before or at the time of closing, and that the governmental agency was acting in its legal capacity in providing these funds. Documentation is also required from the government that the agency has the authority to provide the funds, and from an attorney for the government entity verifying that the property is within the government agency's jurisdiction. There can be no direct transfer of assistance from the government agency to the Mortgagee, and there can be no requirement that the loan be transferred to a specific Mortgagee as a condition of receiving assistance from the government agency.[21]

This guidance was subsequently suspended until further notice[22] and ultimately rescinded.[23]

Homebuyer Counseling

Counseling for homebuyers was encouraged historically by FHA with the idea that if homebuyers were educated on issues of homeownership and mortgages, they would be less likely to default on the mortgage and would be more responsible homeowners. The history of mortgagee letters related to homebuyer counseling is outlined below:

- In 1993, a pilot of a counseling program for pre-purchase and pre-foreclosure situations was announced.[24]

- In 1996, after the pilot of the counseling program, the upfront MIP was decreased by 25 basis points for first-time homebuyers who complete homeownership counseling.[25] Just one year later in 1997, the upfront MIP was decreased by an additional 25 basis points for first-time homebuyers who complete homeownership counseling.[26] This discount was provided to recognize expected improvement in default experience.

- In 1998, a mortgagee letter was released indicating that the homeownership counseling program would be reviewed. This was in response to homeownership counseling programs that were being used that did not meet FHA guidelines. While the requirements of the counseling program were that it should involve 15 to 20 hours of instruction, there were cases where homebuyers were being provided with

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[21] Mortgagee Letter 19-06, April 18, 2019: Downpayment Assistance and Operating in a Governmental Capacity.
[22] Mortgagee Letter 19-06, July 23, 2019: Suspension of the Effective Date of Mortgagee Letter 2019-06, *Downpayment Assistance and Operating in a Governmental Capacity*.
[23] Mortgagee Letter 19-12, August 13, 2019: Rescission of Mortgagee Letters 2019-06, *Downpayment Assistance and Operating in a Governmental Capacity*; 2019-07, *Extension of the Effective Date of Mortgagee Letter 2019-06, Downpayment Assistance and Operating in a Governmental Capacity*; and 2019-10, *Suspension of the Effective Date of Mortgagee Letter 2019-06, Downpayment Assistance and Operating in a Governmental Capacity*.
[24] Mortgagee Letter 93-28, September 20, 1993: Prepurchase and Foreclosure Prevention Counseling Demonstration.
[25] Mortgagee Letter 96-48, August 28, 1996: Single Family Production - Reduction in Up-Front Mortgage Insurance Premiums (UFMIP) for First-Time Homebuyers Who Receive Housing Counseling.
[26] Mortgagee Letter 97-37, August 13, 1997: Single Family Production - Further Reduction in Up-Front Mortgage Insurance Premiums (UFMIP) for First-Time Homebuyers Who Receive Housing Counseling.

workbooks without additional interaction or instruction. The guidelines of the homeownership counseling program were reiterated in this letter.[27]

- In 2000, in conjunction with an overall reduction in upfront MIP, the homeownership counseling discount was discontinued.[28]

Adjustable Rate Mortgages

Adjustable rate mortgages (ARMs) are mortgages where the interest rate adjusts over the life of the loan. The interest rate adjustments are tied to interest rate indexes, such as Constant Maturity Treasury (CMT) rates. The interest rate at the beginning of the loan is typically lower than the prevailing fixed rate mortgage, and increases over the early years of the loan. The initial interest rate can be fixed for a varying period of time (one year, three years, five years, etc.) and, after the fixed interest rate period, can change yearly. Most ARMs also have a lifetime cap on how much the interest rate can increase relative to the initial interest rate.

Historically, the default rates related to ARM's have been higher than the default rates for fixed rate mortgages. This is based in part on the fact that as the interest rate increases, the monthly mortgage payment increases, and, as a result, the likelihood of borrower defaults increases. To address this, HUD has issued a series of mortgagee letters related to ARMs:

- In 1998, HUD issued guidance that for ARMs, borrowers must qualify using mortgage payments based on the contract or initial rate plus one percent, which effectively represents the second year interest rate. This applied to all mortgages with LTV ratios of greater than or equal to 95%. In addition, it prohibited any form of a temporary interest rate buydown. This was due to the fact that the payment shock associated with the termination of the buydown was causing default rates to increase to an unacceptable level.[29]

- In 2004, HUD expanded mortgage insurance availability to cover three-, five-, seven- and 10-year ARMs.[30]

- In 2007, the one-year London Interbank Offered Rate (LIBOR) was added as an acceptable index for ARMs.[31]

[27] Mortgagee Letter 98-1, January 2, 1998: Single Family Loan Production - Underwriting Adjustable Rate Mortgages, Interest Buydowns, Homeownership Counseling and Other Credit Policy Issues.
[28] Mortgagee Letter 2000-38, October 27, 2000: Single Family Loan Production - Further Reduction in Upfront Mortgage Insurance Premiums and Other Mortgage Insurance Premium Changes
[29] Mortgagee Letter 98-1, January 2, 1998: Single Family Loan Production - Underwriting Adjustable Rate Mortgages, Interest Buydowns, Homeownership Counseling and Other Credit Policy Issues.
[30] Mortgagee Letter 2004-10, March 19, 2004: Adjustable Rate Mortgages.
[31] Mortgagee Letter 2007-13, October 12, 2007: Adjustable Rate Mortgages—Addition of LIBOR Index.

Automated Underwriting Systems

Beginning in 1995, the use of automated underwriting systems (AUSs) began to increase. Theoretically, the use of AUSs increases the availability of mortgages, and improves the efficiency and speed of mortgage processing:

- In 1995, HUD approved usage of AUSs. Mortgagees had to request permission to use these systems and receive approval from HUD.[32]

- In 1996, criteria were established for the approval by HUD of AUSs.[33]

In 1998, FHA approved Freddie Mac's Loan Prospector for underwriting FHA-insured mortgages, using a scorecard custom-estimated for FHA endorsed loans. FHA also made a substantial number of revisions to its credit policies and reduced documentation requirements for loans assessed by Loan Prospector. This was the first time that FHA incorporated an AUS in its insurance endorsement process. Fannie Mae's Desktop Underwriter and PMI Mortgage Services' Automated Underwriting Risk Analysis (AURA) were approved to underwrite FHA mortgages in 1999, followed soon thereafter by Countrywide Funding Corporation's Countrywide Loan-Underwriting Expert System (CLUES) and JP Morgan-Chase's Zippy. Beginning in May 2004, all approved AUSs applied FHA's Technology-Open-To-Approved-Lenders (TOTAL) mortgage scorecard to evaluate loan applications for possible automated approval for FHA insurance. Initially, more than two-thirds of loans submitted generally received automated approval, eliminating the need for manual underwriting reviews. Since May 2004, HUD required lenders to submit borrower credit scores. Starting in July 2008, all loans were to be submitted through FHA's TOTAL scorecard. Additional guidance issued in February 2011 prohibited the use of the TOTAL scorecard on streamline refinance transactions.

Foreclosure Avoidance and Loss Mitigation Programs

The pre-foreclosure sale (PFS) program allows mortgagors to sell their homes and use the proceeds to satisfy their mortgage debt obligations even if the proceeds were less than owed. Ultimately, these programs help limit the number of defaults that turn into claims, and also limit the losses sustained by MMIF when a claim occurs. Over the years, FHA has issued a number of mortgagee letters related to foreclosure and loss mitigation:

- In 1996, a mortgagee letter was released to provide information on the loss mitigation procedures, including special forbearance plans, mortgage modifications, PFS's, deeds in lieu of foreclosure and partial claims. The primary objective was to keep the homeowner in the home, and if that was not possible then the objective was disposition of the property without full foreclosure.[34]

- In 2008, due to the increase in defaults resulting from the housing crisis, FHA released a mortgagee letter reminding mortgagees of PFS as an option and also consolidated the provisions of the PFS

[32] Mortgagee Letter 95-7, January 27, 1995: Single Family Loan Production - Revised Underwriting Guidelines and Other Policy Issues.
[33] Mortgagee Letter 96-34, July 10, 1996: Single Family Loan Production - Automated Underwriting Systems.
[34] Mortgagee Letter 96-61, November 12, 1996: FHA Loss Mitigation Procedures - Special Instructions.

program into one place. This letter also updated provisions of the PFS to better address the mortgage crisis.[35]

- In 2010, FHA released a mortgagee letter announcing enhancements to the FHA refinance program to allow responsible borrowers an opportunity to stay in their homes. This could occur if the lender agreed to write off at least 10% of the principal balance and if the remaining loan provisions were met.[36]

- In 2011, FHA issued guidance requiring a trial payment program prior to completing a permanent loan modification or partial claim. During the trial payment period, the borrower must complete three months of payments at the amount that will continue under the modification.[37]

- In 2012, FHA revised the Loss Mitigation Home Retention Options to reduce the claims against the MMIF and help more borrowers stay in their homes. These revisions included eliminating the maximum Back End Debt to Income ratio; eliminating the restriction on the principal, interest, taxes and insurance that can be included in the claim; and, eliminating the requirement that the existing mortgage be no more than 12 months past due.[38]

- In 2013, FHA established updated requirements for PFSs and Deed in Lieu (DIL) requirements. These changes included the use of the Deficit Income Test (DIT) and the elimination of the financial hardship/deficit income PFS requirement for servicemen who have received a Permanent Change of Station order.[39]

- In 2013, additional modifications were made to the FHA Loss Mitigation Home Retention Options. These changes included defining continuous income that can be considered in the transaction, allowing for arrearages to be included in partial claims, and allowing for modifications for mortgagors in bankruptcy.[40]

- In 2014, the updated PFS guideline required a minimum marketing period of 15 calendar days for all PFS transactions. It also clarified that non-arms-length transactions are permitted only if they are necessary to comply with state law.[41]

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[35] Mortgagee Letter 2008-43, December 24, 2008: Pre-Foreclosure Sale (PFS) Program - Utilizing the PFS Loss Mitigation Option to Assist Families Facing Foreclosure.
[36] Mortgagee Letter 2010-23, August 6, 2010: FHA Refinance of Borrowers in Negative Equity Positions.
[37] Mortgagee Letter 2011-28, August 15, 2011: Trial Payment Plan for Loan Modifications and Partial Claims under Federal Housing Administration's Loss Mitigation Program.
[38] Mortgagee Letter 2012-22, November 16, 2012: Revisions to FHA's Loss Mitigation Home Retention Options.
[39] Mortgagee Letter 2013-23, July 9, 2013: Updated Pre-Foreclosure Sale (PFS) and Deed in Lieu (DIL) of Foreclosure Requirements.
[40] Mortgagee Letter 2013-32, September 20, 2013: Update to FHA's Loss Mitigation Home Retention Options.
[41] Mortgagee Letter 2014-15, July 10, 2014: Updated Requirements for Pre-Foreclosure Sales (PFS) and Deeds in Lieu (DIL)

- Also in 2014, FHA issued a mortgagee letter to increase the use of Claims Without Conveyance of Title (CWCOT) procedures. This letter also established that the Commissioner's Adjusted Fair Market Value must be used for all foreclosure sales and PFS efforts.[42]

- In 2018, FHA issued a mortgagee letter implementing special loss mitigation processes for victims of Hurricanes Irma, Harvey and Maria and the California Wildfires. These procedures were implemented to help homeowners stay in their homes and reduce losses to FHA.[43]

- Later in 2018, FHA issued a mortgagee letter in response to continued elevated default rates and lower utilization of loss mitigation options in Puerto Rico and the U.S. Virgin Islands. This mortgagee letter expanded loss mitigation assistance to borrowers in default.[44]

- In 2019, HUD incorporated additional changes to further streamline and revise Loss Mitigation Procedures for Presidentially Declared Major Disaster Areas (PDMDAs).[45]

Current and Future Market Environment

In addition to the policies related to the MMIF, the default and claim rate and ultimately the Cash Flow NPV of the MMIF are dependent on the economic environment. As interest rates increase, mortgage rates tend to increase, which in turn causes default rates to increase. The general health of the economy impacts the value of homes. As home values increase, losses to the MMIF will tend to decrease as the value received in the disposition of a home increases. Also, as the general health of the economy improves, the demand for mortgages increases. This generally results in an increase in the demand for mortgages endorsed by the MMIF for mortgage insurance.

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of Foreclosure.

[42] Mortgagee Letter 2014-24, November 26, 2014: Increasing Use of FHA's Claims Without Conveyance of Title (CWCOT) Procedures.

[43] Mortgagee Letter 2018-01, February 22, 2018: Loss Mitigation for borrowers with FHA-insured mortgages whose property and/or place of employment is located in Presidentially-Declared Major Disaster Areas, adversely affected by Hurricanes Harvey, Irma, Maria, certain California wildfires that occurred in October 2017 (FEMA-DR-4344) or certain California Wildfires, Flooding, Mudflows, and Debris Flows that occurred in December 2017 (FEMA-DR-4353).

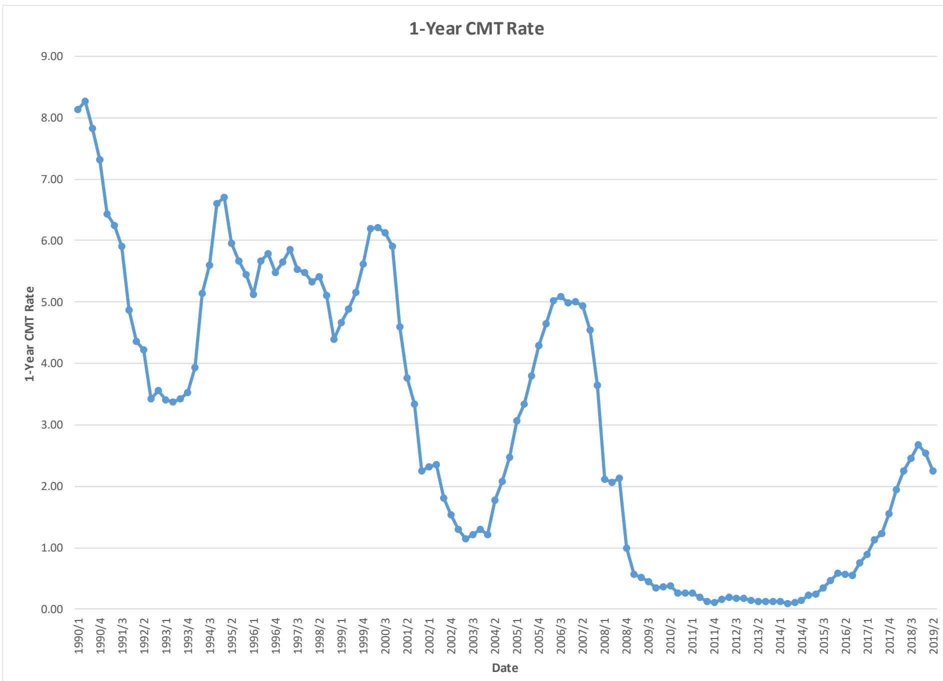
[44] Mortgagee Letter 2018-05, August 15, 2018: Updated Loss Mitigation for mortgagees servicing mortgage loans for borrowers with FHA-insured mortgages whose property and/or place of employment is located in the Presidentially-Declared Major Disaster Areas (PDMDAs) of Puerto Rico Hurricane Maria DR-4339 or Virgin Islands Hurricane Maria DR-4340 and Disaster Foreclosure Moratorium for certain FHA-insured mortgages secured by properties located in areas of Puerto Rico and the U.S. Virgin Islands that the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) has declared to be eligible for Individual Assistance (Affected Counties) as a result of Hurricane Maria (Puerto Rico Hurricane Maria DR-4339 and Virgin Islands Hurricane Maria DR-4340).

[45] Mortgagee Letter 2019-14, August 29, 2019: Updates to FHA's Loss Mitigation Options for Borrowers in Presidentially-Declared Major Disaster Areas (PDMDAs)

Interest Rates

Figure 1 shows the historical one-year CMT rate since 1990.

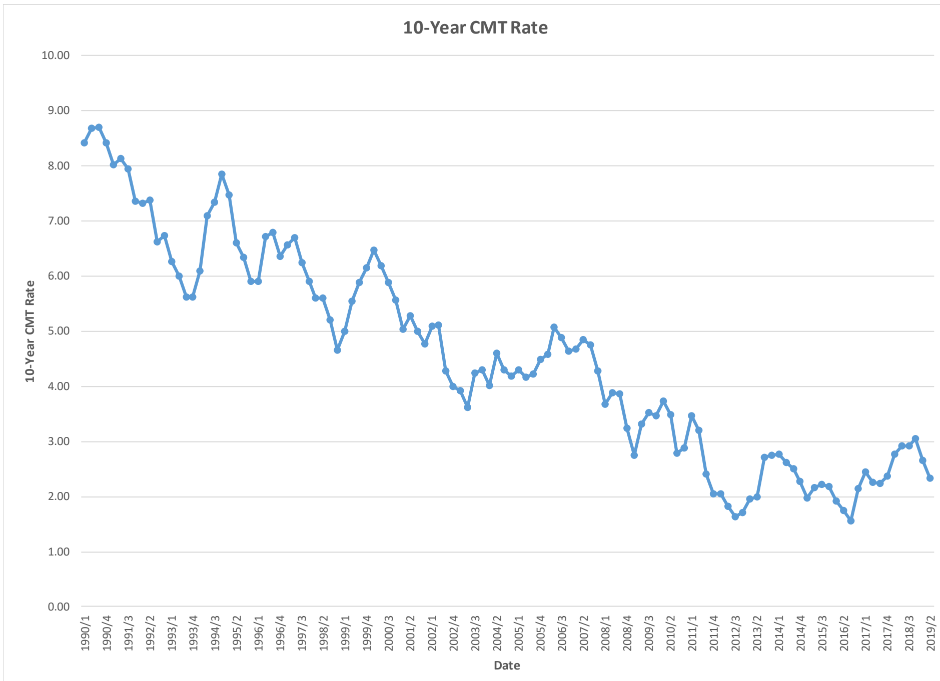
Figure 1: 1-Year CMT Rate



In 2008, in response to the housing crisis and economic recession, the Federal Reserve began decreasing interest rates as part of an active monetary policy. At the beginning of 2007, the one-year CMT rate was around 5%. Over the next seven years, the rate dropped steadily to a low of 0.1% in the fourth quarter of 2014. Since that time, the rate increased to 2.7% by December 2018. As of the second quarter of 2019, the rate has decreased to 2.3%.

Figure 2 shows the 10-year CMT rate since 1990.

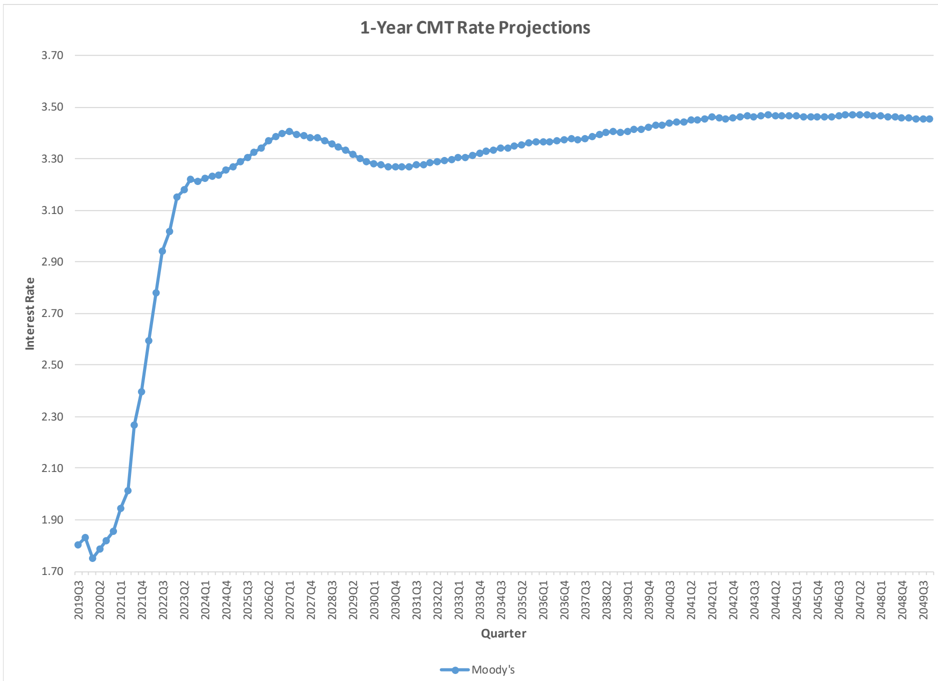
Figure 2: 10-Year CMT Rate



This shows a similar trend, although the changes are not as significant. In mid-2007, the 10-year CMT rate was nearly 5%. Since that time, the rate dropped to under 2% in 2012. Since that time, the rate increased to just over 3.0% in December 2018. The rate has since dropped to 2.3% in the second quarter of 2019.

For the purposes of projecting Cash Flow NPV, it is required that Pinnacle produce an estimate using the projection figures from the OMB. In addition to OMB projections, Pinnacle has also used Moody's economic projections to generate a range of indications of the economic value. Figure 3 shows the one-year CMT rate projections from Moody's Baseline Scenario.

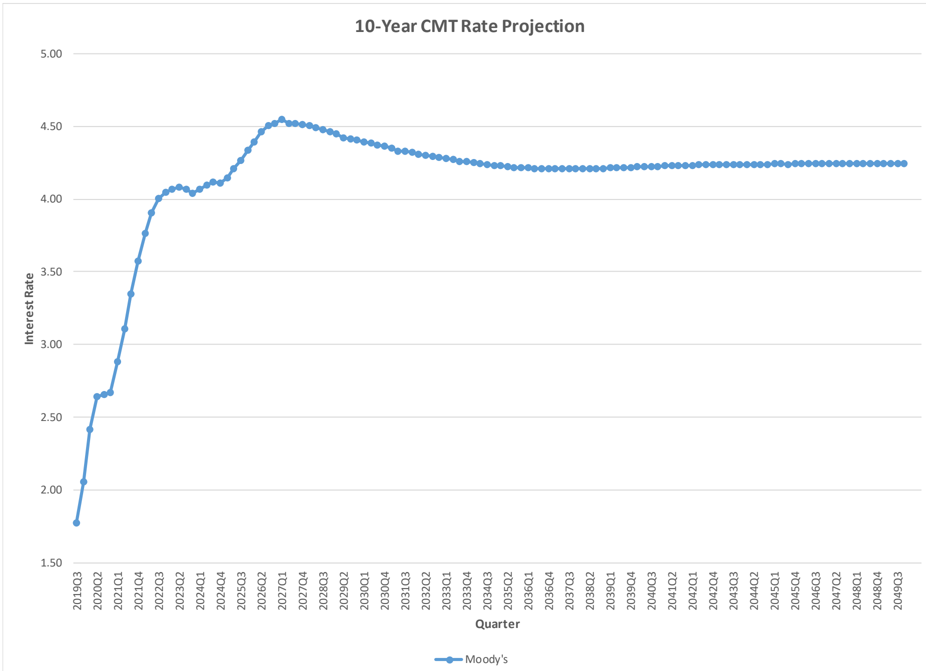
Figure 3: One-Year CMT Rate Projections



Moody's projections show increases in the one-year CMT rates. The rate increases to 3.4% by 2027, and then decreases to about 3.3% in 2030. The rate then increases to just under 3.5% by the end of the projection period.

The 10-year CMT rate projections from Moody's are shown below.

Figure 4: 10-Year CMT Rate Projection



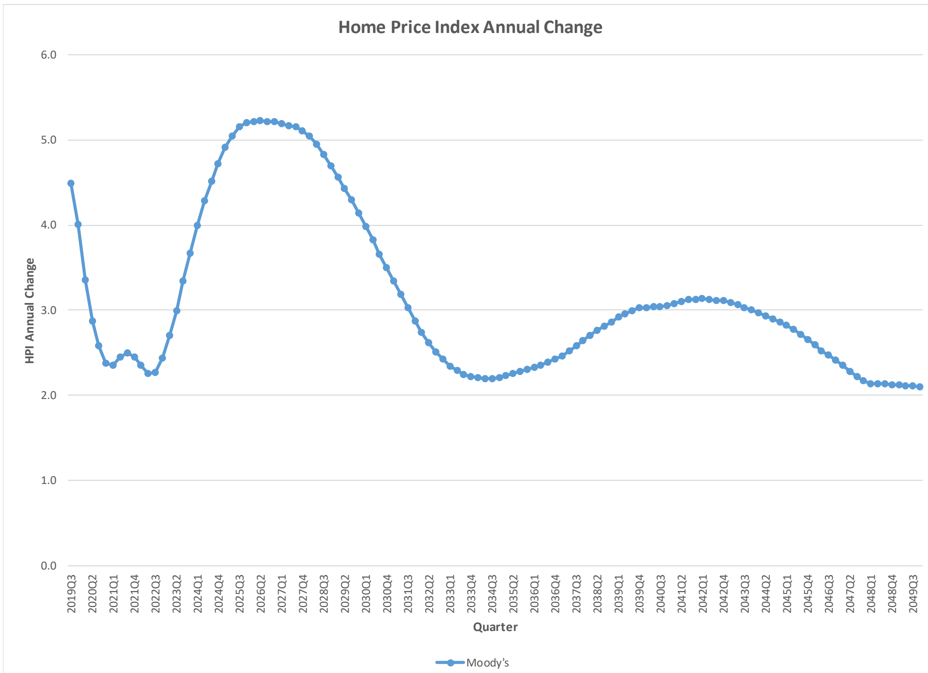
The interest rates increase gradually and then stabilize at 4.25% by the end of the projection period.

Home Price Index Growth

The growth rate in home prices will have an impact on the volume of mortgages endorsed by FHA, the percentage of defaults in mortgages and the ultimate cost of the mortgage insurance claims. Moody's produces a home price index which projects home prices to 2049. Moody's also produces a forecast for local areas, including metropolitan areas and states.

The annual percentage change in the projected Federal Housing Finance Agency (FHFA) Purchase Only House Price Index by quarter is shown below for Moody's baseline projections.

Figure 5: FHFA Purchase Only House Price Index

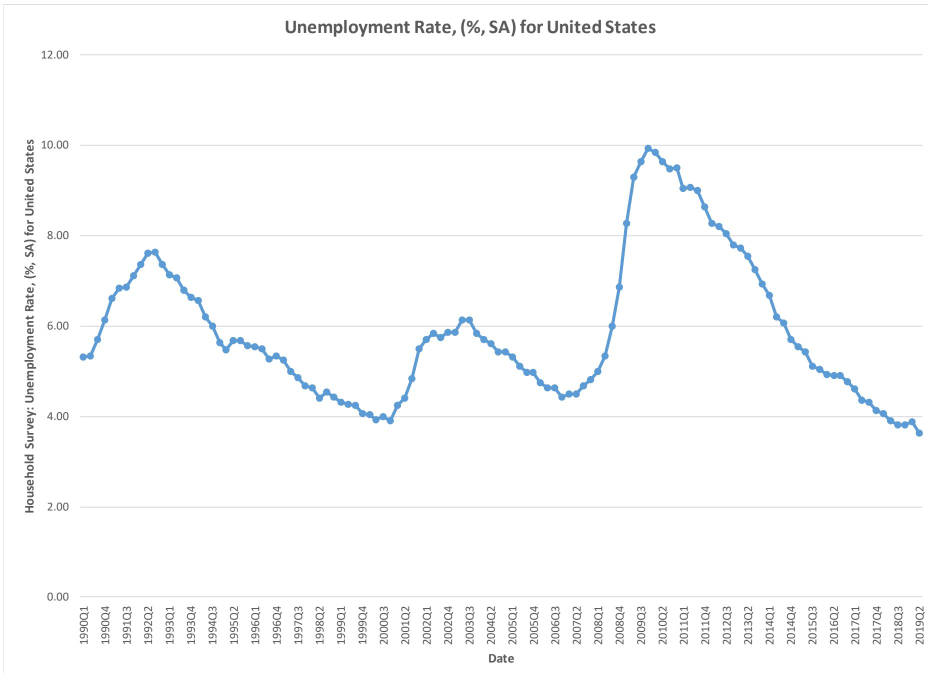


For Moody's projections, the index decreases from about 4.5% to 2.5% in 2020. The rate then increases sharply to just under 5.2% by 2026. The rate then decreases and stabilizes long-term near 2%.

Unemployment Rate

The unemployment rate has an impact on the ability of homeowners to make their mortgage payments. This impacts the default rates and ultimate projections of the MMIF. The historical unemployment rate is shown below.

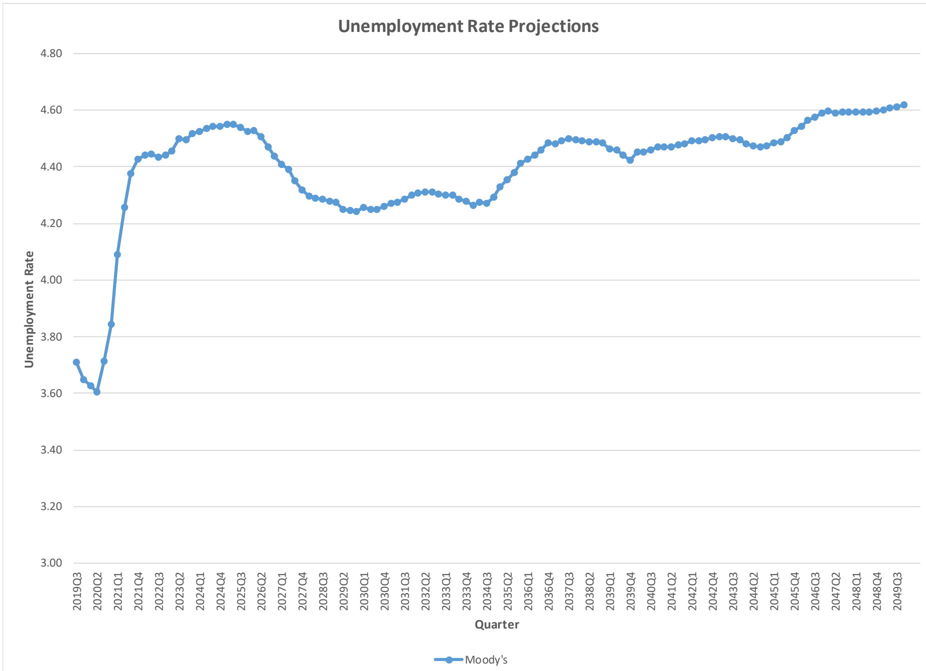
Figure 6: Historical Unemployment Rate



Beginning in 2008, as the economic downturn occurred, the seasonally adjusted unemployment rate nearly doubled from 5% to just under 10% by the end of 2009. Since 2009, the rate has decreased steadily to 3.6% in the second quarter of 2019.

The projected unemployment rates from Moody's are shown in Figure 7.

Figure 7: Unemployment Rate Projection



Moody's projections are cyclical over the next 10 years, oscillating between 4.2% and 4.6%. Subsequently, the long term unemployment rate settles at 4.6%.

Mortgage Volume

The mortgage endorsement volume for FHA and the U.S. home market is shown in Table 5. The health and capacity of the private mortgage insurance market can impact the projected value of the MMIF. If the private mortgage insurance market increases capacity and is successful in providing insurance to borrowers who are less likely to default, it could have an impact on the Cash Flow NPV of the MMIF.

Table 5: FHA Share of Home Sales

	Volume of Home Sales ($ Billions)		
Calender Year	**FHA**	**Market**	**FHA Share (%)**
2001	89	960	9.2%
2002	82	1,097	7.5%
2003	71	1,280	5.6%
2004	53	1,309	4.1%
2005	37	1,512	2.5%
2006	36	1,399	2.5%
2007	39	1,140	3.5%
2008	129	731	17.7%
2009	185	664	27.8%
2010	167	530	31.6%
2011	129	505	25.6%
2012	127	588	21.5%
2013	119	734	16.2%
2014	107	759	14.1%
2015	154	903	17.0%
2016	176	1,052	16.7%
2017	174	1,110	15.7%
2018	158	1,185	13.3%
2019	119	958	12.4%

Sources: FHA Volume from FHA Data Warehouse, September 30, 2019 extract. Market volume from Mortgage Bankers Association.

FHA's share of the volume of home sales has increased significantly from its low of 2.5% in 2005 and 2006. From 2002 to 2006, FHA's share of the number and volume of home sales declined as the subprime mortgage market expanded from 2003 to 2007. The housing and economic crisis that occurred in 2008 decreased the availability of mortgages in general, and significantly impacted the availability of subprime mortgages. Private mortgage insurers were also facing significant losses and decreased the volume of insurance they were providing. As a result, FHA's market share began to increase significantly. The volume of FHA endorsed mortgages increased from 2.5% to 31.6% from 2006 to 2010. As the housing market has recovered, the percentage of loans endorsed by FHA has decreased steadily. As of the third quarter of 2019, the FHA share has decreased to 12.4%.

Report Structure

The remainder of this report is divided into the following sections:

- **Section 2. Summary of Findings and Comparison with Fiscal Year 2018 Actuarial Review** – presents the MMIF Economic Net Worth for fiscal year 2019 and the projected Cash Flow NPV by cohort and product. This section also provides a reconciliation and explanation of the major differences between the fiscal year 2018 and fiscal year 2019 Reports.

- **Section 3. Cash Flow NPV Based on Alternative Scenarios** – presents estimates of the MMIF Cash Flow NPV using a range of alternative economic assumptions.

- **Section 4. Characteristics of the Fiscal Year 2019 Insurance Portfolio** – describes the fiscal year 2019 insurance portfolio and compares the risk characteristics of the origination books of business across historical fiscal years.

- **Section 5. Summary of Methodology** – presents an overview of the data processing, transition, loss severity and cash flow models used in the analysis.

- **Appendix A: Data Sources – Processing and Reconciliation** – provides a description of the data sources used for the analysis, the data processing required to prepare the data for analysis and the data reconciliation performed.

- **Appendix B: Transition Models** – provides a technical description of our predictive models of current and default transitions, the model parameters and model validation results.

- **Appendix C: Loss Severity Models** – provides a technical description of our predictive models of loss severity rates, the model parameters and model validation results.

- **Appendix D: Economic Scenarios** – describes the forecast of future values of economic factors that affect the performance of the MMIF and presents the variation in estimated Cash Flow NPV based on the additional economic scenarios. Details of the stochastic analysis are also provided.

- **Appendix E: Cash Flow Analysis** – describes the process used to project future cash flows.

- **Appendix F: Review of HUD Analysis of Economic Net Worth, Comparison of HUD and Pinnacle Models, and Assessment of Vulnerabilities** – high-level review of HUD models developed to project Economic Net Worth, comparison of the models developed by HUD with the models developed by Pinnacle, and assessment of the vulnerabilities of the models developed.

- **Appendix G: Summary of Historical and Projected Claim Rates, Non-Claim Termination Rates and Loss Severities** – historical and projected claim, non-claim termination and loss severity rates.

Section 2 - Summary of Findings and Comparison with Fiscal Year 2018 Actuarial Review

This section presents the Economic Net Worth and the details of the Cash Flow NPV of the MMIF Forward Loan portfolio as of the end of fiscal year 2019, and also shows a comparison of the elements of the Economic Net Worth between the 2018 Actuarial Review and this review.

Economic Net Worth Estimate

The Economic Net Worth is defined as cash available to the Fund plus the Cash Flow NPV of all future cash outflows and inflows that are expected to result from the mortgages currently insured by the MMIF. The 2019 Actuarial Review estimates the Cash Flow NPV of the MMIF as of the end of fiscal year 2019 using data through September 30, 2019. We developed this estimate by analyzing historical loan performance using data provided by FHA, developing predictive models for loan transition and losses, and using these model results along with economic projections from the OMB and Moody's to project future cash flows of the MMIF. The NPV of these cash flows along with the MMIF's capital resources represent the economic value of the MMIF.

The predictive models used in this report are similar conceptually to the models developed in the 2018 Actuarial Review, however we have made one structural change to the modeling technique. For the 2018 Actuarial Review, we developed multinomial logistical models by product type which predicted the likelihood of all possible transitions simultaneously. For this analysis, we developed binomial logistical models by product type to predict each transition type independently. This change was made to provide more flexibility in modeling each individual transition, which ultimately resulted in a better model fit for specific transitions. The binomial model results were then combined in the final simulation to reflect the multiple possible transition outcomes.

Appendices A through G describe the individual models, the assumptions used and the detailed projection model results. Our main findings are as follows:

The Cash Flow NPV is computed from the projected cash flows occurring during fiscal year 2020 and subsequent years. It is computed based on economic projections associated with the OMB Economic Assumptions. **As of the end of Fiscal Year 2019, Pinnacle estimates that the MMIF Cash Flow NPV is $18.643 billion.** The Cash Flow NPV estimate provided by FHA to be used in FHA's Annual Report to Congress is $12.014 billion.

The capital resources available to the MMIF are $54.600 billion**,** which results in an Economic Net Worth of $73.243**.**

In addition to the overall estimate of the Cash Flow NPV, we have estimated the Cash Flow NPV by cohort. The Pinnacle estimate compared to the FHA estimate by cohort is shown below.

Table 6: Cash Flow NPV by Cohort

Cohort	Pinnacle	FHA	Dollar Difference
1992	0.0	0.0	0.0
1993	0.0	0.0	0.0
1994	0.0	0.0	0.0
1995	0.0	0.0	0.0
1996	0.0	0.0	0.0
1997	0.0	0.0	0.0
1998	0.0	0.0	0.0
1999	0.0	0.0	0.0
2000	0.0	0.0	0.0
2001	-0.1	0.0	0.0
2002	-0.1	-0.1	-0.1
2003	-0.3	-0.1	-0.1
2004	-0.4	-0.3	-0.1
2005	-0.4	-0.3	-0.1
2006	-0.4	-0.4	0.0
2007	-0.5	-0.5	0.0
2008	-1.5	-1.0	-0.5
2009	-2.2	-1.2	-1.0
2010	-1.8	-0.9	-0.9
2011	-0.9	-0.3	-0.6
2012	-0.7	0.0	-0.7
2013	-0.1	1.0	-1.1
2014	2.1	1.7	0.5
2015	3.8	3.0	0.8
2016	5.5	3.8	1.7
2017	6.5	3.7	2.8
2018	4.9	2.0	2.9
2019	5.3	2.2	3.1
Total	18.6	12.0	6.6

The Pinnacle estimates by cohort are consistent with the FHA estimates through 2007, lower for cohorts 2008 – 2013, and higher for cohorts 2014 and 2019. The total Pinnacle Cash Flow NPV estimate is $6.6 billion higher than the FHA estimate, which as a percentage of unamortized IIF is 0.49%. The current unamortized IIF is $1,364 billion. The difference between the Pinnacle and FHA estimate as a percentage of amortized IIF is 0.54%. The current amortized IIF is $1,224 billion.

The housing and economic crisis that occurred in 2008 has resulted in higher claim rates for mortgages originated during fiscal years 2005 - 2010. Given that their upfront MIP has already been collected and is included as part of the current capital resources, and due to their large origination volume, the fiscal year 2008 - 2010 cohorts are estimated to experience larger negative Cash Flow NPVs than any other cohorts. However, at the end of the housing recession, house prices bottomed out and then turned positive, and as a result mortgages originated in fiscal years 2014 - 2019 have positive Cash Flow NPVs. The NPV is also being positively impacted for these more recent cohorts due to MIP now being collected over the life of the mortgage.

The table below shows Pinnacle's Cash Flow NPV estimates by cohort and product.

Table 7: Cash Flow NPV by Cohort and Product

Cohort	Fixed Rate 30	Fixed Rate 15	Adjustable Rate Mortgage	Total
1992	(886,039)	-	(78,341)	(964,379)
1993	(1,465,750)	-	(40,106)	(1,505,856)
1994	(3,310,460)	-	(381,127)	(3,691,587)
1995	(2,091,263)	-	(126,059)	(2,217,322)
1996	(4,467,837)	-	(356,548)	(4,824,385)
1997	(3,926,356)	-	(473,391)	(4,399,747)
1998	(16,182,020)	-	(283,027)	(16,465,047)
1999	(20,465,875)	-	(786,628)	(21,252,503)
2000	(18,815,307)	-	(1,244,645)	(20,059,952)
2001	(78,330,842)	-	(1,733,250)	(80,064,092)
2002	(138,625,516)	-	(7,029,767)	(145,655,283)
2003	(248,510,016)	-	(6,236,800)	(254,746,816)
2004	(368,527,761)	-	(19,636,327)	(388,164,088)
2005	(379,174,518)	(165,092)	(28,715,618)	(408,055,227)
2006	(375,640,980)	(406,708)	(9,669,763)	(385,717,452)
2007	(541,606,016)	(640,953)	(7,028,357)	(549,275,326)
2008	(1,503,464,773)	(3,710,312)	(15,258,639)	(1,522,433,723)
2009	(2,175,075,807)	(10,567,955)	(26,629,553)	(2,212,273,315)
2010	(1,697,434,357)	(13,778,602)	(61,400,522)	(1,772,613,482)
2011	(843,717,072)	(10,655,790)	(38,014,796)	(892,387,658)
2012	(650,153,954)	(13,677,660)	(16,160,967)	(679,992,580)
2013	(125,884,604)	(5,861,936)	(989,748)	(132,736,288)
2014	2,111,017,308	13,554,761	23,590,088	2,148,162,157
2015	3,763,395,359	17,890,499	20,438,125	3,801,723,984
2016	5,474,112,169	25,190,659	12,299,642	5,511,602,471
2017	6,451,698,757	39,496,215	15,717,925	6,506,912,896
2018	4,851,812,730	32,847,302	19,047,707	4,903,707,739
2019	5,219,026,428	30,873,205	20,265,246	5,270,164,879
Total	18,673,305,632	100,387,634	(130,915,245)	18,642,778,021

The value of the overall Cash Flow NPV is influenced primarily by the fixed rate 30-year mortgage (FRM30) product, which has the largest volume of mortgages historically. The total Cash Flow NPV is positive for the FRM30 and Fixed Rate 15 year (FRM15) products, and is negative for the ARM products.

Change in the Economic Net Worth

Table 8 shows the comparison of our estimate of the Fund's Cash Flow NPV and IIF at the end of fiscal year 2019 to the Cash Flow NPV estimate in the 2018 Review.

Table 8: Estimate of Cash Flow NPV as of the end of Fiscal Year 2019 ($ in millions)

Item	2018	2019	Percent Change
Cash Flow NPV	3,457	18,643	439.3%
Capital Resources	45,438	54,600	20.2%
Economic Net Worth	48,895	73,243	49.8%
Unamortized Insurance-In-Force	1,319,678	1,363,985	3.4%

As seen in Table 8, the estimated fiscal year 2019 Cash Flow NPV of the MMIF has increased by $15.186 billion from the level estimated in fiscal year 2018, from $3.457 billion to $18.643 billion. The Capital Resources available to the MMIF have increased by 20.2%, from $45.438 billion to $54.600 billion. The unamortized IIF increased by 3.4% from $1.320 trillion to $1.364 trillion. The change in the Cash Flow NPV represents the net impact of several significant factors, which are described in the next section.

Sources of Change in the Cash Flow NPV from the Fiscal Year 2018 Review to the Fiscal Year 2019 Review

Table 9 provides a summary of the decomposition of changes in the Cash Flow NPV of the MMIF as of the end of fiscal year 2019 as compared to the Cash Flow NPV in the fiscal year 2018 report. The overall net change in the Cash Flow NPV is positive.

Table 9: Changes in Projected Cash Flow NPV

	Change in NPV	Cash Flow NPV - 9/30/19
Baseline FY2009-FY2017		3,456,740,663
Impact of assumption change	-651,802,724	2,804,937,939
Impact of model change	10,183,295,779	12,988,233,718
Impact of book change	384,379,423	13,372,613,142
FY2009-FY2018	9,915,872,478	
FY2019	5,270,164,879	18,642,778,021
Cumulative Change	15,186,037,357	

This section describes the sources of change in estimates of Cash Flow NPV between this year's review and last year's review. Separating out the specific impacts can be done only up to a certain degree of accuracy as the results can vary depending on the order in which the decomposition is done. The interdependency among the various components of the analysis prevents us from identifying and analyzing these as purely independent effects. Given this limitation, this section presents a description of the approximate differences in the Cash Flow NPV from that presented in the fiscal year 2018 Review by source of change.

Updated Economic Scenario Forecast

For this decomposition step, we updated the forecasts for the purchase-only HPI and the interest and unemployment rates from 2019 PEA forecast to the 2020 PEA forecast. There was a slight increase in the rate of annual increase for the HPI projection, ranging from 0.1% to 0.7% higher. Short term treasury rate projections are slightly lower than the projections used in the 2018 Actuarial Report, ranging from 0.1% to 0.7% lower. The projected mortgage rates are also slightly lower through 2029, and then slightly higher after 2029 in the forecast this year. The unemployment rate projections are also slightly lower this year than in the 2018 Actuarial Report. The cumulative result of these economic assumption changes is a decrease of $652 million in the projected Cash Flow NPV.

This change also includes the impact of updating the discount factors.

Updated Predictive Models

With this analysis, we have continued to refine the predictive models to better capture the termination behavior and projected claim amounts of loans in the MMIF. We have also adjusted our methodology to develop multiple binomial models by product and transition type, rather than developing one multinomial model by product type. We re-estimated the models using updated data and revised variable specifications, and the model assumptions have been adjusted to reflect better than expected ultimate projected claim rates. For details about these model updates and refinements, refer to Appendices B, C and E.

These model changes led to an increase in estimated economic value in the Cash Flow NPV of $10.183 billion.

Actual Performance of Cohorts 2018 and Prior in Fiscal Year 2019

The actual performance of the MMIF 2018 and prior cohorts realized during Fiscal Year 2019 affects the Cash Flow NPV of the MMIF estimate of the in-force portfolio. The actual experience for this period was $384 million better than expected.

Fiscal Year 2019 Origination Volume

The addition of the origination volume for the fiscal year 2019 book of business had a positive impact on the NPV. This additional origination volume increased the Cash Flow NPV projection by $5.270 billion.

Section 3 - Cash Flow NPV Based on Alternative Scenarios

The Cash Flow NPV of the MMIF will vary from our estimates if the actual drivers of mortgage performance deviate from the baseline projections associated with the OMB Economic Assumptions. In this section, we develop additional estimates of the Cash Flow NPV based on the following approaches:

1. Moody's economic scenarios
2. Stochastic simulation of key economic variables
3. Sensitivity testing of key economic variables

We use these additional estimates of the Cash Flow NPV to develop a range of estimates and associated percentiles. These alternative estimates were then compared to the Cash Flow NPV resulting from the OMB Economic Assumptions to determine the sensitivity of the Cash Flow NPV estimate to alternative assumptions.

Each Moody's scenario produces an estimate of the Cash Flow NPV using future interest, unemployment and HPI rates as a deterministic path.

The Moody's scenarios are:

- Baseline
- Exceptionally Strong Growth
- Slower Near-Term Growth
- Moderate Recession
- Protracted Slump
- Below-Trend Long-Term Growth
- Stagflation
- Next-Cycle Recession
- Low Oil Price

The resulting Cash Flow NPV associated with each alternative scenario is summarized in Table 10. Below, we discuss the characteristics of each Moody's scenario.

Moody's Baseline Assumptions

In this scenario, the HPI increases over the entire projection period, and the rate of change is between 2.5% and 5.0% per year. The mortgage interest rate increases as well and settles at a long-term average of about 5.5%. The unemployment rate is flat at 3.6% over the next year, increases to 4.5% by 2023, and then decreases to 4.3% by 2030.

Exceptionally Strong Growth Scenario

In Moody's Exceptionally Strong Growth scenario, the HPI is projected to increase more quickly than under the Baseline scenario. In addition, mortgage interest rates are projected to be higher than the Baseline scenario throughout the entire projection period. The unemployment rate is lower than projected in the Baseline scenario throughout the entire projection period.

Stronger Near-Term Rebound Scenario

In Moody's Stronger Near-Term Rebound scenario, the HPI is projected to increase at a slightly higher rate than the Baseline scenario through the entire projection period. In addition, mortgage interest rates are projected to be higher than the Baseline scenario through 2023, then projected to be the same as the Baseline for the remainder of the projection period. The unemployment rate also is lower than projected in the Baseline scenario throughout the entire projection period.

Slower Near-Term Growth Scenario

In Moody's Slower Near-Term Growth scenario, the HPI increases slower than the Baseline scenario, but is still increasing throughout the entire projection period. Mortgage interest rates are projected to be flat through 2020, and then increase for the remainder of the projection period. The unemployment rate is projected to be higher than the Moody's assumptions for the entire projection period.

Moderate Recession Scenario

In the Moderate Recession scenario, the HPI decreases through the end of 2020, and then begins to increase. Mortgage interest rates drop significantly through the end of 2020, and then begin to slowly increase until they reach the long-term average of about 5.8%. The unemployment rate spikes to 7.4% by 2021, and then recovers to a long-term average of 4.5%.

Protracted Slump

In Moody's Protracted Slump scenario, the HPI decreases significantly over the next 18 months, and then begins to increase again. Mortgage interest rates drop until the end of 2020, then begin to slowly increase until they reach the long-term average of 5.6%. The unemployment rate spikes to 8.3% by 2021, and then recovers to a long-term average of 4.5%.

Below-Trend Long-Term Growth

In Moody's Below-Trend Long-Term Growth scenario, the HPI increases more slowly than in the Baseline scenario. Mortgage interest rates increase gradually and settle at a long-term average of about 5.4%. The unemployment rate increases to 5.7% by 2021, and then decreases to a long-term average of approximately 4.5%.

Stagflation

In Moody's Stagflation scenario, the HPI decreases through the third quarter of 2021, and then begins to increase. Mortgage interest rates increase sharply to 5.4% by the second quarter of 2020, and then drop through the second quarter of 2021. Mortgage interest rates then begin to slowly increase to the long-term average of 5.7%. Unemployment rates increase significantly to just over 7.4% by 2021, and then decrease to a long-term average of 4.3%.

Next-Cycle Recession

In Moody's Next-Cycle Recession scenario, the HPI increases through the beginning of 2022, and then decreases significantly through the second quarter of 2023. The HPI then increases again. The mortgage interest rates increase through the first quarter of 2021, and then increase significantly to 6.1% by the end of 2021. The rates then drop significantly, and then settle in at a long term average of about 5.7%. The unemployment rate is equal to the Baseline assumptions through 2021, and then increases sharply to 7.6% by 2023. It then decreases to 4.5% by 2026.

Low Oil Price

In Moody's Low Oil Price scenario, the HPI increases throughout the entire projection period. Mortgage interest rates increase at a slow rate through 2021, and then increase at a higher rate through the remainder of the projection period. Unemployment rates decrease through the second quarter of 2020, and then increase for the remainder of the projection period, settling at a long-term average of 4.4%.

Summary of Alternative Scenarios

Table 10 shows the projected Cash Flow NPV from the ten deterministic scenarios. The range of projected results is between negative $20.722 billion and positive $22.674 billion.

Table 10: Cash Flow NPV Summaries from Alternative Scenarios

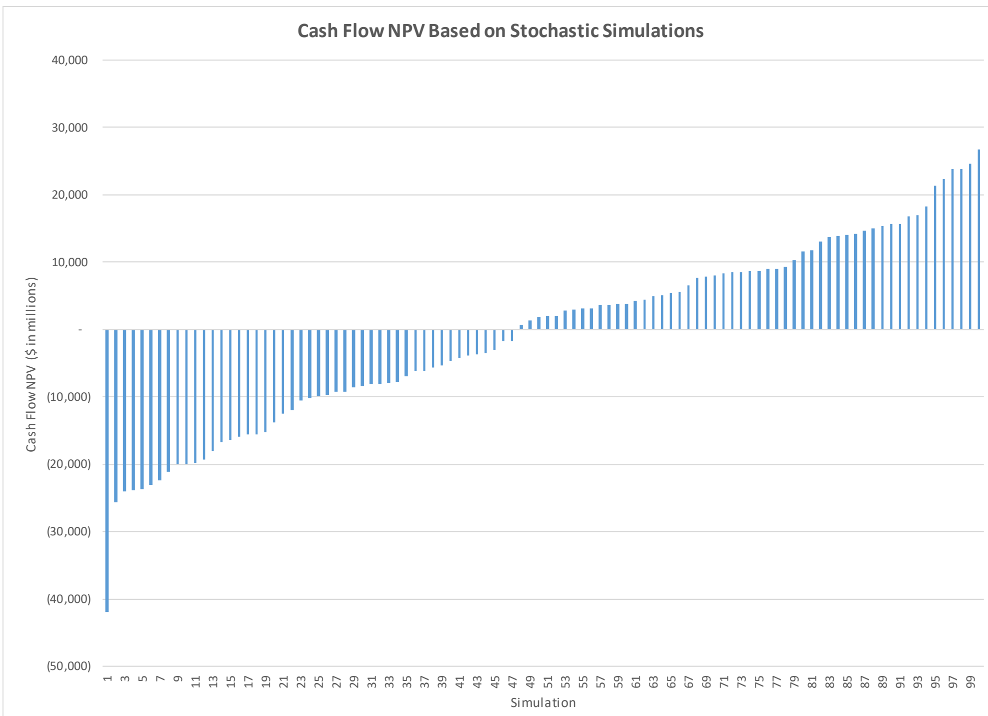
Cohort	Pinnacle ACE	Moody's Baseline	Moody's Exceptionally Strong Growth	Moody's Stronger Near-Term Rebound	Slower Near Term Growth	Moderate Recession	Protracted Slump	Below-Trend Long-Term Growth	Stagflation	Next Cycle Recession	Low Oil Price
1992	-964,379	-877,835	-729,108	-961,486	-738,033	-1,219,752	-935,650	-1,142,595	-1,129,658	-866,509	-988,568
1993	-1,505,856	-1,971,655	-1,543,748	-1,767,332	-2,552,119	-2,869,769	-3,117,874	-2,635,095	-2,195,933	-1,936,693	-2,168,950
1994	-3,691,587	-4,151,775	-2,569,426	-3,373,402	-4,336,918	-5,856,957	-7,951,221	-5,851,207	-4,651,387	-4,073,021	-3,713,550
1995	-2,217,322	-2,695,861	-1,780,929	-2,591,253	-3,803,626	-4,826,643	-5,846,090	-4,164,431	-4,061,399	-3,218,629	-2,497,743
1996	-4,824,385	-6,134,482	-3,041,978	-5,030,406	-6,382,355	-10,208,875	-12,089,145	-7,260,240	-7,702,879	-5,451,404	-5,102,148
1997	-4,399,747	-6,267,336	-3,756,988	-6,310,599	-8,333,093	-11,351,011	-14,290,387	-8,632,212	-8,539,858	-7,021,592	-6,473,396
1998	-16,465,047	-17,914,417	-11,000,762	-17,342,235	-24,658,829	-32,858,001	-40,498,999	-23,264,225	-26,016,012	-18,376,179	-18,956,522
1999	-21,252,503	-23,205,488	-12,118,845	-21,445,877	-31,878,785	-45,564,929	-59,829,161	-32,843,192	-34,419,644	-25,972,018	-24,449,086
2000	-20,059,952	-22,410,967	-13,491,359	-19,508,787	-31,659,046	-43,134,000	-52,116,593	-30,240,510	-33,137,701	-25,464,828	-24,210,768
2001	-80,064,092	-85,931,487	-67,141,933	-81,240,281	-100,327,839	-127,836,973	-147,960,792	-101,469,573	-107,036,522	-86,904,735	-89,717,582
2002	-145,655,283	-150,665,067	-123,536,199	-144,061,891	-174,684,233	-204,853,089	-255,438,938	-178,728,500	-184,736,101	-152,963,462	-161,555,675
2003	-254,746,816	-261,458,844	-207,307,766	-243,398,860	-295,050,615	-354,406,265	-439,454,918	-294,875,916	-332,525,906	-267,877,530	-265,809,668
2004	-388,164,088	-400,627,966	-327,761,237	-375,642,201	-460,662,161	-524,427,335	-664,410,539	-452,224,338	-491,397,810	-411,004,790	-419,030,453
2005	-408,055,227	-427,792,436	-350,074,474	-394,980,239	-479,232,691	-562,454,979	-687,313,380	-478,373,746	-525,968,811	-441,528,702	-454,157,449
2006	-385,717,452	-393,826,266	-316,449,443	-378,403,836	-450,303,651	-524,247,008	-623,441,491	-456,844,178	-479,134,612	-399,968,773	-416,743,115
2007	-549,275,326	-571,991,650	-464,504,718	-539,361,793	-642,744,493	-753,163,434	-858,768,126	-646,977,621	-675,794,508	-569,155,478	-585,001,147
2008	-1,522,433,723	-1,534,244,233	-1,280,782,568	-1,445,441,719	-1,699,053,094	-1,952,477,965	-2,316,149,845	-1,702,461,694	-1,843,147,459	-1,559,934,529	-1,564,451,359
2009	-2,212,273,315	-2,242,899,540	-1,627,400,317	-2,044,840,004	-2,489,576,918	-3,168,992,118	-4,051,879,778	-2,644,237,034	-2,571,113,341	-2,329,641,475	-2,246,628,378
2010	-1,772,613,482	-1,701,718,703	-1,349,005,394	-1,623,217,904	-1,817,165,171	-2,447,736,832	-3,135,301,704	-1,916,439,818	-1,978,544,528	-1,745,180,031	-1,719,124,443
2011	-892,387,658	-839,932,322	-590,606,023	-744,922,501	-922,936,667	-1,340,825,768	-1,769,177,305	-1,003,591,750	-1,003,498,123	-868,979,221	-824,617,267
2012	-679,992,580	-685,622,179	-447,000,279	-621,116,798	-890,834,190	-1,406,007,828	-2,015,877,115	-869,631,327	-880,101,098	-747,260,812	-784,500,089
2013	-132,736,288	-213,714,826	106,973,216	-128,219,255	-514,431,526	-1,270,796,760	-2,200,175,354	-534,230,740	-569,374,422	-366,086,034	-336,943,352
2014	2,148,162,157	1,909,547,353	2,110,506,284	1,954,631,315	1,710,514,750	787,975,261	184,097,312	1,666,064,708	1,735,385,623	1,847,050,555	1,824,217,428
2015	3,801,723,984	3,346,793,287	3,854,831,342	3,534,535,885	2,896,164,225	888,557,612	-434,899,780	2,877,296,293	2,929,253,677	3,215,953,687	3,210,304,356
2016	5,511,602,471	4,570,132,465	5,345,949,494	4,896,371,598	3,704,972,022	1,178,935,618	-1,053,392,124	3,569,843,477	3,868,418,673	4,149,116,362	4,206,222,915
2017	6,506,912,896	5,514,564,174	6,591,449,388	5,911,430,258	4,607,857,770	1,956,754,998	310,459,354	4,380,749,120	4,587,608,602	5,222,858,116	5,328,389,551
2018	4,903,707,739	4,640,710,348	5,715,581,342	5,050,315,057	3,766,574,559	1,402,220,773	64,792,692	3,311,900,505	3,382,011,326	4,205,563,115	4,433,551,337
2019	5,270,164,879	4,536,360,002	6,150,353,200	5,111,566,130	3,544,451,571	1,171,805,664	-431,302,504	3,169,453,382	2,978,881,119	4,005,882,126	4,447,527,008
Total	18,642,778,021	14,922,052,292	22,674,040,769	17,615,671,583	9,179,188,845	-7,409,866,362	-20,722,269,452	7,579,187,543	7,717,331,307	12,607,557,514	13,493,371,888

Stochastic Simulation

The stochastic simulation approach provides information about the probability distribution of the Cash Flow NPV of the MMIF with respect to different possible future economic conditions and the corresponding prepayments, claims and loss rates. The simulation provides the Cash Flow NPV associated with each one of the 100 simulated future economic paths. The distribution of Cash Flow NPV based on these scenarios allows us to gain insights into the sensitivity of the MMIF's Cash Flow NPV to different economic conditions.

Figure 8 below shows the range of Cash Flow NPV for the 100 scenarios.

Figure 8: Stochastic Simulation Results



Based on the stochastic simulation results, the range of Cash Flow NPV estimates is negative $41.910 billion to positive $26.753 billion. The largest negative Cash Flow NPV result is $16 billion lower than the next lowest outcome. Excluding this outlier, the range of Cash Flow NPV estimates is negative $25.647 billion to positive $26.753 billion.

The range of Cash Flow NPV estimates may not include all conceivable outcomes. For example, it would not include conceivable extreme events where the contribution of such events to an expected value is not reliably estimable.

The Cash Flow NPV estimate provided by FHA to be used in the FHA Annual Report to Congress is $12.014 billion. Based on Pinnacle's Actuarial Central Estimate and range estimates, we conclude that the FHA estimate of Cash Flow NPV is reasonable.

Sensitivity Tests of Economic Variables

The above scenario analyses were conducted to estimate the distribution of the Cash Flow NPV of the MMIF with different combinations of the interest rate and house price movements in the future. It is also useful to understand the marginal impact of each single economic factor on the Cash Flow NPV. Below, we show the sensitivity of the Cash Flow NPV with respect to the change of a single economic factor at a time. This sensitivity test is conducted for two sets of economic variables:

- Interest rates, including:
    - 10-year CMT rate
    - 1-year CMT rate
    - Commitment rate on 30-year fixed-rate mortgages
- Unemployment Rate

The marginal impact is measured by the change in Cash Flow NPV from the OMB Economic Assumption scenario result. These simulations change each of these variables one at a time from the baseline scenario. The changes are parallel shifts in the path of each variable in the OMB Economic Assumption scenario, where all three interest rates are shifted together and at the same magnitudes, but are kept from going negative.

Figure 9 shows the sensitivity of the Cash Flow NPV with respect to changes in future interest rates. Specifically, we applied parallel shift to the 1-year CMT rate, 10-year CMT rate and the mortgage rates up and down from the base scenario by 20, 50, 100 and 200 basis points. Interest rates are not allowed to be negative. The results show a positive slope, indicating that the Cash Flow NPV of the MMIF is positively related to future interest rates. Higher future interest rates benefit the MMIF in two ways. First, a higher future interest rate means lower refinance incentive for existing borrowers. Thus, there would be fewer prepayments, which lead to a longer stream of annual MIP revenue. Second, higher future interest rates imply that the mortgage payments of existing borrowers would be lower than that of a new mortgage with the market interest rate. The below-market mortgage payment serves as an incentive for borrowers to keep their mortgages longer and thus is a disincentive to default in order to continue to benefit from their below-market payments. A 100 basis point fall in interest rates will incur an decrease in Cash Flow NPV of $6.399 billion, and a positive 100 basis point change in interest rates will result in an increase in Cash Flow NPV of $3.186 billion For the interest rate sensitivity, the range of Cash Flow NPV impacts are -0.93% to +0.31% of IIF.

Figure 9 also reports the sensitivity of the Cash Flow NPV with respect to the unemployment rate. The results show a negative slope, indicating that the Cash Flow NPV of the MMIF is negatively related to future unemployment rates. A negative 100 basis point change in the unemployment rates will produce an increase in Cash Flow NPV of positive $9.867 billion, and a positive 100 basis point change in the unemployment rate will result in a decrease in Cash Flow NPV of $5.933 billion. This results from the fact that as unemployment increases, the likelihood of defaults and claims increase, and the average net loss increases as well. For the unemployment rate sensitivity, the range of Cash Flow NPV impacts are -0.97% to +1.01% of IIF.

These sensitivity analyses show that Cash Flow NPV of the MMIF portfolio would be significantly affected by changes in employment rates, while a change in interest rates has a smaller impact.

Figure 9: Sensitivity Test of Selected Economic Variables

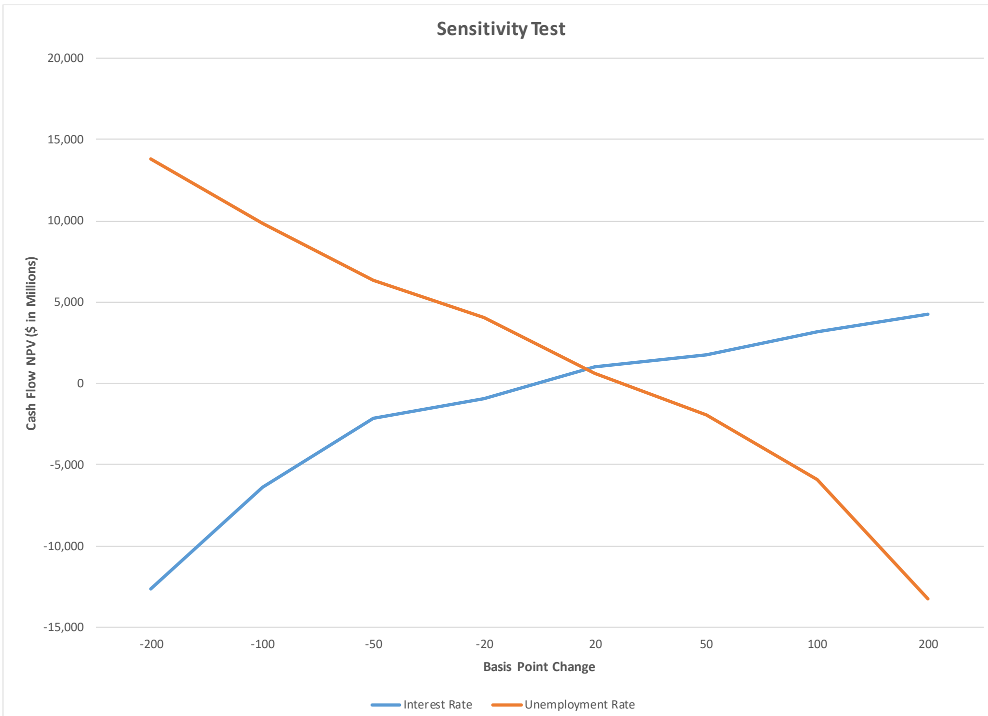
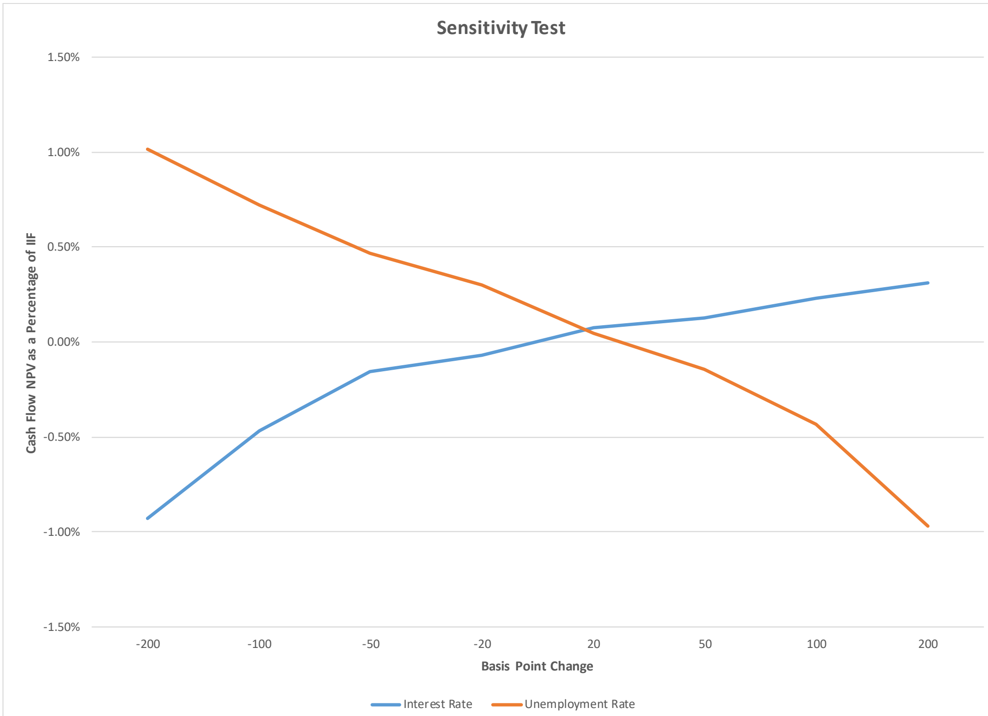


Figure 10: Sensitivity Test of Selected Economic Variables as a Percentage of IIF



Section 4 - Characteristics of the Fiscal Year 2019 Insurance Portfolio

This section analyzes the characteristics of the loan portfolio insured by the MMIF as of fiscal year 2019. This discussion covers the following three areas:

1. analysis of the volume and composition of loan types,
2. comparison of new purchase loans versus refinances and
3. the distribution of loans by loan characteristics.

This section also examines and compares the 2019 cohort with previous cohorts in order to determine how the 2019 cohort is likely to influence the future performance of the MMIF.

Volume and Share of Mortgage Originations

FHA insured $212 billion in single-family forward mortgages for fiscal year 2019, bringing the MMIF's total unamortized IIF to $1.364 trillion. Table 11 shows FHA's origination count and volume by cohort. The new purchase count dropped significantly from fiscal year 2003 to fiscal year 2007, increased dramatically through fiscal year 2010, then returned to levels similar to those in fiscal years 2001 - 2003. The decline and subsequent rise were due to the Government Sponsored Enterprise (GSE)[46] and non-conforming lenders aggressive marketing strategies during the subprime era and their capital limitations when the housing market crashed. The capital impairment of the private mortgage insurance companies also contributed to FHA's rising volume after the crash. As the private mortgage insurance industry faced severe capital constraints, the GSEs had been unable to purchase or guarantee loans with less than a 20% down payment. FHA became the primary source of high LTV loans after fiscal year 2008. Private mortgage insurance companies have begun underwriting more policies during the past seven years.

The volumes show a similar pattern, for the same reasons cited above, but the volumes subsequent to the housing crisis were much higher than volumes in the early 2000s. The loan size limits were increased to the levels of the GSEs, making more loans eligible for FHA insurance. The private mortgage insurers and non-conforming lenders faced capital constraints, making FHA the only feasible channel for high LTV loans.

[46] Fannie Mae, Freddie Mac and the Federal Home Loan Banks

Table 11: Total Count and Volume of FHA-Insured Originations

	Count of Originations			Volume of Originations ($ Billions)		
Cohort	New Purchase	Fully Underwritten Refinance	Streamline Refinance	New Purchase	Fully Underwritten Refinance	Streamline Refinance
1985	340,286	7	45	20.19	0.00	0.00
1986	737,217	18	7,023	45.56	0.00	0.43
1987	1,119,343	21	143,403	69.83	0.00	9.08
1988	670,354	2	42,198	40.95	0.00	2.60
1989	557,895	3	16,287	34.85	0.00	0.97
1990	689,946	127	27,516	45.25	0.01	1.69
1991	629,189	464	27,063	42.87	0.03	1.74
1992	524,680	1,889	72,353	37.19	0.13	4.88
1993	537,867	12,252	300,984	39.99	0.89	21.78
1994	652,711	16,968	549,688	51.84	1.21	38.70
1995	476,712	4,298	41,917	38.08	0.32	2.83
1996	590,486	27,110	91,107	49.85	2.22	7.44
1997	629,615	28,624	43,590	54.82	2.44	3.82
1998	742,465	54,577	174,645	68.04	5.02	17.41
1999	831,805	73,511	258,376	80.86	7.17	25.14
2000	763,063	36,640	31,843	79.40	3.83	3.04
2001	730,105	59,782	172,664	79.71	6.85	20.99
2002	787,094	87,444	293,642	91.02	10.64	34.47
2003	602,452	94,268	522,214	73.03	12.12	62.17
2004	540,314	77,985	274,123	66.84	10.28	30.51
2005	328,543	42,858	106,952	40.20	5.87	11.91
2006	293,257	72,064	34,585	37.10	10.65	3.98
2007	261,166	120,291	20,887	35.00	18.51	3.00
2008	591,326	376,522	63,733	95.37	65.78	10.65
2009	995,101	506,822	329,395	171.67	92.90	65.82
2010	1,109,164	344,877	212,871	191.60	62.61	43.29
2011	777,101	239,344	180,227	134.36	44.36	38.92
2012	733,700	176,767	274,033	124.45	31.83	56.99
2013	702,415	130,588	511,842	124.93	24.07	91.11
2014	594,998	76,315	115,038	105.72	13.19	16.31
2015	753,387	130,032	232,811	140.26	24.75	48.11
2016	879,511	165,506	213,030	171.63	32.14	41.64
2017	882,078	200,257	164,099	178.62	40.54	31.79
2018	776,276	185,815	52,510	160.89	38.10	10.06
2019	733,763	185,929	56,962	157.30	39.81	14.44

Table 12 shows FHA's origination volume and market share in home purchase mortgages from fiscal year 2001 through fiscal year 2019.

Table 12: FHA's Market Share in the Home Purchase Mortgage Market

	Volume of Home Sales ($ Billions)		
Calender Year	FHA	Market	FHA Share (%)
2001	89	960	9.2%
2002	82	1,097	7.5%
2003	71	1,280	5.6%
2004	53	1,309	4.1%
2005	37	1,512	2.5%
2006	36	1,399	2.5%
2007	39	1,140	3.5%
2008	129	731	17.7%
2009	185	664	27.8%
2010	167	530	31.6%
2011	129	505	25.6%
2012	127	588	21.5%
2013	119	734	16.2%
2014	107	759	14.1%
2015	154	903	17.0%
2016	176	1,052	16.7%
2017	174	1,110	15.7%
2018	158	1,185	13.3%
2019	119	958	12.4%

Sources: FHA Volume from FHA Data Warehouse, September 30, 2019 extract. Market volume from Mortgage Bankers Association. Calendar year 2019 includes data through September 30, 2019.

FHA's market share declined to a low of 2.5% in 2005. This trend reversed during the next several years and by fiscal year 2010, FHA's market share was up to 31.6%. Subsequently, the market share has decreased. The FHA share for the first six months of calendar year 2019 is 12.4%.

Originations by Location

FHA insures loans in all regions of the U.S., but over half of FHA's total dollar volume is concentrated in only ten states. Table 13 shows the percentage of FHA's total dollar volume originated in these ten states from fiscal year 2013 through fiscal year 2019. The states are ordered based on the dollar volume endorsed during fiscal year 2019.

Table 13: Percentage of Mortgage Origination Volume in the Top 10 States

	Fiscal Year						
State	2013	2014	2015	2016	2017	2018	2019
California	17.1%	16.3%	18.8%	17.5%	16.8%	14.7%	14.4%
Florida	4.8%	6.0%	6.0%	6.8%	7.5%	8.5%	8.9%
Texas	7.1%	8.9%	7.3%	7.5%	7.6%	8.0%	8.3%
Georgia	3.1%	3.4%	3.2%	3.7%	3.7%	4.0%	4.0%
Colorado	3.3%	3.2%	3.4%	3.3%	3.5%	3.5%	3.6%
New Jersey	3.5%	3.1%	3.5%	3.4%	3.5%	3.5%	3.5%
New York	3.9%	4.0%	3.5%	3.5%	3.7%	3.7%	3.5%
Maryland	3.5%	3.1%	3.6%	3.6%	3.5%	3.3%	3.3%
Arizona	2.9%	3.5%	3.7%	3.4%	3.2%	3.1%	3.2%
Washington	3.1%	2.6%	3.0%	3.1%	3.0%	3.0%	3.0%

Currently, loans in California comprise the largest percentage of all FHA loans based on dollar volume, which is 14.4%, however the percentage of loans in California has been decreasing over the last four years. The percentage of loans in Florida has increased by 4.2% since 2013. Florida is the second largest state based on origination volume, passing Texas in 2018.

Originations by Product

Table 14 shows that the fully underwritten 30-year fixed-rate mortgage (FRM) has comprised the majority of FHA's single-family business, representing a dollar-weighted average share of approximately 75.6% of the business over fiscal years 1986 - 2019. The share of total mortgages represented by 30-year FRMs began to change in the early 1990s when FHA started insuring ARMs and streamline refinancing mortgages (SRs). For the next few years, ARM and SR mortgages gradually assumed a larger share of annual loan originations and the 30-year FRM share decreased. The 1993 and 1994 cohorts recorded the lowest shares of 30-year FRMs. An opposite trend emerged from fiscal year 2003 through fiscal year 2007, in which 30-year FRM endorsements increased from 52.4% to 92.1%, while 30-year SR endorsements dropped from 36.0% to 5.1%. However, the share of 30-year FRMs in fiscal year 2009 through fiscal year 2013 dropped from 77.1% to 58.3%. From this point, the percentage has increased to 91.8% in fiscal year 2019.

The ARM share of the portfolio, including SR ARMs, shrank dramatically from 12.0% in fiscal year 2005 to 1.1% in fiscal year 2009. It subsequently rose to 6.0% in fiscal year 2011, and then has decreased since then. ARMs account for only 0.4% of the endorsements in the 2019 cohort. The 15-year FRMs increased from 1.2% in fiscal year 2007 to 6.4% in fiscal year 2012, but have declined in the last six years and are at 0.9% in fiscal year 2019. The 15-year SR continues to be a minor product type in the MMIF.

Table 14: Percentage of Origination Volume by Mortgage Product

	Fully Underwritten Mortgages			Streamline Refinancing		
Fiscal Year	30-Year FRM	15-Year FRM	ARMs	30-Year SRs	15-Year SRs	ARMs SRs
1986	89.88	8.30	0.88	0.80	0.15	0.00
1987	81.83	5.52	1.15	9.85	1.61	0.05
1988	85.55	3.99	4.50	5.27	0.66	0.03
1989	92.82	2.70	1.76	2.55	0.17	0.00
1990	92.91	2.79	0.70	3.33	0.26	0.00
1991	89.52	3.13	3.45	3.37	0.50	0.02
1992	70.24	2.62	15.57	8.75	1.71	1.11
1993	49.91	2.21	13.11	26.43	6.46	1.87
1994	40.92	1.83	15.07	30.66	8.75	2.77
1995	62.66	1.54	28.93	4.43	1.62	0.82
1996	62.29	1.32	23.89	8.98	1.74	1.77
1997	61.57	1.19	30.98	3.64	0.81	1.80
1998	60.20	1.09	19.46	15.35	1.21	2.68
1999	73.04	1.14	3.61	19.48	1.79	0.95
2000	84.29	0.73	11.45	2.50	0.35	0.67
2001	77.30	0.90	2.28	18.37	0.58	0.57
2002	68.13	1.19	5.36	21.11	1.48	2.73
2003	52.38	1.31	4.11	35.97	2.92	3.32
2004	62.19	1.37	8.10	21.49	2.60	4.26
2005	69.14	1.26	9.06	16.17	1.41	2.96
2006	88.10	1.36	2.85	6.96	0.48	0.25
2007	92.13	1.22	1.33	5.12	0.11	0.07
2008	90.78	1.61	1.42	5.91	0.14	0.15
2009	77.11	2.18	0.79	19.26	0.37	0.29
2010	78.99	3.63	2.83	13.16	0.36	1.02
2011	72.29	5.64	4.19	15.46	0.62	1.80
2012	65.41	6.38	1.49	24.54	1.18	1.00
2013	58.28	3.08	0.69	36.59	0.96	0.39
2014	82.47	2.51	2.96	11.01	0.37	0.68
2015	74.46	1.67	1.30	21.93	0.19	0.45
2016	81.14	1.34	0.55	16.66	0.25	0.06
2017	85.65	1.27	0.40	12.30	0.36	0.00
2018	93.58	1.13	0.48	4.66	0.14	0.01
2019	91.84	0.90	0.44	6.75	0.07	0.00
	75.56	2.36	4.18	15.99	0.99	0.92

Initial Loan to Value Distributions

Based on studies of mortgage behavior, a borrower's equity position in the mortgaged house is one of the most important drivers of default behavior. The larger the equity position a borrower has, the greater the incentive to avoid default on the loan. The original LTV is the complement of the borrower's equity at origination. Table 15 shows the distribution of mortgage originations by original LTV categories.

Table 15: Percentage of Origination Volume by Original LTV Category

Cohort	Unknown	≤ 80%	> 80% ≤ 90%	> 90% ≤ 95%	> 95% < 97%	≥ 97
1986	0.67%	17.98%	30.59%	27.02%	20.75%	2.99%
1987	0.23%	18.27%	29.17%	27.97%	21.24%	3.12%
1988	0.08%	10.15%	21.72%	33.84%	29.51%	4.70%
1989	0.43%	7.58%	18.46%	35.95%	32.36%	5.22%
1990	20.81%	5.90%	14.77%	28.83%	25.62%	4.07%
1991	3.42%	5.99%	16.06%	30.32%	29.59%	14.61%
1992	10.92%	4.52%	13.29%	24.87%	33.23%	13.17%
1993	27.25%	3.73%	11.22%	19.57%	23.24%	15.00%
1994	34.40%	3.56%	9.67%	16.38%	19.79%	16.20%
1995	5.64%	3.15%	10.39%	22.94%	31.68%	26.21%
1996	9.48%	2.97%	10.55%	23.07%	30.84%	23.09%
1997	4.55%	3.41%	11.29%	24.94%	32.49%	23.31%
1998	13.34%	3.62%	11.76%	23.29%	29.09%	18.89%
1999	12.89%	4.00%	10.94%	14.77%	25.17%	32.23%
2000	1.44%	2.66%	6.86%	7.26%	31.89%	49.89%
2001	9.52%	3.61%	8.77%	8.63%	22.75%	46.71%
2002	0.27%	4.67%	11.08%	9.99%	23.74%	50.25%
2003	0.00%	6.03%	12.57%	11.73%	23.67%	45.99%
2004	0.00%	6.56%	11.70%	10.33%	22.46%	48.94%
2005	0.01%	6.39%	10.72%	9.06%	22.17%	51.65%
2006	0.01%	7.12%	10.72%	14.35%	19.89%	47.91%
2007	0.01%	7.38%	11.68%	21.24%	18.20%	41.50%
2008	0.14%	6.18%	12.18%	24.03%	14.11%	43.35%
2009	0.01%	4.99%	13.33%	18.82%	35.68%	27.17%
2010	0.01%	4.81%	14.53%	12.63%	58.79%	9.24%
2011	0.01%	4.86%	14.80%	14.07%	59.89%	6.37%
2012	0.01%	5.50%	13.45%	20.00%	57.17%	3.87%
2013	0.01%	5.66%	16.15%	27.25%	48.60%	2.34%
2014	0.01%	6.07%	14.09%	12.92%	65.04%	1.86%
2015	0.01%	6.06%	14.84%	12.95%	63.83%	2.30%
2016	0.01%	6.86%	16.11%	11.14%	64.12%	1.75%
2017	0.02%	7.84%	17.19%	10.08%	63.65%	1.23%
2018	0.02%	7.80%	16.81%	8.10%	66.16%	1.11%
2019	0.02%	7.56%	17.41%	7.75%	65.51%	1.75%

The distribution among original LTV categories shifted significantly after fiscal year 1998. Almost half of the loans insured during from fiscal year 2000 to fiscal year 2006 had LTVs greater than or equal to 97%. This concentration in the highest risk category gradually declined during the next few years. In 2008, MMIF placed a limit of 96.5% on original LTV, with no additional allowance for the financing of closing costs. During fiscal year 2009, 27.2% of mortgages had LTV ratios of 97% or more. In fiscal years 2010 - 2018, this concentration continued to decline, and is 1.75% in fiscal year 2019. Since fiscal year 2014, over 60% of mortgages have LTV ratios between 95 to 97%.

The original LTV concentration of individual books of business affects the predictive models in two ways. First, it serves as the starting position for updating the current LTV. Holding everything else constant, loans with higher original LTVs will experience a higher current LTV in future years. Second, the original LTV itself is also included in the models to capture potential behavioral differences among borrowers who self-select into different original LTV categories. For SR loans, we use the original LTV of the prior fully underwritten mortgage, updated for the local house price index and amortization, as a proxy for this variable.

The LTV position of cash-out refinances has also been an issue of concern for HUD. The share of cash-out refinances had increased significantly through the mid-2000's, however as the housing market weakened in the late 2000's, this was shown to have contributed to an increase in the number of foreclosures. In response, FHA decreased the LTV requirement for cash out refinances from 95% to 85% in 2009. FHA data shows that the number of cash out refinances is increasing significantly again, and as a result in 2019 has decreased the LTV requirement again from 85% to 80% effective September 1, 2019.[47]

Borrower Credit History Distribution

Credit score data has been collected from two different sources. The first source includes credit scores collected for a sample of FHA applications from fiscal years 1992, 1994, and 1996, and subsequently extended to loan applications during fiscal years 1997 - 2004. This credit score data is particularly useful because these loans have existed for many years and provide valuable historical delinquency, claim and prepayment performance information. The limitation of this data source is that it covers only a limited sample of FHA loans. In addition, the sample was originally collected for policy research purposes and represents a choice-based sample. For example, there was over-sampling of loans that defaulted early among applications over fiscal years 1997 - 2004.

Since May 2004, all lenders originating loans for FHA insurance have been required to report borrower credit scores directly to HUD if any credit scores were ordered as part of the underwriting process. All loans going through the FHA TOTAL scorecard have credit scores obtained electronically by the affiliated automated underwriting systems. This is the second source of credit score data. As there are no exceptions to this requirement, the credit scores collected from this source are considered to be comprehensive and unbiased. These loans have grown to be the dominant source of credit score information for our analysis.

Table 16 shows the distribution of fully underwritten FHA mortgage loans by borrower credit score categories and cohort. The distribution among credit score categories remained relatively stable for the 2005 - 2008 cohorts. For loans originated after fiscal year 2008, the credit score distribution showed significant improvement over the previous years. Approximately 33% of the fiscal year 2019 loans have credit scores above 680. Loans with credit scores below 600 are only 5.0% of the loans originated in fiscal year 2019, which is substantially lower than in the fiscal year 2007 book, where 31.5% of the loans had credit scores below 600. However, despite the distributions having improved since 2007, the trend in credit scores over the past few years are concerning. The proportion of loans with credit scores below 600 has been increasing slowly since 2014, rising from 1.0% to 5.0%. Also, the proportion of loans with credit scores above 680 has decreased since 2016 from 40.2% to 33.0%. This deterioration in credit scores will result in worse default and loss experience, and thus will contribute negatively to the economic value of the MMIF for the more recent cohorts.

[47] Mortgagee Letter 2019-11, August 1, 2019: Maximum Loan-To-Value and Combined Loan-To-Value Percentages for Cash-out Refinance Mortgages.

In the predictive models, we also controlled for missing and uncollected credit scores. In Table 16, the category "Missing" refers to loans with insufficient borrower credit history to generate a credit score, and the category "Not Collected" refers to loans where no attempt was made to obtain the credit score for some of the fiscal year 2004 and earlier loans. These categories have been combined in the table.

Table 16: Percentage of Origination Volume by Credit Score for Fully Underwritten Loans

Cohort	Missing / Not Collected	300-499	500-559	560-599	600-639	640-679	680-850
1997	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1998	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1999	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2000	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2001	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2002	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2003	99.97%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%
2004	81.98%	0.16%	1.66%	3.11%	4.61%	3.89%	4.58%
2005	23.34%	0.80%	7.69%	13.75%	19.93%	16.36%	18.13%
2006	10.25%	0.90%	8.28%	15.68%	23.13%	19.53%	22.22%
2007	7.77%	1.48%	11.31%	18.71%	24.19%	18.25%	18.29%
2008	7.08%	0.81%	6.63%	13.40%	23.03%	21.57%	27.47%
2009	18.38%	0.07%	1.00%	4.17%	14.82%	20.56%	41.00%
2010	11.62%	0.04%	0.20%	0.78%	10.93%	22.45%	53.97%
2011	10.93%	0.02%	0.14%	0.45%	7.24%	24.16%	57.06%
2012	26.82%	0.00%	0.07%	0.39%	6.04%	22.62%	44.06%
2013	36.46%	0.00%	0.05%	0.28%	4.10%	23.02%	36.09%
2014	10.20%	0.00%	0.10%	0.91%	10.09%	37.23%	41.48%
2015	17.63%	0.00%	0.11%	1.34%	11.75%	31.00%	38.16%
2016	13.16%	0.01%	0.15%	1.67%	13.33%	31.48%	40.21%
2017	9.99%	0.01%	0.24%	2.34%	15.81%	32.35%	39.25%
2018	3.97%	0.00%	0.41%	3.77%	20.11%	35.42%	36.32%
2019	4.86%	0.00%	0.53%	4.48%	21.32%	35.86%	32.95%

Initial Relative Loan Size Distribution

The relative loan size variable is computed by comparing the mortgage origination amount with the average loan size of all FHA-insured loans originated within the same period and in the same state. Empirical results show that this variable is very significant in predicting prepayments.

FHA experience indicates that larger loans tend to perform better compared with smaller loans in the same geographical area, all else being equal. Larger loans incur claims at a lower probability and in those cases where a claim occurs, loss severity tends to be lower. Prior to the increase in FHA's loan limits in fiscal year 2008, houses securing larger FHA loans tended to fall into the average house price range within their surrounding areas. Since this market is relatively liquid and there are a relatively large number of similar-quality homes in the area, the house price volatility of these houses tends to be relatively low in comparison to the house price volatility of extremely low- and high-priced houses. With the increased FHA loan size limit, FHA started endorsements of higher-priced houses after fiscal year 2008.

Table 17 shows the percentage of new fully underwritten mortgage originations within each relative loan size category. The distribution has been reasonably stable over time with the largest share in the 75-to-125 percent of area average loan size categories. However, since fiscal year 2000, there has been a steady increase in the dispersion among loan size categories. The proportion in the highest loan size category increased from 10.77% in fiscal year 2001 to 26.06% in fiscal year 2011, but has decreased since then to 18.43% in 2019. On the other hand, the share in lowest loan size category also increased from 2.50% percent in fiscal year 2006 to 4.35% in fiscal year 2011, and has since decreased to 3.05% in fiscal year 2019. The increase in both the highest and lowest loan size categories demonstrated the penetration of FHA products into high-balance loans and the resurgence of the low-balance loan, but this penetration has decreased slightly since 2011.

Table 17: Percentage of Origination Count by Relative Loan Size

Cohort	0-50% of Average Loan Size	50-75% of Average Loan Size	75-100% of Average Loan Size	100-125% of Average Loan Size	125-150% of Average Loan Size	>150% of Average Loan Size
1985	1.75%	10.64%	26.03%	34.72%	21.11%	5.75%
1986	1.37%	10.11%	27.02%	38.74%	18.86%	3.90%
1987	1.15%	9.85%	26.95%	38.79%	19.68%	3.59%
1988	1.50%	10.82%	25.90%	35.57%	20.13%	6.08%
1989	1.74%	11.31%	25.56%	32.44%	20.94%	8.00%
1990	1.77%	11.54%	25.43%	31.12%	20.78%	9.36%
1991	1.85%	11.57%	25.44%	30.03%	21.41%	9.69%
1992	1.73%	11.30%	25.91%	31.42%	21.28%	8.36%
1993	1.44%	10.77%	27.26%	33.28%	20.62%	6.64%
1994	1.51%	11.08%	26.78%	31.72%	20.62%	8.28%
1995	1.80%	11.93%	25.15%	30.26%	21.85%	9.02%
1996	1.73%	11.63%	25.25%	31.47%	22.24%	7.68%
1997	1.83%	12.01%	25.11%	31.72%	21.76%	7.58%
1998	1.54%	10.86%	24.79%	33.76%	21.99%	7.06%
1999	1.76%	11.76%	25.70%	31.99%	19.63%	9.16%
2000	2.09%	11.95%	24.65%	29.28%	20.12%	11.92%
2001	2.01%	11.58%	26.03%	30.32%	19.30%	10.77%
2002	2.08%	11.29%	25.70%	30.24%	19.22%	11.47%
2003	2.03%	11.15%	25.77%	30.78%	19.01%	11.26%
2004	2.49%	11.75%	24.07%	28.63%	19.80%	13.26%
2005	2.64%	12.05%	23.57%	28.06%	19.98%	13.70%
2006	2.50%	12.39%	23.34%	27.90%	19.71%	14.16%
2007	2.50%	12.51%	23.44%	27.68%	19.45%	14.42%
2008	2.77%	12.88%	24.42%	25.72%	17.24%	16.99%
2009	3.40%	13.39%	23.11%	22.62%	16.12%	21.36%
2010	3.94%	14.06%	22.21%	20.94%	14.87%	23.99%
2011	4.35%	14.03%	20.98%	19.98%	14.61%	26.06%
2012	4.16%	13.94%	21.54%	20.67%	14.89%	24.79%
2013	3.62%	14.09%	22.76%	21.26%	14.88%	23.40%
2014	3.80%	14.16%	22.43%	20.89%	15.00%	23.72%
2015	3.51%	13.61%	22.90%	21.85%	15.85%	22.28%
2016	3.36%	13.32%	23.09%	22.35%	16.51%	21.38%
2017	3.31%	12.97%	23.11%	23.09%	17.23%	20.28%
2018	3.23%	12.72%	23.38%	24.26%	17.02%	19.39%
2019	3.05%	12.31%	23.88%	25.13%	17.21%	18.43%

Initial Contract Interest Rate

Table 18 shows the average mortgage contract rate by mortgage type since fiscal year 1997. Average contract rates in fiscal year 2013 were the lowest of this entire time period. Rates have been increasing slowly since 2019.

In general, an FRM with a lower initial contract rate tends to prepay at a slower speed. As interest rates are projected to rise, the prepayment rates of the recent originations are likely to remain low. As these loans will have longer durations, as reflected in our predictive models, more insurance premium income will be generated, thus tending to improve the economic value of these recent books with historically low contract rates.

Also, a mortgage with a contract rate lower than the market rate tends to experience a lower probability of default because the borrower has the incentive to keep the below-market rate mortgage longer even when experiencing some negative equity. This tendency is reflected in our predictive models. As mortgage rates rise in the future, the recent low-interest-rate books are projected to incur fewer defaults and claims. This also tends to improve the economic value.

Table 18: Average Contract Interest Rate by Loan Type (Percent)

Fiscal Year	30-Year FRM	15-Year FRM	ARMs	30-Year SRs	15-Year SRs	ARMs SRs	Book of Business
1997	8.01	7.77	6.60	8.30	8.04	6.86	7.62
1998	7.42	7.23	6.25	7.62	7.24	6.54	7.22
1999	7.21	6.94	5.96	7.20	6.91	6.11	7.15
2000	8.22	7.95	6.87	8.07	7.81	6.15	8.07
2001	7.69	7.25	6.57	7.44	6.89	6.22	7.61
2002	7.07	6.60	5.37	7.02	6.46	5.38	6.92
2003	6.21	5.62	4.59	6.07	5.55	4.56	6.02
2004	6.08	5.52	4.41	5.92	5.46	4.34	5.84
2005	5.94	5.64	4.78	5.85	5.65	4.67	5.80
2006	6.29	6.14	5.36	6.10	6.02	5.03	6.25
2007	6.51	6.40	5.62	6.38	6.22	5.59	6.49
2008	6.33	5.95	5.39	6.09	5.64	5.33	6.30
2009	5.62	5.14	5.05	5.26	4.81	4.54	5.53
2010	5.14	4.62	3.98	5.13	4.65	4.28	5.08
2011	4.65	4.16	3.51	4.63	4.16	3.69	4.57
2012	3.98	3.46	3.14	3.98	3.53	3.38	3.93
2013	3.62	3.16	2.82	3.71	3.36	2.86	3.63
2014	4.30	3.71	3.31	4.51	3.91	3.39	4.28
2015	4.03	3.47	3.26	3.99	3.69	3.36	4.00
2016	3.91	3.40	3.23	3.87	3.53	3.35	3.89
2017	4.03	3.50	3.18	3.75	3.59	3.02	3.98
2018	4.54	3.87	3.51	4.08	4.03	3.49	4.50
2019	4.69	4.16	4.00	4.24	4.44	4.02	4.65

Source of Down Payment Assistance

Table 19 shows the distribution of annual loan endorsements by source of down payment assistance. Secondary loans provided by governments were included in the category of down payment assistance, and typically these were local government units.

Starting in fiscal year 2000, there was a rapid increase in the share of loans with gift letters from non-profit, religious, or community institutions. Home sellers contributed a large share of these funds to the non-profit organizations, which subsequently provided the gift to the buyers of the same properties to fulfill the down payment requirements. This concentration increased to over 20% in the 2005 - 2007 cohorts. FHA effectively terminated seller-financed down payment assist on October 1, 2008 because of the high losses associated with these loans. The share of loans with this type of assistance declined to negligible amounts after fiscal year 2008.

Since 2008, the percentage of loans with down payment assistance from a relative has increased from 6.8% to 20.6% in fiscal year 2019. Also, the share of loans with government down payment assistance increased from 2013 to 2016, but then has decreased since then.

Table 19: Percentage of Down payment assist Loan Counts by Source

Cohort	No Gift	Relative	Non-Profit, Religious or Community	Government
1998	76.81%	22.76%	0.20%	0.23%
1999	81.69%	17.11%	0.53%	0.68%
2000	77.56%	18.97%	1.69%	1.78%
2001	83.35%	11.72%	3.75%	1.17%
2002	83.22%	9.32%	6.29%	1.18%
2003	81.92%	7.61%	9.33%	1.13%
2004	71.69%	9.75%	16.95%	1.61%
2005	64.64%	9.91%	22.96%	2.48%
2006	64.13%	9.44%	23.04%	3.39%
2007	68.25%	7.66%	21.27%	2.81%
2008	74.46%	6.82%	17.38%	1.33%
2009	86.54%	10.34%	2.70%	0.42%
2010	83.99%	15.42%	0.09%	0.51%
2011	85.25%	13.91%	0.12%	0.72%
2012	85.76%	13.44%	0.13%	0.68%
2013	86.89%	12.33%	0.09%	0.70%
2014	77.73%	20.66%	0.29%	1.32%
2015	79.44%	17.88%	0.72%	1.95%
2016	77.31%	19.26%	0.91%	2.53%
2017	77.40%	19.70%	0.74%	2.16%
2018	76.34%	21.71%	0.41%	1.54%
2019	78.15%	20.62%	0.22%	1.01%

Section 5 – Summary of Methodology

This section provides an overview of the analytical approach used in this analysis.

Data Sources

In our analysis, we have relied on data from FHA, Moody's and the OMB.

From FHA, we have received the following data:

1. Claims_601_Case_Data: used for the cash entry from note sales
2. IDB: core case data, this table is derived based on fields from IDB_1, IDB_2, and the Decision_FICO_Score (one file each for 1975 – 2019)
3. Lossmit_Costs: derived table based on the Loss Mitigation table and IDB_1, used to obtain mitigation claim amounts
4. Sams_case_record: used to determine the status of the conveyances, the capital income/expense amounts, the sales and REO expenses and sales proceeds to FHA, where applicable
5. SFDW_Default_History: used to create period information related to default histories
6. Fannie_FICO_pre2004: used for supplemental credit data
7. Current_Status:
8. SFDW Dictionary for Pinnacle: data dictionary for the data tables provided by FHA

From Moody's, we have received the following data elements:

1. Historical Economic Data
2. Baseline Economic Projections
3. Modified Economic Scenario Projections

From OMB, we have received the Economic Assumptions for the 2020 Mid-Session Review (updated as of March, 2019).

The economic data that is included in the analysis is shown below.

1. HPI
2. Mortgage rates
3. Treasury rates
4. Unemployment rates
5. GDP

Data Processing – Mortgage Level Modeling (Appendix A)

Starting with the raw data, Pinnacle processed the data to create datasets for developing the mortgage level transition and loss severity models. The first step in preparing the data for analysis was the processing of the economic data. Historical economic data was imported by quarter, additional data elements were derived, and data was joined to the FHA mortgage data.

Once the economic data was prepared, the core data processing occurred. We used mortgage-level data to reconstruct quarterly mortgage-event histories by relating mortgage origination information to other data reflecting events that occurred over the history of the mortgage. In the process of creating quarterly event histories, each mortgage contributed an observed transition for every quarter from origination up to and including the period of mortgage termination, or until the end of fiscal year 2019 if the mortgage remained active.

Data Reconciliation

To reconcile the data processed by Pinnacle with the data provided by FHA, Pinnacle compared summaries of key data elements with summaries provided by FHA. The summaries for the number of active mortgages, IIF, number of 90-day delinquencies, and the number of claims to date are shown in the following tables.

The following tables are based on data as of September 30, 2019.

Table 20: Data Reconciliation - Number of Active Loans

Number of Active Loans				
Credit Subsidy Cohort	Federal Housing Administration (Data as of September 2019)	Independent Actuary (Data as of September 2019)	Absolute Difference (Actuary - FHA)	Percent Difference (Actuary - FHA) / FHA
1992	11,839	11,800	(39)	0%
1993	19,518	19,250	(268)	-1%
1994	28,213	27,902	(311)	-1%
1995	13,894	13,857	(37)	0%
1996	22,782	22,710	(72)	0%
1997	24,535	24,523	(12)	0%
1998	38,942	38,762	(180)	0%
1999	48,985	48,973	(12)	0%
2000	27,266	27,333	67	0%
2001	47,510	47,544	34	0%
2002	69,279	69,735	456	1%
2003	101,051	101,917	866	1%
2004	125,572	126,796	1,224	1%
2005	94,605	94,685	80	0%
2006	75,387	75,409	22	0%
2007	71,805	71,817	12	0%
2008	168,652	168,656	4	0%
2009	377,696	377,701	5	0%
2010	481,594	481,594	(0)	0%
2011	388,606	388,608	2	0%
2012	481,196	481,183	(13)	0%
2013	671,738	671,741	3	0%
2014	319,117	319,121	4	0%
2015	600,671	600,677	6	0%
2016	871,784	871,785	1	0%
2017	1,006,526	1,006,521	(5)	0%
2018	886,110	886,102	(8)	0%
2019	939,823	939,822	(1)	0%
Total	8,014,695	8,016,524		0%

Table 21: Data Reconciliation - Insurance in Force

Insurance in Force ($M) = Original Loan Amount on Active Loans				
Credit Subsidy Cohort	Federal Housing Administration (Data as of September 2019)	Independent Actuary (Data as of September 2019)	Absolute Difference (Actuary - FHA)	Percent Difference (Actuary - FHA) / FHA
1992	725,774	$726,515	741	0%
1993	1,270,592	$1,272,337	1,745	0%
1994	1,875,371	$1,878,123	2,752	0%
1995	875,897	$876,527	630	0%
1996	1,494,687	$1,496,406	1,720	0%
1997	1,655,543	$1,657,432	1,889	0%
1998	2,831,013	$2,838,869	7,856	0%
1999	3,756,576	$3,767,357	10,781	0%
2000	2,071,667	$2,075,885	4,218	0%
2001	4,067,657	$4,078,346	10,688	0%
2002	6,450,389	$6,487,510	37,121	1%
2003	10,640,020	$10,716,799	76,779	1%
2004	13,278,778	$13,381,689	102,911	1%
2005	10,183,047	$10,187,474	4,427	0%
2006	8,547,906	$8,548,650	744	0%
2007	8,781,946	$8,782,479	534	0%
2008	23,576,855	$23,578,118	1,263	0%
2009	57,635,229	$57,636,311	1,082	0%
2010	72,038,099	$72,038,099	0	0%
2011	59,952,085	$59,952,085	0	0%
2012	76,207,641	$76,207,641	0	0%
2013	109,565,058	$109,565,058	0	0%
2014	44,815,452	$44,815,452	0	0%
2015	102,824,898	$102,824,898	0	0%
2016	161,080,985	$161,080,985	0	0%
2017	196,897,527	$196,897,527	0	0%
2018	177,560,834	$177,560,834	0	0%
2019	201,691,054	$201,691,054	0	0%
Total	1,362,352,582	1,362,620,464		0%

Table 22: Data Reconciliation - Number of 90 Day Delinquencies

Number of 90 Day Delinquencies				
= Current Number of 90 Day Delinquencies				
Credit Subsidy Cohort	Federal Housing Administration (Data as of September 2019)	Independent Actuary (Data as of September 2019)	Absolute Difference (Actuary - FHA)	Percent Difference (Actuary - FHA) / FHA
1992	379	381	2	1%
1993	626	574	(52)	-8%
1994	978	895	(83)	-9%
1995	691	685	(6)	-1%
1996	1,208	1,217	9	1%
1997	1,394	1,400	6	0%
1998	2,177	2,152	(25)	-1%
1999	3,046	3,035	(11)	0%
2000	2,226	2,244	18	1%
2001	3,255	3,280	25	1%
2002	4,261	4,314	53	1%
2003	4,996	5,088	92	2%
2004	7,094	7,218	124	2%
2005	6,047	6,080	33	1%
2006	5,904	5,934	30	1%
2007	7,090	7,121	31	0%
2008	16,790	16,857	67	0%
2009	23,693	23,764	71	0%
2010	20,601	20,665	64	0%
2011	13,729	13,767	38	0%
2012	14,129	14,180	51	0%
2013	16,958	17,008	50	0%
2014	14,587	14,632	45	0%
2015	23,495	23,558	63	0%
2016	29,847	29,955	108	0%
2017	32,427	32,572	145	0%
2018	26,337	26,500	163	1%
2019	5,855	5,919	64	1%
Total	289,822	290,995	1,173	0%
Note:	Outstanding Delinquencies as of September 30, 2019			
	= Reported Delinquencies - Submitted Claims - Cured Delinquencies			
	on a cumulative basis.			

Table 23: Data Reconciliation - Number of Claims to Date

Number of Claims To Date				
Credit Subsidy Cohort	Federal Housing Administration (Data as of September 2019)	Independent Actuary (Data as of September 2019)	Absolute Difference (Actuary - FHA)	Percent Difference (Actuary - FHA) / FHA
1992	36,755	36,758	3	0%
1993	52,233	52,236	3	0%
1994	65,850	65,854	4	0%
1995	44,625	44,628	3	0%
1996	63,366	63,367	1	0%
1997	59,738	59,739	1	0%
1998	67,263	67,263	0	0%
1999	83,945	83,946	1	0%
2000	71,099	71,099	0	0%
2001	85,009	85,010	1	0%
2002	90,009	90,009	0	0%
2003	90,647	90,647	0	0%
2004	114,985	114,985	0	0%
2005	91,325	91,325	0	0%
2006	93,376	93,376	0	0%
2007	105,066	105,066	0	0%
2008	220,813	220,813	0	0%
2009	221,486	221,486	0	0%
2010	111,977	111,977	0	0%
2011	45,375	45,375	0	0%
2012	27,460	27,460	0	0%
2013	24,375	24,375	0	0%
2014	13,395	13,395	0	0%
2015	11,586	11,586	0	0%
2016	8,289	8,289	0	0%
2017	4,001	4,001	0	0%
2018	885	885	0	0%
2019	14	14	0	0%
Total	1,904,947	1,904,964		0%
Note:	Cumulated Number of Submitted Claims as of September 30, 2019			

Specification of Mortgage Transition Models (Appendix B)

The purpose of the transition predictive models is to estimate the likelihood of future occurrences of claim and prepayment terminations for FHA forward mortgages in the MMIF portfolio. The models are used to project future outstanding balances, cash flows, and ultimately the Cash Flow NPV.

The predictive models reflect the fact that mortgage borrowers possess two mutually exclusive options to terminate the mortgage, one to prepay the mortgage and the other to default by permanently ceasing payment. From FHA's point of view, prepayment and claim events are the corresponding outcomes of "competing risks" in the sense that they are mutually exclusive, and realization of one of these events precludes the other. Prepayment means cessation of cash inflows from MIP, but at the same time eliminates any chance of incurring claim losses. Conversely, termination through foreclosure means claim costs are incurred and MIP inflows cease, but uncertainty about the possibility and timing of prepayment is eliminated.

The models developed for this analysis also include additional transitions. These include the transition from current to 90 days or more delinquent (Default), cures from Default separated into cures by mortgage modification, and self-cures with no modification or with "light" modifications. We track the post-cure behavior of modified mortgages and self-cured mortgages separately with modification-related variables, namely a modification flag and the payment reduction ratio. We also track the status of mortgages post-default by including a prior default flag and the time since the most recent default.

We model five possible transitions from a mortgage in current status: remain current, default (enter 90+ days delinquent), prepay by streamlined refinance (SR), other prepayments or self-cure. (There is also one additional transition possible – cure with a modification. This transition rarely occurs for a mortgage in Current status, but most often with a mortgage in Default Status. Therefore, we have include these transitions in the Default transition model development). Given that these are mutually exclusive outcomes, the sum of the probabilities for all possible transitions is one. For a mortgage in default status at the beginning of a particular time period, the five possible transitions are that it may be prepaid, transition into a claim, self-cure, cure with a mortgage modification, or remain in default.

In the 2017 and 2018 Actuarial Review, Pinnacle used multinomial logistic models to estimate the probability of transition for current and default mortgages. For this review, we are using binomial logistic models to predict each transition separately, and once all the binomial models are completed, we adjust the binomial probabilities to reflect the multinomial nature of the transitions. The primary reason for making this change is that it allows us to better model each transition with the variables that impact that transition. The multinomial structure used in the 2017 and 2018 reports did not allow for the use of variables just for individual transitions - if a variable was included in the model it applied to all transitions. This can result in model over-specification, as there are some independent variables that are not significant for some transitions. To address this, Pinnacle used binomial models for each transitions and applied an adjustment to reflect the multinomial nature of the process.

There are several benefits to using a multinomial logistic model structure. First, it ensures that the event probabilities sum to unity. This means that at any point in time, a mortgage must experience only one of the possible transitions over the next period. Second, the possible values of each probability are constrained to be between zero and one. Third, as the probability of one transition type increases, the probabilities of the others are automatically reduced, reflecting the competing-risk nature among the transition events. Finally, they allow the conditional termination rates using mortgage-level data to be estimated. With mortgage-level observations, the possible outcomes at each point in time are either 0 (the event did not happen), or 1 (the event happened).

In the 2017 and 2018 Actuarial Reports, we developed the predictive models based on estimation samples of the data for the Current Status transition models with ending condition of Current, Prepayment of Streamline Refinance. For Default Status transition models, we sampled data with the ending condition of Default. With this analysis, for the transition models with the initial condition of C for the FRM30 non-SR product, we used a random sample of 50% of the data. For all other products, we used 100% of the data in the model development. For Default transition models, we used 100% of the data in the model development for all products.

Loss Severity Model (Appendix C)

FHA incurs a loss from a mortgage claim event. This loss amount depends on many factors, including the disposition channel. In practice, foreclosed properties generally have higher severity compared to pre-foreclosure-sales (PFS). Foreclosure mortgages can be further separated into real-estate-owned (REO) and Claims Without Conveyance of Title (CWCOT). We have developed multiple models to predict loss severity: a model to predict whether the property is disposed by PFS, REO or CWCOT, and separate loss severity models for REO, PFS and CWCOT cases. The loss severity models capture characteristics of the mortgage, the collateral, the borrower, and the housing market environment when a claim occurs. The claim disposition selection model was estimated using multinomial logistic regression, while Generalized Linear Models (GLM) were developed for loss severity models.

In addition to the loss severity models, we have also developed separate models to project the frequency of loss mitigation claims and the severity associated with these claims.

Cash Flow Projections (Appendix E)

After projecting the future transitions and severities using the predictive models, we use this information to project future cash flows. The cash flow model includes the calculation of five types of cash flows:

1. Upfront MIP
2. Annual MIP
3. Claim payments
4. Loss mitigation related expenses
5. Premium refunds

The federal credit subsidy present value conversion factors provided by OMB are used to discount future cash flows to determine their present value as of the end of fiscal year 2019.

FHA executed note sales in November 2015 and September 2016. Based on information provided by HUD, there are no current planned or pending note sales. Therefore, we have not projected any future note sales in our analysis.

We have calculated the Cash Flow NPV based on multiple deterministic economic scenario paths. The ACE projection is based on the OMB Economic Assumptions, and the variation in the estimate is calculated in part by using ten alternative economic projection scenarios from Moody's. These scenarios includes both more favorable than expected and less favorable than expected economic assumptions. The resulting Cash Flow NPV is then calculated based on these varying assumptions. The following are the economic variables that drive the variation in the MMIF Cash Flow NPV:

- 1-year CMT rates
- 3-year CMT rates
- 5-year CMT rates
- 10-year CMT rates
- 30-year CMT rates
- 30-year Fixed Rate Mortgage (FRM) rates
- FHFA national purchase-only HPI
- Unemployment rates by state
- Change in unemployment rate
- 1-year GDP ratio

Appendices

A. Data - Sources, Processing and Reconciliation
B. Transition Models
C. Loss Severity Models
D. Economic Scenarios
E. Cash Flow Analysis
F. Review of HUD Analysis of Economic Net Worth, Comparison of HUD and Pinnacle Models, and Assessment of Vulnerabilities
G. Summary of Historical and Projected Claim Rates, Non-Claim Termination Rates and Loss Severities

Appendix A: Data – Sources, Processing and Reconciliation

Data Sources

In our analysis, we have relied on data from FHA, Moody's and the OMB.

From FHA, we have received the following data:

1. Claims_601_Case_Data: used for the cash entry from note sales
2. IDB: core case data, this table is derived based on fields from IDB_1, IDB_2, and the Decision_FICO_Score (one file each for 1975 – 2018)
3. Lossmit_Costs: derived table based on the Loss Mitigation table and IDB_1, used to obtain mitigation claim amounts
4. Sams_case_record: used to determine the status of the conveyances, the capital income/expense amounts, the sales and REO expenses and sales proceeds to FHA, where applicable
5. SFDW_Default_History: used to create period information related to default histories
6. Fannie_FICO_pre2004: used for supplemental credit data
7. Current_Status:
8. SFDW Dictionary for Pinnacle: data dictionary for the data tables provided by FHA

From Moody's, we have received the following data elements:

1. Historical Economic Data
2. Baseline Economic Projections
3. Modified Economic Scenario Projections

From OMB, we have received the Economic Assumptions for the 2020 Mid-Session Review (updated as of May, 2019).

The economic data that is included in the analysis is shown below.

1. HPI
2. Mortgage rates
3. Treasury rates
4. Unemployment rates
5. GDP

Data Processing – Mortgage Level Modeling (Appendix A)

Starting with the raw data, Pinnacle processed the data to create datasets for developing the mortgage level transition and loss severity models. The first step in preparing the data for analysis was the processing of the economic data. Historical economic data was imported by quarter, additional data elements were derived, and data was joined to the FHA mortgage data.

Once the economic data was prepared, the core data processing occurred. We used mortgage-level data to reconstruct quarterly mortgage-event histories by relating mortgage origination information to other data reflecting events that occurred over the history of the mortgage. In the process of creating quarterly event histories, each mortgage contributed an observed transition for every quarter from origination up to and including the period of mortgage termination, or until the end of the end of the fourth quarter of fiscal year 2019 if the mortgage remained active.

Data Reconciliation

To reconcile the data processed by Pinnacle with the data provided by FHA, Pinnacle compared summaries of key data elements with summaries provided by FHA. The summaries for the number of active mortgages, IIF, number of 90-day delinquencies, and the number of claims to date are shown in the following tables.

The following tables are based on data as of September 30, 2019, as this was the data used to develop the transition and net loss models.

Table 24: Data Reconciliation - Number of Active Loans

Number of Active Loans				
Credit Subsidy Cohort	Federal Housing Administration (Data as of September 2019)	Independent Actuary (Data as of September 2019)	Absolute Difference (Actuary - FHA)	Percent Difference (Actuary - FHA) / FHA
1992	11,839	11,800	(39)	0%
1993	19,518	19,250	(268)	-1%
1994	28,213	27,902	(311)	-1%
1995	13,894	13,857	(37)	0%
1996	22,782	22,710	(72)	0%
1997	24,535	24,523	(12)	0%
1998	38,942	38,762	(180)	0%
1999	48,985	48,973	(12)	0%
2000	27,266	27,333	67	0%
2001	47,510	47,544	34	0%
2002	69,279	69,735	456	1%
2003	101,051	101,917	866	1%
2004	125,572	126,796	1,224	1%
2005	94,605	94,685	80	0%
2006	75,387	75,409	22	0%
2007	71,805	71,817	12	0%
2008	168,652	168,656	4	0%
2009	377,696	377,701	5	0%
2010	481,594	481,594	(0)	0%
2011	388,606	388,608	2	0%
2012	481,196	481,183	(13)	0%
2013	671,738	671,741	3	0%
2014	319,117	319,121	4	0%
2015	600,671	600,677	6	0%
2016	871,784	871,785	1	0%
2017	1,006,526	1,006,521	(5)	0%
2018	886,110	886,102	(8)	0%
2019	939,823	939,822	(1)	0%
Total	8,014,695	8,016,524		0%

Table 25: Data Reconciliation - Insurance in Force

Insurance in Force ($M) = Original Loan Amount on Active Loans				
Credit Subsidy Cohort	Federal Housing Administration (Data as of September 2019)	Independent Actuary (Data as of September 2019)	Absolute Difference (Actuary - FHA)	Percent Difference (Actuary - FHA) / FHA
1992	725,774	$726,515	741	0%
1993	1,270,592	$1,272,337	1,745	0%
1994	1,875,371	$1,878,123	2,752	0%
1995	875,897	$876,527	630	0%
1996	1,494,687	$1,496,406	1,720	0%
1997	1,655,543	$1,657,432	1,889	0%
1998	2,831,013	$2,838,869	7,856	0%
1999	3,756,576	$3,767,357	10,781	0%
2000	2,071,667	$2,075,885	4,218	0%
2001	4,067,657	$4,078,346	10,688	0%
2002	6,450,389	$6,487,510	37,121	1%
2003	10,640,020	$10,716,799	76,779	1%
2004	13,278,778	$13,381,689	102,911	1%
2005	10,183,047	$10,187,474	4,427	0%
2006	8,547,906	$8,548,650	744	0%
2007	8,781,946	$8,782,479	534	0%
2008	23,576,855	$23,578,118	1,263	0%
2009	57,635,229	$57,636,311	1,082	0%
2010	72,038,099	$72,038,099	0	0%
2011	59,952,085	$59,952,085	0	0%
2012	76,207,641	$76,207,641	0	0%
2013	109,565,058	$109,565,058	0	0%
2014	44,815,452	$44,815,452	0	0%
2015	102,824,898	$102,824,898	0	0%
2016	161,080,985	$161,080,985	0	0%
2017	196,897,527	$196,897,527	0	0%
2018	177,560,834	$177,560,834	0	0%
2019	201,691,054	$201,691,054	0	0%
Total	1,362,352,582	1,362,620,464		0%

Table 26: Data Reconciliation - Number of 90 Day Delinquencies

Number of 90 Day Delinquencies				
= Current Number of 90 Day Delinquencies				
Credit Subsidy Cohort	Federal Housing Administration (Data as of September 2019)	Independent Actuary (Data as of September 2019)	Absolute Difference (Actuary - FHA)	Percent Difference (Actuary - FHA) / FHA
1992	379	381	2	1%
1993	626	574	(52)	-8%
1994	978	895	(83)	-9%
1995	691	685	(6)	-1%
1996	1,208	1,217	9	1%
1997	1,394	1,400	6	0%
1998	2,177	2,152	(25)	-1%
1999	3,046	3,035	(11)	0%
2000	2,226	2,244	18	1%
2001	3,255	3,280	25	1%
2002	4,261	4,314	53	1%
2003	4,996	5,088	92	2%
2004	7,094	7,218	124	2%
2005	6,047	6,080	33	1%
2006	5,904	5,934	30	1%
2007	7,090	7,121	31	0%
2008	16,790	16,857	67	0%
2009	23,693	23,764	71	0%
2010	20,601	20,665	64	0%
2011	13,729	13,767	38	0%
2012	14,129	14,180	51	0%
2013	16,958	17,008	50	0%
2014	14,587	14,632	45	0%
2015	23,495	23,558	63	0%
2016	29,847	29,955	108	0%
2017	32,427	32,572	145	0%
2018	26,337	26,500	163	1%
2019	5,855	5,919	64	1%
Total	289,822	290,995	1,173	0%
Note:	Outstanding Delinquencies as of September 30, 2019			
	= Reported Delinquencies - Submitted Claims - Cured Delinquencies			
	on a cumulative basis.			

Table 27: Data Reconciliation - Number of Claims to Date

Number of Claims To Date				
Credit Subsidy Cohort	Federal Housing Administration (Data as of September 2019)	Independent Actuary (Data as of September 2019)	Absolute Difference (Actuary - FHA)	Percent Difference (Actuary - FHA) / FHA
1992	36,755	36,758	3	0%
1993	52,233	52,236	3	0%
1994	65,850	65,854	4	0%
1995	44,625	44,628	3	0%
1996	63,366	63,367	1	0%
1997	59,738	59,739	1	0%
1998	67,263	67,263	0	0%
1999	83,945	83,946	1	0%
2000	71,099	71,099	0	0%
2001	85,009	85,010	1	0%
2002	90,009	90,009	0	0%
2003	90,647	90,647	0	0%
2004	114,985	114,985	0	0%
2005	91,325	91,325	0	0%
2006	93,376	93,376	0	0%
2007	105,066	105,066	0	0%
2008	220,813	220,813	0	0%
2009	221,486	221,486	0	0%
2010	111,977	111,977	0	0%
2011	45,375	45,375	0	0%
2012	27,460	27,460	0	0%
2013	24,375	24,375	0	0%
2014	13,395	13,395	0	0%
2015	11,586	11,586	0	0%
2016	8,289	8,289	0	0%
2017	4,001	4,001	0	0%
2018	885	885	0	0%
2019	14	14	0	0%
Total	1,904,947	1,904,964		0%
Note:	Cumulated Number of Submitted Claims as of September 30, 2019			

Appendix B – Transition Models

This appendix describes the technical details of the predictive models used to estimate the transition behavior of forward mortgages.

Section 1 summarizes the model specifications used to analyze FHA mortgage status transitions and the subsequent ultimate claim and prepayment rates. This section also presents the statistical theory behind multinomial logistic models.

Section 2 describes the explanatory variables used in the models.

Section 3 shows the model parameters.

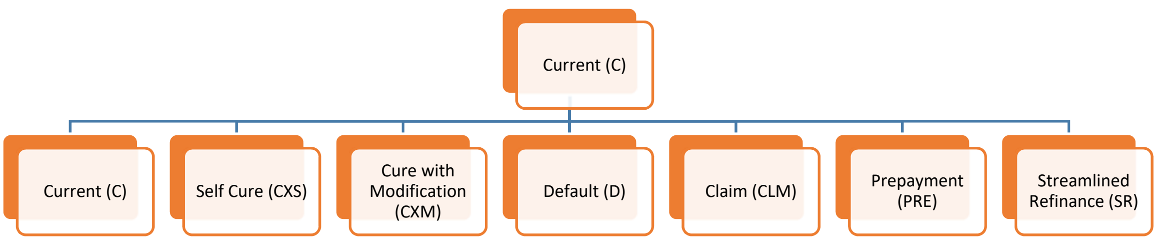
Section 4 shows the model validation of the binomial logistic models.

Section 1: Model Specification

Prior to the 2010 Actuarial Review, a competing-risk framework based on multinomial logistic models for quarterly conditional probabilities of prepayment and claim terminations was used. Starting with the 2010 Review, a third "competing risk" was introduced: 90-day delinquency, or default. The date from which a mortgage is first reported to be 90 or more days late is used to identify the start of a default episode, and this episode continues until ended by cure or the mortgage terminates through claim or prepayment. Active mortgages that are not in a 90-day default episode at the beginning of the quarter are classified as current.

Figure 11 below shows the possible "current" status transitions that have been modeled using the multinomial framework.

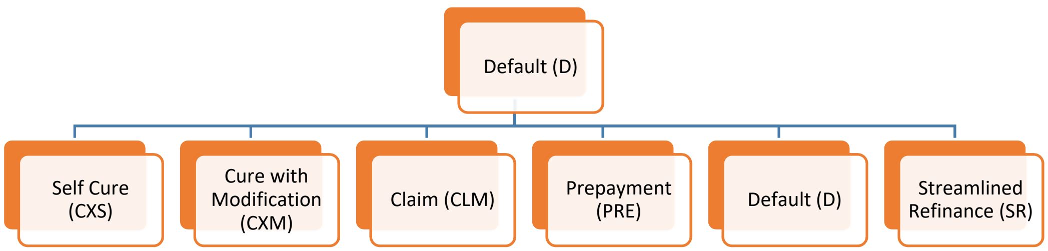
Figure 11: Transition Models – Initial Current Status



Mortgages in current status (C) at the beginning of the quarter can default and cure in the same quarter (CXS and CXM), transition to default status (D) at the start of the next quarter, result in a claim (CLM) or terminate as a prepayment due to an FHA Streamlined Refinance (SR) or as a prepayment (PRE) for any reason other than SR. There are two types of cures, a self-cure (CXS) and a cure that includes a mortgage modification (CXM). Also, due to the very low likelihood of a current mortgage transitioning into to a CLM in one quarter, we have combined D and CLM into one category (DCLM).

The figure below shows the possible default status transitions that have been modeled using the multinomial framework.

Figure 12: Transition Models – Initial Default Status



For mortgages that begin the quarter in default, they can cure either by the borrower becoming current on their own (CXS), or they can cure with a modification in the terms of the mortgage (CXM). The mortgage can also terminate as a prepayment due to an SR or as a prepayment (PRE) for any reason other than SR, turn into a claim (CLM) for the MMIF or remain in default (D). For the development of the transition models, we have combined PRE and SR into one category (END).

As the mortgage transitions through multiple stages, the historical status of the mortgage is retained. At any point in the life of the mortgage, we track both the number of prior times the mortgage was either in default or modified as well as the length of time since the mortgage was in the prior stage.

Multinomial Logistic Regression Theory and Model Specification

Multinomial logistic regression is used to model the relationship between a collection of predictor variables and the distributional behavior of a polytomous response variable. It is a likelihood-based methodology and may be viewed as the generalization of logistic regression for a response variable with more than two levels.

To formalize its description, let the response variable Y take m possible levels, denoted for simplicity as 1,…,m, and assume there is a collection of g predictors $\mathrm{X}_1,\ldots,\mathrm{X}_\mathrm{g}$, that are used to model Y's distribution. We assume that Y and $\mathrm{X}_1,\ldots,\mathrm{X}_\mathrm{g}$ are jointly observed n times with the ith random observation being labeled as

$$\mathrm{Y}_i,\ \mathrm{X}_{1i},\ldots,\mathrm{X}_{\mathrm{g}i} \text{ and its realized value } \mathrm{y}_i,\ \mathrm{x}_{1i},\ldots,\mathrm{x}_{\mathrm{g}i}.$$

In a multinomial logistic regression, the mathematical structure of the model is set by the following two assumptions:

1. The g+1 length random vectors <Y_i, X_{1i},…, X_{gi}> are jointly independent across all i
2. Given that X_{1i},…, X_{gi} have been observed at x_{1i},…, x_{gi}, Y_i's distribution is assumed to be multinomial with

$$P(Y_i = l) = \exp(\mu^l + \sum_{k=1}^{g} \beta_k^l \cdot \mathrm{x_{ki}}) / (\sum_{j=1}^{m} \exp(\mu^j + \sum_{k=1}^{g} \beta_k^j \cdot \mathrm{x_{ki}})) \,,$$

   where the β_k^j are unknown regression parameters and the μ^j are unknown intercept parameters. [Note: To prevent over-specification of the model due to the constraint that the above probabilities sum to 1 over l=1,…,m, a base level j is chosen such that β_k^j and μ^j are set equal to zero.] Thus, if j = 1, then

$$P(Y_i=1) = 1/(1 + \sum_{j=2}^{g} \exp(\mu^j + \sum_{k=1}^{g} \beta_k^j \cdot \mathrm{x_{ki}})) \,.$$

It now follows the likelihood equation for this model is given by

$$\prod_{i=1}^{n} P(Y_i = y_i) = \prod_{i=1}^{n} \exp(\mu^{y_i} + \sum_{k=1}^{g} \beta_k^{y_i} \cdot \mathrm{x_{ki}}) / (\sum_{j=1}^{m} \exp(\mu^j + \sum_{k=1}^{g} \beta_k^j \cdot \mathrm{x_{ki}})).$$

The multinomial logistic regression procedure optimizes the above likelihood over the unknown parameters in order to find those parameters that are most likely to have given rise to the data.

In the 2017 and 2018 Actuarial Review, we used multinomial logistic models to estimate the probability of transition for current and default mortgages. For this review, we are using binomial logistic models to predict each transition separately, and once all the binomial models are completed, we compute multinomial probabilities from the binomial models. The primary reason for making this change is that it allows us to better model each transition with the variables that impact that transition, whereas the specific multinomial model structure used last year required us to include a variable for all transitions even if it is only predictive of one of the transitions.

The multinomial structure used in the 2017 and 2018 reports did not allow for the use of variables just for individual transitions, if a variable was included in the model it applied to all transitions. This can result in model over-specification, as there are some independent variables that are not significant for some transitions. To address this, Pinnacle used binomial models for each transitions and applied an adjustment to reflect the multinomial nature of the process.

The target variables for the current and default transition models are shown above in Figure 11 and Figure 12. The independent variables used in the models are described in the following section. 31 models were built, 15 for the current (C) transitions and 16 for the Default (D) transitions. Four product groups are modeled: non-streamlined refinance fixed rate 30-year term (FRM30NSR), streamlined refinance fixed rate 30-year term (FRM30SR), fixed rate 15-year term (FRM15) and adjustable rate mortgages (ARM). The model development was completed using a train/validate approach. A random sample of the data is used to train the model, to determine inclusion and exclusion of explanatory variables, and to calculate model parameters. The remaining sample, the validation, is used as a final validation step to measure the predictive power of the final model.

To generate the random sample, random numbers were added to the dataset at the case level using a random number generator. The random numbers were drawn from a uniform distribution between 0 and 1. Based on these random numbers, 60% of the cases were assigned to the train dataset and 40% were assigned to the validation dataset.

There are over 35 million single-family mortgages insured by FHA originated between the first quarter of fiscal year 1975 and the fourth quarter of fiscal year 2019. For the transition models with the initial condition of C for the FRM30NSR, we used a random sample of 50% of the data. For all other products, we used 100% of the data in the model development.

For transition models with the initial condition of D we used 100% of the data for all ending condition models for all products.

Computation of Multinomial Logistic Probabilities from Binomial Models

As stated above, we compute multinomial probabilities from the binomial models described developed. To arrive at the multinomial logit model for *K* possible outcomes, *K*-1 independent binary logistic regression models are run and the *Kth* outcome is derived from the *K-1* models*.* The linear predictor (*lp*) is formulated by a binomial logistic regression for all transitions except for the transition representing remaining in the same state (C_C or D_D), which is the *Kth* outcome. This is consistent with the approach developed by Begg and Gray (1984)[48], in which separate binomial logistic models for each possible transition type are developed, and then the estimates are recombined to derive the multinomial logistic probabilities.

For the C transitions:

$$lp(C\_D) = e^{\alpha^{C\_D} + X^{C\_D}(t)\,\beta^{C\_D}}$$

$$lp(C\_CXS) = e^{\alpha^{C\_CXS} + X^{C\_CXS}(t)\,\beta^{C\_CXS}}$$

$$lp(C\_SR) = e^{\alpha^{C\_SR} + X^{C\_SR}(t)\,\beta^{C\_SR}}$$

$$lp(C\_PRE) = e^{\alpha^{C\_PRE} + X^{C\_PRE}(t)\,\beta^{C\_PRE}}$$

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[48] Begg, C.B. and R. Gray, "Calculation of Polychotomous Logistic Regression Parameters Using Individualized Regressions," Biometrika, 71(1):11-18, 1984.

The probabilities can then be derived for each of the *K-1* transitions:

$$Prob(C\_D) = lp(C\_D) / [1+lp(C\_D)+lp(C\_CXS)+lp(C\_SR)+lp(C\_PRE)]$$

$$Prob(C\_CXS) = lp(C\_CXS) / [1+lp(C\_D)+lp(C\_CXS)+lp(C\_SR)+lp(C\_PRE)]$$

$$Prob(C\_SR) = lp(C\_D) / [1+lp(C\_D)+lp(C\_CXS)+lp(C\_SR)+lp(C\_PRE)]$$

$$Prob(C\_PRE) = lp(C\_D) / [1+lp(C\_D)+lp(C\_CXS)+lp(C\_SR)+lp(C\_PRE)]$$

The *Kth* probability is

$$Prob(C\_C) = 1- Prob(C\_D)- Prob(C\_CXS)- Prob(C\_SR)- Prob(C\_PRE)$$

For the D transitions:

$$lp(D\_CLM) = e^{\alpha^{D\_CLM} + X^{D\_CLM}(t)\beta^{D\_CLM}}$$

$$lp(D\_CXS) = e^{\alpha^{D\_CXS} + X^{D\_CXS}(t)\beta^{D\_CXS}}$$

$$lp(D\_CXM) = e^{\alpha^{D\_CXM} + X^{D\_CXM}(t)\beta^{D\_CXM}}$$

$$lp(D\_END) = e^{\alpha^{D\_END} + X^{D\_END}(t)\beta^{D\_END}}$$

The probabilities can then be derived for each of the *K-1* transitions:

$$Prob(D\_CLM)= lp(D\_CLM) / [1+lp(D\_CLM)+lp(D\_CXS)+lp(D\_CXM)+lp(D\_END)]$$

$$Prob(D\_CXS) = lp(D\_CXS) / [1+lp(D\_CLM)+lp(D\_CXS)+lp(D\_CXM)+lp(D\_END)]$$

$$Prob(D\_CXM)\ l=p(D\_CXM) / [1+lp(D\_CLM)+lp(D\_CXS)+lp(D\_CXM)+lp(D\_END)]$$

$$Prob(D\_END) = lp(D\_END) / [1+lp(D\_CLM)+lp(D\_CXS)+lp(D\_CXM)+lp(D\_END)]$$

The *Kth* probability is

$$Prob(D\_D) = 1- Prob(D\_CLM)- Prob(D\_CXS)- Prob(D\_CXM)- Prob(D\_END)$$

Finally, a check is built into the simulation to assure the sum of all transition probabilities does not exceed 1.0.

Section 2: Transition Model Explanatory Variables

Multiple categories of explanatory variables were considered in development of the transition models.

- Fixed initial mortgage characteristics: market rate, initial mortgage size, spread at origination, refinance indicator
- Fixed initial borrower characteristics: down payment assistance, first-time home buyer, credit score, cohort year
- Property characteristics: the number of living units, initial home values
- Dynamic variables based on mortgage information: prior default indicator, number of prior default episodes, prior mortgage modification, number of prior modifications, LTV ratio, interest rate spread, TEI (expense to income ratio), mortgage period, duration of default episode, time since last default episode
- Dynamic variables derived by combining mortgage information and external economic data: spread, season
- Dynamic macroeconomic variables: average unemployment rate over multiple time periods, change in the unemployment rate, HPI, change in HPR, treasury rates, GDP measures, slope of yield curve
- Geographic variables: judicial state, collateral state

The following explanatory variables are used in the transition models. A general description of the variable is provided below, and more specific detail is included in the Model Parameters section.

- **Periodnbr**: the number of quarters since the inception of the mortgage. This variable is incorporated as a piecewise variate and a grouped categorical variable.
- **Refiincent**: refinance incentive - the ratio of the difference in the initial mortgage rate to the current market mortgage rate. This variable is calculated as *(100*mortgage interest rate)/(market FRM30 rate)*. This variable is incorporated as a piecewise variate.
- **Priordef**: number of prior default episodes. This variable is incorporated as a grouped categorical variable and a piecewise variate.
- **Timesinced**: time since more recent default. This variable is incorporated as a grouped categorical variable.
- **Credit**: credit score. This variable is incorporated as a piecewise variate.
- **Ratiotmptei**: front end ratio, the portion of an individual's income allocated to mortgage payments. This variable is incorporated as a piecewise variate.
- **Deltaue**: change in unemployment rate from mortgage inception to current. This variable is incorporated as a piecewise variate.
- **Deltauepr3**: change in unemployment rate from three quarters prior to current. This variable is incorporated as a piecewise variate.

- **Hpa2yb**: house price appreciation over the past two years. This variable is calculated as (*hpi_index 4 quarters forward/hpi_index 4 quarters prior)*. This variable is incorporated as a piecewise variate.
- **LTV**: ratio of the amortized loan balance to the current home value. This variable is incorporated as a piecewise variate.
- **Loanraw**: the initial mortgage amount. This variable is incorporated as a piecewise variate.
- **Frst_tm_by**: first time home buyer. This variable is incorporated as a categorical variable.
- **Season**: the quarter of the year. Possible values are 1 – January through March, 2 – April through June, 3 – July through September, and 4 – October through December. This variable is incorporated as a grouped categorical variable.
- **Rfnc_ind**: an indicator of whether the mortgage was a refinance. This variable is incorporated as a categorical variable.
- **Dpa**: down payment assistance. This variable is incorporated as a categorical variable.
- **Ueblend**: current unemployment rate. This variable is incorporated as a piecewise variate.
- **Ycslope**: yield curve. This variable is incorporated as a grouped categorical variable.
- **Sato**: spread at origination. This variable is calculated as the difference between the prevailing interest rate and the mortgage interest rate at time of origination. This variable is incorporated as a piecewise variate.
- **Calperiod**: calendar year and quarter. This variable is incorporated as a grouped categorical variable.
- **Judicial**: whether the property is in a judicial state. This variable is incorporated as a categorical variable.
- **Cred_subs_coht**: credit subsidy cohort. This variable is incorporated as a grouped categorical variable.
- **Treasury_yr30**: 30-year CMT rate. This variable is incorporated as a grouped categorical variable.
- **Deltaty1**: change in 1-year CMT rate from policy inception to current. This variable is incorporated as a piecewise variate.
- **Deltaty10init**: 10-year CMT rate at policy inception. This variable is incorporated as a grouped categorical variable.
- **Durdefep**: duration of default episode. This variable is incorporated as a grouped categorical variable.

For variables that are incorporated as a piecewise variate, further information is provided on how these variates are specified in the Model Parameter section.

The overall percentage of records in each final condition category for the initial condition of Current is shown in the table below.

Table 28: Distribution of Final Condition – Current Transition Models

Final Condition	Percentage
CXS	0.43%
DCLM	2.32%

Final Condition	Percentage
CXM	0.01%
SR	0.74%
PRE	2.31%
C	94.19%

The overall percentage of records in each final condition category for the initial condition of Default is shown in the table below.

Table 29: Distribution of Final Condition - Default Transition Models

Final Condition	Percentage
CLM	3.94%
CXM	2.57%
CXS	19.25%
END	1.49%
D	72.76%

Section 3: Binomial Model Results

Current Transition Model Parameters – FRM30NSR C_SR

The model parameters for the FRM30NSR current to streamlined refinance transition are shown below.

Table 30: Current to Streamlined Refinance Transition FRM30NSR Model Parameters

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept					-11.6743	0.0862	0.0000
mperiodnbr_CSR	L02		Categorical of period_number	period_number = 2	-0.8688	0.0075	0.0000
mperiodnbr_CSR	L03		Categorical of period_number	period_number = 3	0.0785	0.0052	0.0000
mperiodnbr_CSR	L04		Categorical of period_number	period_number = 4	0.3995	0.0045	0.0000
mperiodnbr_CSR	L05		Categorical of period_number	period_number = 5	0.3901	0.0043	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mperiodnbr_CSR	L06		Categorical of period_number	period_number = 6	0.2749	0.0044	0.0000
mperiodnbr_CSR	L07		Categorical of period_number	period_number = 7	0.1544	0.0045	0.0000
mperiodnbr_CSR	Z08		Categorical of period_number	base level: else			
vperiodnbr_CSR_pw1			Variate piecewise of period_number	median(0,period_number-8,22-8)	-0.0524	0.0004	0.0000
vperiodnbr_CSR_pw2			Variate piecewise of period_number	median(0,period_number-22,39-22)	-0.0608	0.0005	0.0000
vperiodnbr_CSR_pw3			Variate piecewise of period_number	median(0,period_number-39,56-39)	-0.0509	0.0010	0.0000
vperiodnbr_CSR_pw4			Variate piecewise of period_number	median(0,period_number-56,70-56)	-0.0292	0.0025	0.0000
vperiodnbr_CSR_pw5			Variate piecewise of period_number	median(0,period_number-70,88-70)	-0.0722	0.0041	0.0000
vrefiincent_CSR_pw1			Variate piecewise of refi_incent2_r[1]	median(0,refi_incent2_r-0,93-0)	-0.0119	0.0006	0.0000
vrefiincent_CSR_pw2			Variate piecewise of refi_incent2_r[1]	median(0,refi_incent2_r-93,113-93)	0.0998	0.0003	0.0000
vrefiincent_CSR_pw3			Variate piecewise of refi_incent2_r[1]	median(0,refi_incent2_r-113,130-113)	0.0638	0.0002	0.0000
vrefiincent_CSR_pw4			Variate piecewise of refi_incent2_r[1]	median(0,refi_incent2_r-130,180-130)	0.0161	0.0001	0.0000
vrefiincent_CSR_pw5			Variate piecewise of refi_incent2_r[1]	max(0,refi_incent2_r-180)	-0.0052	0.0005	0.0000
mpriordef_csr*mtimesinceD_CSR	L01	L01	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time <= 1	-1.1521	0.0121	0.0000
mpriordef_csr*mtimesinceD_CSR	L01	L02	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time = 2	-1.0081	0.0135	0.0000
mpriordef_csr*mtimesinceD_CSR	L01	L03	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time = 3	-0.7891	0.0142	0.0000
mpriordef_csr*mtimesinceD_CSR	L01	L04	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time = 4	-0.4143	0.0136	0.0000
mpriordef_csr*mtimesinceD_CSR	L01	L05	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time = 5	-0.3407	0.0148	0.0000
mpriordef_csr*mtimesinceD_CSR	L01	L06	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time = 6	-0.4023	0.0166	0.0000
mpriordef_csr*mtimesinceD_CSR	L01	L07	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; 7 <= cx_time <= 9	-0.2648	0.0106	0.0000
mpriordef_csr*mtimesinceD_CSR	L01	L09	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time > 9	-0.1463	0.0103	0.0000
mpriordef_csr*mtimesinceD_CSR	L02	L01	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 2; cx_time <= 1	-1.8981	0.0235	0.0000
mpriordef_csr*mtimesinceD_CSR	L02	L02	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 2; cx_time = 2	-1.6012	0.0255	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_csr*mtimesinceD_CSR	L02	L03	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt = 2; cx_time = 3	-1.2026	0.0254	0.0000
mpriordef_csr*mtimesinceD_CSR	L02	L04	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt = 2; cx_time = 4	-0.6621	0.0230	0.0000
mpriordef_csr*mtimesinceD_CSR	L02	L05	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt = 2; cx_time = 5	-0.4002	0.0232	0.0000
mpriordef_csr*mtimesinceD_CSR	L02	L06	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt = 2; cx_time = 6	-0.4401	0.0265	0.0000
mpriordef_csr*mtimesinceD_CSR	L02	L07	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt = 2; 7 <= cx_time <= 9	-0.3528	0.0179	0.0000
mpriordef_csr*mtimesinceD_CSR	L02	L09	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt = 2; cx_time > 9	-0.1994	0.0148	0.0000
mpriordef_csr*mtimesinceD_CSR	L03	L01	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt >= 3; cx_time <= 1	-2.3824	0.0226	0.0000
mpriordef_csr*mtimesinceD_CSR	L03	L02	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt >= 3; cx_time = 2	-1.8408	0.0227	0.0000
mpriordef_csr*mtimesinceD_CSR	L03	L03	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt >= 3; cx_time = 3	-1.2282	0.0213	0.0000
mpriordef_csr*mtimesinceD_CSR	L03	L04	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt >= 3; cx_time = 4	-0.4725	0.0182	0.0000
mpriordef_csr*mtimesinceD_CSR	L03	L05	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt >= 3; cx_time = 5	-0.3038	0.0196	0.0000
mpriordef_csr*mtimesinceD_CSR	L03	L06	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt >= 3; cx_time = 6	-0.3466	0.0227	0.0000
mpriordef_csr*mtimesinceD_CSR	L03	L07	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt >= 3; 7 <= cx_time <= 9	-0.2787	0.0164	0.0000
mpriordef_csr*mtimesinceD_CSR	L03	L09	Interaction of prior_default_cnt and cx_time^2	prior_default_cnt >= 3; cx_time > 9	-0.2221	0.0153	0.0000
mpriordef_csr*mtimesinceD_CSR	Z00	Z00	Interaction of prior_default_cnt and cx_time^2	base level: else			
vpriordef_CSR_pw1			Variate piecewise of prior_default_cnt	median(0,prior_default_cnt-3,15-3)	0.0815	0.0037	0.0000
vcredit_CSR_pw1			Variate piecewise of credit_score	median(0,credit_score-500,650-500)	-0.0036	0.0000	0.0000
vcredit_CSR_pw2			Variate piecewise of credit_score	median(0,credit_score-650,680-650)	0.0018	0.0002	0.0000
vcredit_CSR_pw3			Variate piecewise of credit_score	median(0,credit_score-680,720-680)	-0.0036	0.0001	0.0000
vcredit_CSR_pw4			Variate piecewise of credit_score	median(0,credit_score-720,800-720)	-0.0019	0.0001	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vcredit_CSR_pw5			Variate piecewise of credit_score	max(0,credit_score-800)	-0.0109	0.0017	0.0000
mRatioTmpTei	L00		Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei = 0	0.9235	0.0263	0.0000
mRatioTmpTei	Z00		Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_CSR_pw1			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-1,11-1)	0.0121	0.0028	0.0000
vratiotmptei_CSR_pw2			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-11,18-11)	0.0208	0.0011	0.0000
vratiotmptei_CSR_pw3			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-18,22-18)	0.0141	0.0012	0.0000
vratiotmptei_CSR_pw4			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-22,29-22)	0.0011	0.0006	0.0387
vratiotmptei_CSR_pw5			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-29,41-29)	-0.0017	0.0004	0.0000
vtimesinced_CSR_pw1			Variate piecewise of cx_time[2]	median(0,cx_time-9,40-7)	0.0171	0.0010	0.0000
vdeltaue_CSR_pw1			Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-0,60-0)	-0.0164	0.0005	0.0000
vdeltaue_CSR_pw2			Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-60,77-60)	0.0219	0.0004	0.0000
vdeltaue_CSR_pw3			Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-77,94-77)	-0.0096	0.0003	0.0000
vdeltaue_CSR_pw4			Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-94,100-94)	0.0140	0.0010	0.0000
vdeltaue_CSR_pw5			Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy	median(0,deltaUEinit_r-100,105-100)	0.0601	0.0011	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
			inception to current)				
vdeltaue_CSR_pw6			Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-105,145-105)	0.0073	0.0001	0.0000
vdeltaue_CSR_pw7			Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-145,225-145)	-0.0014	0.0001	0.0000
vdeltaue_CSR_pw8			Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-225,226-225)	-0.0259	0.0107	0.0158
vhpa2yb_CSR_pw1			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-0,85-0)	0.0268	0.0005	0.0000
vhpa2yb_CSR_pw2			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-85,100-85)	-0.0518	0.0004	0.0000
vhpa2yb_CSR_pw3			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-100,106-100)	0.1044	0.0008	0.0000
vhpa2yb_CSR_pw4			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-106,111-106)	0.0378	0.0008	0.0000
vhpa2yb_CSR_pw5			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-111,122-111)	-0.0106	0.0004	0.0000
vhpa2yb_CSR_pw6			Variate piecewise of hpa2y_blended_r[4]	max(0,hpa2y_blended_r-122)	-0.0101	0.0003	0.0000
vltv_CSR_pw1			Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-0,70-0)	-0.0040	0.0004	0.0000
vltv_CSR_pw2			Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-70,80-70)	0.0277	0.0009	0.0000
vltv_CSR_pw3			Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-80,89-80)	0.0068	0.0007	0.0000
vltv_CSR_pw4			Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-89,93-89)	-0.0321	0.0011	0.0000
vltv_CSR_pw5			Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-93,95-93)	0.0898	0.0020	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vltv_CSR_pw6			Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-95,97-95)	0.1128	0.0023	0.0000
vltv_CSR_pw7			Variate piecewise of ltv_i_r[5] (loan-to-value)	max(0,ltv_i_r-97)	-0.0875	0.0047	0.0000
vloanraw_CSR_pw1			Variate piecewise of loansize_raw	median(0,loansize_raw-0,57000-0)	0.0001	0.0000	0.0000
vloanraw_CSR_pw2			Variate piecewise of loansize_raw	median(0,loansize_raw-57000,159000-57000)	0.0000	0.0000	0.0000
vloanraw_CSR_pw3			Variate piecewise of loansize_raw	median(0,loansize_raw-159000,345000-159000)	0.0000	0.0000	0.0000
vloanraw_CSR_pw4			Variate piecewise of loansize_raw	max(0,loansize_raw-345000)	0.0000	0.0000	0.0000
mfrst_tm_by	1		Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	-0.1647	0.0022	0.0000
mfrst_tm_by	2		Categorical of frst_tm_by (first-time buyer)	base level: else	0.0000	0.0000	0.0000

Current Transition Model Parameters – FRM30NSR C_PRE

The model parameters for the FRM30NSR current to prepayment transition are shown below.

Table 31: Current to Prepayment Transition FRM30NSR Model Parameters

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept					-5.6684	0.0171	0.0000
mseason	1		Categorical of season	season = "winter"	-0.1388	0.0019	0.0000
mseason	2		Categorical of season	season = "spring"	0.1111	0.0018	0.0000
mseason	3		Categorical of season	season = "summer"	0.0755	0.0018	0.0000
mseason	4		Categorical of season	base level: else			
mfrst_tm_by	1		Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	-0.1208	0.0016	0.0000
mfrst_tm_by	2		Categorical of frst_tm_by (first-time buyer)	base level: else			
mrfnc_ind	2		Categorical of rfnc_ind (refinanced loan indicator)	frnc_ind = "Y"	-0.0731	0.0053	0.0000
mrfnc_ind	3		Categorical of rfnc_ind (refinanced loan indicator)	base level: else			
mdpa_govt	LGovt		Categorical of dpa (down payment assistance)	dpa = "govt"	-0.0905	0.0062	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdpa_govt	ZOthr		Categorical of dpa (down payment assistance)	base level: else			
mdpa_rel	LRela		Categorical of dpa (down payment assistance)	dpa = "relative"	0.0858	0.0020	0.0000
mdpa_rel	ZOthr		Categorical of dpa (down payment assistance)	base level: else			
mperiodnbr_CPre	L02		Categorical of period_number	period_number = 2	-2.7808	0.0116	0.0000
mperiodnbr_CPre	L03		Categorical of period_number	period_number = 3	-1.7813	0.0074	0.0000
mperiodnbr_CPre	L04		Categorical of period_number	period_number = 4	-1.2201	0.0058	0.0000
mperiodnbr_CPre	L05		Categorical of period_number	period_number = 5	-0.6983	0.0047	0.0000
mperiodnbr_CPre	L06		Categorical of period_number	period_number = 6	-0.4317	0.0043	0.0000
mperiodnbr_CPre	L07		Categorical of period_number	period_number = 7	-0.2726	0.0041	0.0000
mperiodnbr_CPre	Z08		Categorical of period_number	base level: else			
vperiodnbr_CPre_pw1			Variate piecewise of period_number	median(0,period_number-8,22-8)	0.0242	0.0002	0.0000
vperiodnbr_CPre_pw2			Variate piecewise of period_number	median(0,period_number-22,39-22)	-0.0068	0.0003	0.0000
vperiodnbr_CPre_pw3			Variate piecewise of period_number	median(0,period_number-35,42-35)	0.0082	0.0007	0.0000
vperiodnbr_CPre_pw4			Variate piecewise of period_number	median(0,period_number-42,70-42)	-0.0222	0.0003	0.0000
vperiodnbr_CPre_pw5			Variate piecewise of period_number	median(0,period_number-70,108-70)	0.0158	0.0005	0.0000
mperiodnbr_CPre*mrfnc_ind	L02	2	Interaction of categorical piecewise of period_number and the categorical of rfnc_ind	same mappings as above	1.1831	0.0197	0.0000
mperiodnbr_CPre*mrfnc_ind	L03	2	Interaction of categorical piecewise of period_number and the categorical of rfnc_ind	same mappings as above	1.0915	0.0133	0.0000
mperiodnbr_CPre*mrfnc_ind	L04	2	Interaction of categorical piecewise of period_number and the categorical of rfnc_ind	same mappings as above	0.8254	0.0118	0.0000
mperiodnbr_CPre*mrfnc_ind	L05	2	Interaction of categorical piecewise of period_number and the categorical of rfnc_ind	same mappings as above	0.4947	0.0110	0.0000
mperiodnbr_CPre*mrfnc_ind	L06	2	Interaction of categorical piecewise of period_number and the	same mappings as above	0.3143	0.0109	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
			categorical of rfnc_ind				
mperiodnbr_CPre*mrfnc_ind	L07	2	Interaction of categorical piecewise of period_number and the categorical of rfnc_ind	same mappings as above	0.2074	0.0109	0.0000
vperiodnbr_CPre_pw1*mrfnc_ind		2	Interaction of variate piecewise of period_number and the categorical of rfnc_ind	same mappings as above	-0.0327	0.0005	0.0000
vperiodnbr_CPre_pw3*mrfnc_ind		2	Interaction of variate piecewise of period_number and the categorical of rfnc_ind	same mappings as above	-0.0230	0.0021	0.0000
vperiodnbr_CPre_pw4*mrfnc_ind		2	Interaction of variate piecewise of period_number and the categorical of rfnc_ind	same mappings as above	0.0178	0.0012	0.0000
vcredit_CPre_pw1			Variate piecewise of credit_score	median(0,credit_score-450,530-450)	-0.0125	0.0001	0.0000
vcredit_CPre_pw2			Variate piecewise of credit_score	median(0,credit_score-530,630-530)	0.0024	0.0001	0.0000
vcredit_CPre_pw3			Variate piecewise of credit_score	median(0,credit_score-630,680-630)	0.0053	0.0001	0.0000
vcredit_CPre_pw4			Variate piecewise of credit_score	median(0,credit_score-680,720-680)	0.0026	0.0001	0.0000
vcredit_CPre_pw5			Variate piecewise of credit_score	median(0,credit_score-720,760-720)	0.0014	0.0001	0.0000
vcredit_CPre_pw6			Variate piecewise of credit_score	median(0,credit_score-760,800-760)	-0.0007	0.0002	0.0001
vhpa2yb_CPre_pw2			Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-85,100-85)	0.0077	0.0005	0.0000
vhpa2yb_CPre_pw3			Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-100,106-100)	0.0903	0.0007	0.0000
vhpa2yb_CPre_pw4			Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-106,111-106)	0.0281	0.0005	0.0000
vhpa2yb_CPre_pw5			Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-111,122-111)	0.0260	0.0002	0.0000
vhpa2yb_CPre_pw6			Variate piecewise of hpa2y_blended_r[1]	max(0,hpa2y_blended_r-122)	0.0301	0.0001	0.0000
vpriordef_CPre_pw1			Variate piecewise of prior_default_cnt	median(0,prior_default_cnt-3,15-3)	-0.0192	0.0019	0.0000
vltv_CPRE_pw1			Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_r-0,78-0)	-0.0066	0.0001	0.0000
vltv_CPRE_pw2			Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_r-78,85-78)	0.0031	0.0005	0.0000
vltv_CPRE_pw3			Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_r-85,87-85)	-0.0136	0.0017	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vltv_CPRE_pw4			Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_r-87,91-87)	-0.0224	0.0008	0.0000
vltv_CPRE_pw5			Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_r-91,94-91)	-0.0535	0.0010	0.0000
vltv_CPRE_pw6			Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_r-94,98-94)	0.0047	0.0014	0.0007
vltv_CPRE_pw7			Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_r-98,99-98)	0.0943	0.0171	0.0000
vueblend_CPre_pw1			Variate piecewise of ue_blended_r[3] (change in unemployment rate)	median(0,ue_blended_r-0,450-0)	-0.0010	0.0000	0.0000
vueblend_CPre_pw2			Variate piecewise of ue_blended_r[3] (change in unemployment rate)	median(0,ue_blended_r-450,700-450)	-0.0004	0.0000	0.0000
vueblend_CPre_pw3			Variate piecewise of ue_blended_r[3] (change in unemployment rate)	median(0,ue_blended_r-700,730-700)	-0.0128	0.0001	0.0000
vueblend_CPre_pw4			Variate piecewise of ue_blended_r[3] (change in unemployment rate)	max(0,ue_blended_r-730)	-0.0006	0.0000	0.0000
vrefiincent_CPre_pw1			Variate piecewise of refi_incent2_r[4]	median(0,refi_incent2_r-0,115-0)	0.0193	0.0001	0.0000
vrefiincent_CPre_pw2			Variate piecewise of refi_incent2_r[4]	median(0,refi_incent2_r-115,150-115)	-0.0002	0.0001	0.0212
vrefiincent_CPre_pw3			Variate piecewise of refi_incent2_r[4]	max(0,refi_incent2_r-150)	-0.0157	0.0001	0.0000
mRatioTmpTei	L00		Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei = 0	-0.2514	0.0046	0.0000
vratiotmptei_CPre_pw1			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,27-0)	-0.0130	0.0002	0.0000
vratiotmptei_CPre_pw2			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-27,32-27)	-0.0089	0.0005	0.0000
vratiotmptei_CPre_pw3			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-32,48-32)	-0.0048	0.0003	0.0000
vratiotmptei_CPre_pw4			Variate piecewise of ratio_tmp_tei (front-end ratio)	max(0,ratio_tmp_tei-48)	0.0036	0.0004	0.0000
vdeltaue_CPre_pw2			Variate piecewise of DeltaUEInit_r[5] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-88,96-88)	0.0132	0.0004	0.0000
vdeltaue_CPre_pw3			Variate piecewise of DeltaUEInit_r[5] (change in unemployment rate from policy	median(0,deltaUEinit_r-96,100-96)	0.0066	0.0010	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
			inception to current)				
vdeltaue_CPre_pw4			Variate piecewise of DeltaUEInit_r[5] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-100,126-100)	0.0065	0.0002	0.0000
vdeltaue_CPre_pw5			Variate piecewise of DeltaUEInit_r[5] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-126,156-126)	0.0044	0.0001	0.0000
vdeltaue_CPre_pw6			Variate piecewise of DeltaUEInit_r[5] (change in unemployment rate from policy inception to current)	max(0,deltaUEinit_r-156)	-0.0003	0.0001	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L01	L01	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 1; cx_time <= 1	-0.5309	0.0077	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L01	L02	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 1; cx_time = 2	-0.5679	0.0089	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L01	L03	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 1; cx_time = 3	-0.5131	0.0096	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L01	L04	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 1; cx_time = 4	-0.4016	0.0100	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L01	L05	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 1; cx_time = 5	-0.3503	0.0104	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L01	L06	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 1; cx_time = 6	-0.3545	0.0112	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L01	L07	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 1; cx_time >= 7	-0.3243	0.0057	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L02	L01	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 2; cx_time <= 1	-0.8577	0.0115	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L02	L02	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 2; cx_time = 2	-0.8656	0.0140	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L02	L03	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 2; cx_time = 3	-0.7794	0.0157	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L02	L04	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 2; cx_time = 4	-0.6228	0.0165	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L02	L05	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 2; cx_time = 5	-0.5332	0.0174	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L02	L06	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 2; cx_time = 6	-0.5207	0.0190	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L02	L07	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt = 2; cx_time >= 7	-0.4996	0.0080	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_cpre*mtimesinceD_CPRE	L03	L01	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt >= 3; cx_time <= 1	-1.1995	0.0099	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L03	L02	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt >= 3; cx_time = 2	-1.1755	0.0120	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L03	L03	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt >= 3; cx_time = 3	-1.0327	0.0136	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L03	L04	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt >= 3; cx_time = 4	-0.8267	0.0144	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L03	L05	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt >= 3; cx_time = 5	-0.7144	0.0154	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L03	L06	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt >= 3; cx_time = 6	-0.6725	0.0168	0.0000
mpriordef_cpre*mtimesinceD_CPRE	L03	L07	Interaction of prior_default_cnt and cx_time[6]	prior_default_cnt >= 3; cx_time >= 7	-0.5880	0.0080	0.0000
mpriordef_cpre*mtimesinceD_CPRE	Z00	Z00	Interaction of prior_default_cnt and cx_time[6]	base level: else			
vtimesinced_CPre_pw1			Variate piecewise of cx_time[6]	median(0,cx_time-7,19-7)	0.0112	0.0008	0.0000
vtimesinced_CPre_pw2			Variate piecewise of cx_time[6]	median(0,cx_time-19,35-19)	0.0042	0.0009	0.0000
vloanraw_CPRE_pw1			Variate piecewise of loansize_raw	median(0,loansize_raw-0,57000-0)	0.0000	0.0000	0.0000
vloanraw_CPRE_pw2			Variate piecewise of loansize_raw	median(0,loansize_raw-57000,159000-57000)	0.0000	0.0000	0.0000
vloanraw_CPRE_pw3			Variate piecewise of loansize_raw	median(0,loansize_raw-159000,345000-159000)	0.0000	0.0000	0.0000
vloanraw_CPRE_pw4			Variate piecewise of loansize_raw	max(0,loansize_raw-345000)	0.0000	0.0000	0.0000

Current Transition Model Parameters – FRM30NSR C_CXS

The model parameters for the FRM30NSR current to self-cure transition are shown below.

Table 32: Current to Self-Cure Transition FRM30NSR Model Parameters

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept					-4.6667	0.0196	0.0000
mseason	1		Categorical of season	season = "winter"	0.4339	0.0033	0.0000
mseason	2		Categorical of season	season = "spring"	-0.0992	0.0036	0.0000
mseason	3		Categorical of season	season = "summer"	0.1399	0.0035	0.0000
mseason	4		Categorical of season	base level: else			
mfrst_tm_by	1		Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	0.0512	0.0027	0.0000
mfrst_tm_by	2		Categorical of frst_tm_by (first-time buyer)	base level: else			

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdpa_govt	LGovt		Categorical of dpa (down payment assistance)	dpa = "govt"	0.0729	0.0074	0.0000
mdpa_govt	ZOthr		Categorical of dpa (down payment assistance)	base level: else			
mdpa_rel	LRela		Categorical of dpa (down payment assistance)	dpa = "relative"	0.0836	0.0032	0.0000
mdpa_rel	ZOthr		Categorical of dpa (down payment assistance)	base level: else			
mperiod_CCXS	0		Categorical of period	period < 200604	-2.3308	0.0073	0.0000
mperiod_CCXS	1		Categorical of period	base level: else			
vpriordef_CCXS_pw1			Variate piecewise verison of prior_default_cnt	median(0,prior_default_cnt-3,15-3)	0.0959	0.0009	0.0000
mperiodnbr_cCXS	L02		Categorical of period_number	period_number = 2	-0.0790	0.0081	0.0000
mperiodnbr_cCXS	L03		Categorical of period_number	period_number = 3	0.1310	0.0073	0.0000
mperiodnbr_cCXS	L04		Categorical of period_number	period_number = 4	0.1598	0.0070	0.0000
mperiodnbr_cCXS	L05		Categorical of period_number	period_number = 5	0.1618	0.0069	0.0000
mperiodnbr_cCXS	L06		Categorical of period_number	period_number = 6	0.1776	0.0067	0.0000
mperiodnbr_cCXS	L07		Categorical of period_number	period_number = 7	0.0939	0.0068	0.0000
mperiodnbr_cCXS	Z08		Categorical of period_number	base level: else			
vperiodnbr_CCXS_pw1			Variate piecewise of period_number	median(0,period_number-8,36-8)	-0.0211	0.0002	0.0000
vperiodnbr_CCXS_pw2			Variate piecewise of period_number	median(0,period_number-36,53-36)	-0.0094	0.0004	0.0000
vperiodnbr_CCXS_pw3			Variate piecewise of period_number	median(0,period_number-53,76-53)	-0.0098	0.0005	0.0000
vperiodnbr_CCXS_pw4			Variate piecewise of period_number	median(0,period_number-76,86-76)	-0.0142	0.0016	0.0000
vcredit_CCXS_pw1			Variate piecewise of credit_score	median(0,credit_score-0,450-0)	-0.0001	0.0000	0.0000
vcredit_CCXS_pw4			Variate piecewise of credit_score	median(0,credit_score-600,630-600)	0.0008	0.0002	0.0000
vcredit_CCXS_pw5			Variate piecewise of credit_score	median(0,credit_score-630,680-630)	-0.0059	0.0001	0.0000
vcredit_CCXS_pw6			Variate piecewise of credit_score	median(0,credit_score-680,720-680)	-0.0091	0.0002	0.0000
vcredit_CCXS_pw7			Variate piecewise of credit_score	median(0,credit_score-720,745-720)	-0.0068	0.0005	0.0000
vcredit_CCXS_pw8			Variate piecewise of credit_score	median(0,credit_score-745,800-745)	-0.0108	0.0004	0.0000
vcredit_CCXS_pw9			Variate piecewise of credit_score	max(0,credit_score-800)	0.0081	0.0033	0.0154
mRatioTmpTei	L00		Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei = 0	0.1668	0.0169	0.0000
mRatioTmpTei	Z00		Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_CCXS_pw1			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,19-0)	0.0074	0.0007	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vratiotmptei_CCXS_pw2			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-19,27-19)	0.0081	0.0006	0.0000
vratiotmptei_CCXS_pw3			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-27,33-27)	0.0034	0.0010	0.0006
vratiotmptei_CCXS_pw4			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-33,34-33)	0.0122	0.0054	0.0232
vhpa2yb_CCXS_pw2			Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-100,104-100)	-0.0063	0.0011	0.0000
vhpa2yb_CCXS_pw3			Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-104,111-104)	0.0061	0.0008	0.0000
vhpa2yb_CCXS_pw4			Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-111,116-111)	0.0036	0.0011	0.0017
vhpa2yb_CCXS_pw5			Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-116,119-116)	-0.0127	0.0021	0.0000
vhpa2yb_CCXS_pw6			Variate piecewise of hpa2y_blended_r[1]	max(0,hpa2y_blended_r-119)	-0.0049	0.0006	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L01	L01	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time <= 1	2.1893	0.0051	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L01	L02	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time = 2	1.9648	0.0065	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L01	L03	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time = 3	1.7206	0.0083	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L01	L04	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time = 4	1.6544	0.0096	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L01	L05	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time = 5	1.3225	0.0126	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L01	L06	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time = 6	1.2041	0.0145	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L01	L07	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time = 7	1.1504	0.0162	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L01	L08	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 1; cx_time >= 8	1.0513	0.0093	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L02	L01	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 2; cx_time <= 1	2.5209	0.0058	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L02	L02	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 2; cx_time = 2	2.3153	0.0077	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L02	L03	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 2; cx_time = 3	2.0653	0.0103	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L02	L04	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 2; cx_time = 4	1.9744	0.0124	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L02	L05	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 2; cx_time = 5	1.6344	0.0166	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L02	L06	Interaction of prior_default_cnt and cx_time[2]	prior_default_cnt = 2; cx_time = 6	1.4921	0.0197	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_ccxs*mtimesinceD_CCXS	L02	L07	Interaction of prior_default_cnt and cx_time²	prior_default_cnt = 2; cx_time = 7	1.4491	0.0221	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L02	L08	Interaction of prior_default_cnt and cx_time²	prior_default_cnt = 2; cx_time >= 8	1.2494	0.0122	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L03	L01	Interaction of prior_default_cnt and cx_time²	prior_default_cnt >= 3; cx_time <= 1	2.7332	0.0047	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L03	L02	Interaction of prior_default_cnt and cx_time²	prior_default_cnt >= 3; cx_time = 2	2.4855	0.0057	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L03	L03	Interaction of prior_default_cnt and cx_time²	prior_default_cnt >= 3; cx_time = 3	2.1863	0.0074	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L03	L04	Interaction of prior_default_cnt and cx_time²	prior_default_cnt >= 3; cx_time = 4	2.1212	0.0087	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L03	L05	Interaction of prior_default_cnt and cx_time²	prior_default_cnt >= 3; cx_time = 5	1.7433	0.0117	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L03	L06	Interaction of prior_default_cnt and cx_time²	prior_default_cnt >= 3; cx_time = 6	1.5627	0.0142	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L03	L07	Interaction of prior_default_cnt and cx_time²	prior_default_cnt >= 3; cx_time = 7	1.5153	0.0161	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	L03	L08	Interaction of prior_default_cnt and cx_time²	prior_default_cnt >= 3; cx_time >= 8	1.2745	0.0101	0.0000
mpriordef_ccxs*mtimesinceD_CCXS	Z00	Z00	Interaction of prior_default_cnt and cx_time²	base level: else			
vtimesinced_CCXS_pw1			Variate piecwise of cx_time²	median(0,cx_time-8,24-8)	-0.0489	0.0010	0.0000
vtimesinced_CCXS_pw3			Variate piecwise of cx_time²	median(0,cx_time-40,41-40)	-0.3800	0.0608	0.0000
vloanraw_CCXS_pw1			Variate piecewise of loansize_raw	median(0,loansize_raw-0,57000-0)	0.0000	0.0000	0.0000
vloanraw_CCXS_pw2			Variate piecewise of loansize_raw	median(0,loansize_raw-57000,159000-57000)	0.0000	0.0000	0.0000
vloanraw_CCXS_pw3			Variate piecewise of loansize_raw	median(0,loansize_raw-159000,345000-159000)	0.0000	0.0000	0.0063
vloanraw_CCXS_pw4			Variate piecewise of loansize_raw	max(0,loansize_raw-345000)	0.0000	0.0000	0.0211

Current Transition Model Parameters – FRM30NSR C_D

The model parameters for the FRM30NSR current to default transition are shown below.

Table 33: Current to Default Transition FRM30NSR Model Parameters

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept					-4.5925	0.0257	0.0000
mseason	1		Categorical of season	season = "winter"	-0.2638	0.0016	0.0000
mseason	2		Categorical of season	season = "spring"	-0.3712	0.0016	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mseason	3		Categorical of season	season = "summer"	-0.1846	0.0015	0.0000
mseason	4		Categorical of season	base level: else			
mjudicial	1		Categorical of judicial	judicial = 1	0.0383	0.0012	0.0000
mjudicial	2		Categorical of judicial	base level: else			
mdpa_govt	LGovt		Categorical of dpa (down payment assistance)	dpa = "govt"	0.1310	0.0037	0.0000
mdpa_govt	ZOthr		Categorical of dpa (down payment assistance)	base level: else			
mdpa_nprof	LNPro		Categorical of dpa (down payment assistance)	dpa = "nonprof"	0.3987	0.0031	0.0000
mdpa_nprof	ZOthr		Categorical of dpa (down payment assistance)	base level: else			
mdpa_rel	LRela		Categorical of dpa (down payment assistance)	dpa = "relative"	0.1247	0.0016	0.0000
mdpa_rel	ZOthr		Categorical of dpa (down payment assistance)	base level: else			
mycslope_CD	L01		Categorical of yield curve	100 <= ycslope_r <= 200	0.0434	0.0014	0.0000
mycslope_CD	Z00		Categorical of yield curve	base level: else			
mfrst_tm_by	1		Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	0.0664	0.0016	0.0000
mfrst_tm_by	2		Categorical of frst_tm_by (first-time buyer)	base level: else			
mrfnc_ind	2		Categorical of rfnc_ind (refinanced loan indicator)	frnc_ind = "Y"	0.0964	0.0023	0.0000
mrfnc_ind	3		Categorical of rfnc_ind (refinanced loan indicator)	base level: else			
mperiod_CD	0		Categorical of period_number	period < 200604	-0.8718	0.0027	0.0000
mperiodnbr_CD	L02		Categorical of period_number	period_number = 2	-0.3910	0.0044	0.0000
mperiodnbr_CD	L03		Categorical of period_number	period_number = 3	-0.0243	0.0038	0.0000
mperiodnbr_CD	L04		Categorical of period_number	period_number = 4	0.0480	0.0037	0.0000
mperiodnbr_CD	L05		Categorical of period_number	period_number = 5	0.0740	0.0037	0.0000
mperiodnbr_CD	L06		Categorical of period_number	period_number = 6	0.0942	0.0037	0.0000
mperiodnbr_CD	L07		Categorical of period_number	period_number = 7	0.0724	0.0038	0.0000
mperiodnbr_CD	Z08		Categorical of period_number	base level: else			
vperiodnbr_CD_pw1			Variate piecewise of period_number	median(0,period_number-8,40-8)	-0.0215	0.0002	0.0000
vperiodnbr_CD_pw2			Variate piecewise of period_number	median(0,period_number-40,53-40)	0.0020	0.0008	0.0154

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vperiodnbr_CD_pw3			Variate piecewise of period_number	median(0,period_number-53,68-53)	-0.0237	0.0013	0.0000
vperiodnbr_CD_pw4			Variate piecewise of period_number	median(0,period_number-68,108-68)	-0.0130	0.0013	0.0000
vperiodnbr_CD_pw1*mdpa_nprof	LNPro		Interaction of period_number and categorical of DPA	median(0,period_number-8,40-8); dpa = "nonprof"	-0.0173	0.0002	0.0000
mcredit_score	L00		Categorical of credit score	credit_score = 0	-0.2409	0.0138	0.0000
mcredit_score	Z00		Categorical of credit score	base level: else			
vcredit_CD_pw1			Variate piecewise of credit score	median(0,credit_score-450,530-450)	-0.0008	0.0002	0.0000
vcredit_CD_pw2			Variate piecewise of credit score	median(0,credit_score-530,630-530)	-0.0018	0.0000	0.0000
vcredit_CD_pw3			Variate piecewise of credit score	median(0,credit_score-630,680-630)	-0.0086	0.0001	0.0000
vcredit_CD_pw4			Variate piecewise of credit score	median(0,credit_score-680,720-680)	-0.0102	0.0001	0.0000
vcredit_CD_pw5			Variate piecewise of credit score	median(0,credit_score-720,760-720)	-0.0083	0.0002	0.0000
vcredit_CD_pw6			Variate piecewise of credit score	median(0,credit_score-760,800-760)	-0.0112	0.0003	0.0000
vdeltaue_CD_pw1			Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(deltaUEinit_r-0,90-0)	0.0020	0.0001	0.0000
vdeltaue_CD_pw2			Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(deltaUEinit_r-90,97-90)	-0.0043	0.0005	0.0000
vdeltaue_CD_pw3			Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(deltaUEinit_r-97,100-97)	0.0039	0.0013	0.0038
vdeltaue_CD_pw4			Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(deltaUEinit_r-100,110-100)	0.0042	0.0004	0.0000
vdeltaue_CD_pw5			Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(deltaUEinit_r-110,140-110)	0.0031	0.0001	0.0000
vdeltaue_CD_pw6			Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(deltaUEinit_r-140,175-140)	-0.0003	0.0001	0.0019

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaue_CD_pw7			Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	max(deltaUEinit_r-175)	0.0007	0.0000	0.0000
mRatioTmpTei	L00		Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei = 0	0.2397	0.0059	0.0000
mRatioTmpTei	Z00		Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_CD_pw1			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,24-0)	0.0162	0.0002	0.0000
vratiotmptei_CD_pw2			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-24,36-24)	0.0110	0.0002	0.0000
vpriordef_CD_pw1			variate piecewise of prior_default	median(0,prior_default_cnt-3,15-3)	0.0678	0.0005	0.0000
mperiodnbr_CD*mpriordef_ind	L02	L01	Interaction of period_number and prior_default	period_number = 2; prior_default_cnt > 0	-2.2601	0.3595	0.0000
mperiodnbr_CD*mpriordef_ind	L03	L01	Interaction of period_number and prior_default	period_number = 3; prior_default_cnt > 0	-0.5490	0.0159	0.0000
mperiodnbr_CD*mpriordef_ind	L04	L01	Interaction of period_number and prior_default	period_number = 4; prior_default_cnt > 0	-0.2468	0.0093	0.0000
mperiodnbr_CD*mpriordef_ind	L05	L01	Interaction of period_number and prior_default	period_number = 5; prior_default_cnt > 0	-0.1325	0.0076	0.0000
mperiodnbr_CD*mpriordef_ind	L06	L01	Interaction of period_number and prior_default	period_number = 6; prior_default_cnt > 0	-0.0685	0.0068	0.0000
mperiodnbr_CD*mpriordef_ind	L07	L01	Interaction of period_number and prior_default	period_number = 7; prior_default_cnt > 0	-0.0336	0.0065	0.0000
mperiodnbr_CD*mpriordef_ind	Z08	Z00	Interaction of period_number and prior_default	base level: else			
vperiodnbr_CD_pw1*mpriordef_ind		L01	Interaction of period_number and prior_default	median(0,period_number-8,40-8); prior_default_cnt > 0	0.0081	0.0002	0.0000
vperiodnbr_CD_pw2*mpriordef_ind		L01	Interaction of period_number and prior_default	median(0,period_number-40,53-40); prior_default_cnt > 0	-0.0030	0.0009	0.0008
vperiodnbr_CD_pw3*mpriordef_ind		L01	Interaction of period_number and prior_default	median(0,period_number-53,68-53); prior_default_cnt > 0	0.0185	0.0014	0.0000
vperiodnbr_CD_pw4*mpriordef_ind		L01	Interaction of period_number and prior_default	median(0,period_number-68,108-68); prior_default_cnt > 0	0.0137	0.0013	0.0000
vsato_cd_pw2			Variate piecewise of sato (spread at origination)	median(sato-(-.1),0,.7-(-.1))	0.2796	0.0021	0.0000
vsato_cd_pw3			Variate piecewise of sato (spread at origination)	max(sato-.7,0)	0.2281	0.0040	0.0000
vdeltaUEpr3_cd_pw1			Variate piecewise of deltauepr3_r[2] (change in unemployment from 3 quarters prior)	min(0,deltauepr3_r-(-20))	0.0001	0.0000	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaUEpr3_cd_pw2			Variate piecewise of deltauepr3_r[2] (change in unemployment from 3 quarters prior)	median(deltauepr3_r-(-20),0,10-(-20))	0.0015	0.0001	0.0000
vdeltaUEpr3_cd_pw3			Variate piecewise of deltauepr3_r[2] (change in unemployment from 3 quarters prior)	max(deltauepr3_r-10,0)	0.0007	0.0000	0.0000
vltv_CD_pw1			Variate piecewise of ltv_i_r[3] (loan-to-value)	median(0,ltv_i_r-0,70-0)	0.0026	0.0002	0.0000
vltv_CD_pw2			Variate piecewise of ltv_i_r[3] (loan-to-value)	median(0,ltv_i_r-70,80-70)	0.0108	0.0004	0.0000
vltv_CD_pw3			Variate piecewise of ltv_i_r[3] (loan-to-value)	median(0,ltv_i_r-80,94-80)	0.0086	0.0002	0.0000
vltv_CD_pw4			Variate piecewise of ltv_i_r[3] (loan-to-value)	max(0,ltv_i_r-94)	0.0171	0.0009	0.0000
vhpa2yb_CD_pw1			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-0,85-0);	0.0079	0.0002	0.0000
vhpa2yb_CD_pw2			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-85,95-85);	-0.0137	0.0003	0.0000
vhpa2yb_CD_pw3			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-95,113-95);	-0.0085	0.0001	0.0000
vhpa2yb_CD_pw4			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-113,120-113);	-0.0082	0.0004	0.0000
vhpa2yb_CD_pw5			Variate piecewise of hpa2y_blended_r[4]	max(0,hpa2y_blended_r-120);	0.0015	0.0002	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L01	Interaction of prior_default and cx_time[5]	prior_default_cnt = 1; cx_time <= 1	2.4242	0.0032	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L02	Interaction of prior_default and cx_time[5]	prior_default_cnt = 1; cx_time = 2	2.1786	0.0036	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L03	Interaction of prior_default and cx_time[5]	prior_default_cnt = 1; cx_time = 3	1.9541	0.0041	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L04	Interaction of prior_default and cx_time[5]	prior_default_cnt = 1; cx_time = 4	1.6365	0.0050	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L05	Interaction of prior_default and cx_time[5]	prior_default_cnt = 1; cx_time = 5	1.4494	0.0059	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L06	Interaction of prior_default and cx_time[5]	prior_default_cnt = 1; cx_time = 6	1.3028	0.0067	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L07	Interaction of prior_default and cx_time[5]	prior_default_cnt = 1; cx_time = 7	1.2127	0.0075	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L08	Interaction of prior_default and cx_time[5]	prior_default_cnt = 1; cx_time >= 8	1.0277	0.0049	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L01	Interaction of prior_default and cx_time[5]	prior_default_cnt = 2; cx_time <= 1	2.7753	0.0035	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_CD*mtimesinceD_CD	L02	L02	Interaction of prior_default and cx_time5	prior_default_cnt = 2; cx_time = 2	2.5352	0.0042	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L03	Interaction of prior_default and cx_time5	prior_default_cnt = 2; cx_time = 3	2.3199	0.0051	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L04	Interaction of prior_default and cx_time5	prior_default_cnt = 2; cx_time = 4	1.9987	0.0065	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L05	Interaction of prior_default and cx_time5	prior_default_cnt = 2; cx_time = 5	1.7859	0.0078	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L06	Interaction of prior_default and cx_time5	prior_default_cnt = 2; cx_time = 6	1.6211	0.0092	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L07	Interaction of prior_default and cx_time5	prior_default_cnt = 2; cx_time = 7	1.4888	0.0105	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L08	Interaction of prior_default and cx_time5	prior_default_cnt = 2; cx_time >= 8	1.2213	0.0064	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L01	Interaction of prior_default and cx_time5	prior_default_cnt >= 3; cx_time <= 1	2.9813	0.0033	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L02	Interaction of prior_default and cx_time5	prior_default_cnt >= 3; cx_time = 2	2.7259	0.0037	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L03	Interaction of prior_default and cx_time5	prior_default_cnt >= 3; cx_time = 3	2.4968	0.0043	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L04	Interaction of prior_default and cx_time5	prior_default_cnt >= 3; cx_time = 4	2.1461	0.0051	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L05	Interaction of prior_default and cx_time5	prior_default_cnt >= 3; cx_time = 5	1.9074	0.0061	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L06	Interaction of prior_default and cx_time5	prior_default_cnt >= 3; cx_time = 6	1.7109	0.0072	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L07	Interaction of prior_default and cx_time5	prior_default_cnt >= 3; cx_time = 7	1.5754	0.0082	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L08	Interaction of prior_default and cx_time5	prior_default_cnt >= 3; cx_time >= 8	1.2349	0.0056	0.0000
mpriordef_CD*mtimesinceD_CD	Z00	Z00	Interaction of prior_default and cx_time5	base level: else			
vtimesinced_CD_pw1			Variate piecewise of cx_time5	median(0,cx_time-8,24-8)	-0.0572	0.0006	0.0000
vtimesinced_CD_pw2			Variate piecewise of cx_time5	median(0,cx_time-24,40-24)	-0.0040	0.0016	0.0142
vtimesinced_CD_pw3			Variate piecewise of cx_time5	median(0,cx_time-40,41-40)	-0.2609	0.0374	0.0000

Current Transition Model Parameters – FRM30SR C_CXS

The model parameters for the FRM30SR current to self-cure transition are shown below.

Table 34: Current to Self-Cure Transition FRM30SR Model Parameters

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept					-5.2805	0.0998	0.0000
mseason	1		Categorical of season	season = "winter"	0.3092	0.0056	0.0000
mseason	2		Categorical of season	season = "spring"	-0.0827	0.0060	0.0000
mseason	3		Categorical of season	season = "summer"	0.2486	0.0056	0.0000
mseason	4		Categorical of season	base level: else			
mcalperiod	L200104		Categorical of calendar period	period < 200104	-2.8915	0.0197	0.0000
mcalperiod	L200604		Categorical of calendar period	200104 <= period < 200604	-1.9693	0.0143	0.0000
mcalperiod	Z201800		Categorical of calendar period	base level: else			
mltv	L00		Categorical of ltv_i_r[1] (loan-to-value)	ltv_i_r = .	0.1856	0.0128	0.0000
mltv	Z01		Categorical of ltv_i_r[1] (loan-to-value)	base level: else			
mperiodnbr_CCXS	L03		Categorical of period_number	period_number <= 3	0.0319	0.0099	0.0012
mperiodnbr_CCXS	L04		Categorical of period_number	period_number = 4	0.0899	0.0118	0.0000
mperiodnbr_CCXS	L05		Categorical of period_number	period_number = 5	0.0833	0.0116	0.0000
mperiodnbr_CCXS	L06		Categorical of period_number	period_number = 6	0.0730	0.0114	0.0000
mperiodnbr_CCXS	L07		Categorical of period_number	period_number = 7	-0.0428	0.0119	0.0003
mperiodnbr_CCXS	Z08		Categorical of period_number	base level: else			
vperiodnbr_CCXS_pw1			Variate piecewise of period_number	median(0,period_number-8,30-8)	-0.0224	0.0004	0.0000
vperiodnbr_CCXS_pw2			Variate piecewise of period_number	median(0,period_number-30,54-30)	-0.0050	0.0005	0.0000
vperiodnbr_CCXS_pw3			Variate piecewise of period_number	median(0,period_number-54,70-54)	-0.0194	0.0013	0.0000
vperiodnbr_CCXS_pw4			Variate piecewise of period_number	median(0,period_number-70,108-70)	-0.0093	0.0014	0.0000
vcredit_CCXS_pw1			Variate piecewise of credit score	median(0,credit_score-0,630-0)	0.0003	0.0000	0.0000
vcredit_CCXS_pw2			Variate piecewise of credit score	median(0,credit_score-630,680-630)	-0.0053	0.0004	0.0000
vcredit_CCXS_pw3			Variate piecewise of credit score	median(0,credit_score-680,720-680)	-0.0083	0.0008	0.0000
vcredit_CCXS_pw4			Variate piecewise of credit score	median(0,credit_score-720,745-720)	-0.0050	0.0019	0.0082
vcredit_CCXS_pw5			Variate piecewise of credit score	median(0,credit_score-745,800-745)	-0.0130	0.0014	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L01	L01	Interaction of prior_default and cx_time[2]	prior_default_cnt = 1; cx_time <= 1	2.2477	0.0086	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L01	L02	Interaction of prior_default and cx_time[2]	prior_default_cnt = 1; cx_time = 2	2.0032	0.0108	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L01	L03	Interaction of prior_default and cx_time[2]	prior_default_cnt = 1; cx_time = 3	1.7667	0.0137	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_CCXS*mtimesinceD_CCXS	L01	L04	Interaction of prior_default and cx_time²	prior_default_cnt = 1; cx_time = 4	1.6694	0.0158	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L01	L05	Interaction of prior_default and cx_time²	prior_default_cnt = 1; cx_time = 5	1.4070	0.0198	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L01	L06	Interaction of prior_default and cx_time²	prior_default_cnt = 1; cx_time = 6	1.2470	0.0230	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L01	L07	Interaction of prior_default and cx_time²	prior_default_cnt = 1; cx_time = 7	1.2468	0.0250	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L01	L08	Interaction of prior_default and cx_time²	prior_default_cnt = 1; cx_time = 8	1.1279	0.0281	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L01	L09	Interaction of prior_default and cx_time²	prior_default_cnt = 1; cx_time = 9	0.9703	0.0329	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L01	L10	Interaction of prior_default and cx_time²	prior_default_cnt = 1; cx_time = 10	0.9432	0.0350	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L01	L11	Interaction of prior_default and cx_time²	prior_default_cnt = 1; cx_time = 11	0.9902	0.0369	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L01	L12	Interaction of prior_default and cx_time²	prior_default_cnt = 1; cx_time = 12	0.9732	0.0407	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L01	L13	Interaction of prior_default and cx_time²	prior_default_cnt = 1; cx_time > 12	0.6491	0.0178	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L02	L01	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time <= 1	2.6935	0.0097	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L02	L02	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time = 2	2.4697	0.0129	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L02	L03	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time = 3	2.1998	0.0171	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L02	L04	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time = 4	2.0911	0.0206	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L02	L05	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time = 5	1.7588	0.0273	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L02	L06	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time = 6	1.6520	0.0317	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L02	L07	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time = 7	1.6263	0.0352	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L02	L08	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time = 8	1.4697	0.0412	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L02	L09	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time = 9	1.3323	0.0479	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L02	L10	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time = 10	1.3604	0.0505	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L02	L11	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time = 11	1.3171	0.0556	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L02	L12	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time = 12	1.2080	0.0630	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_CCXS*mtimesinceD_CCXS	L02	L13	Interaction of prior_default and cx_time²	prior_default_cnt = 2; cx_time > 12	0.9368	0.0270	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L01	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time <= 1	2.8324	0.0091	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L02	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time = 2	2.5566	0.0107	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L03	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time = 3	2.2851	0.0133	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L04	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time = 4	2.1912	0.0155	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L05	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time = 5	1.8357	0.0202	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L06	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time = 6	1.7061	0.0237	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L07	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time = 7	1.6156	0.0272	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L08	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time = 8	1.4868	0.0314	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L09	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time = 9	1.3159	0.0372	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L10	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time = 10	1.3493	0.0392	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L11	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time = 11	1.2295	0.0450	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L12	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time = 12	1.0871	0.0516	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	L03	L13	Interaction of prior_default and cx_time²	prior_default_cnt >= 3; cx_time > 12	0.8329	0.0243	0.0000
mpriordef_CCXS*mtimesinceD_CCXS	Z00	Z00	Interaction of prior_default and cx_time²	base level: else			
vpriordef_CCXS_pw1			Variate piecewise of prior default count	median(0,prior_default_cnt-2,10-2)	0.1057	0.0020	0.0000
vpriordef_CCXS_pw2			Variate piecewise of prior default count	median(0,prior_default_cnt-10,15-10)	0.0822	0.0069	0.0000
vhpa2yb_CCXS_pw1			Variate piecewise of hpa2y_blended_r³	median(0,hpa2y_blended_r-0,85-0)	0.0044	0.0011	0.0000
vhpa2yb_CCXS_pw2			Variate piecewise of hpa2y_blended_r³	median(0,hpa2y_blended_r-85,105-85)	-0.0123	0.0005	0.0000
vhpa2yb_CCXS_pw3			Variate piecewise of hpa2y_blended_r³	median(0,hpa2y_blended_r-105,123-105)	-0.0015	0.0004	0.0006
vhpa2yb_CCXS_pw4			Variate piecewise of hpa2y_blended_r³	max(0,hpa2y_blended_r-123)	-0.0138	0.0011	0.0000
vratiotmptei_CCXS_pw2			Variate piecewise of ratio_tmp_tei (front-end ratio)	max(0,ratio_tmp_tei-5)	-0.0027	0.0002	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vltv_CCXS_pw2			Variate piecewise of ltv_i_r[1] (loan-to-value)	median(0,ltv_i_r-75,78-75)	-0.0105	0.0032	0.0010
vltv_CCXS_pw3			Variate piecewise of ltv_i_r[1] (loan-to-value)	median(0,ltv_i_r-78,85-78)	0.0075	0.0016	0.0000
vltv_CCXS_pw4			Variate piecewise of ltv_i_r[1] (loan-to-value)	median(0,ltv_i_r-85,88-85)	0.0206	0.0031	0.0000
vltv_CCXS_pw5			Variate piecewise of ltv_i_r[1] (loan-to-value)	median(0,ltv_i_r-88,92-88)	-0.0388	0.0025	0.0000
vltv_CCXS_pw6			Variate piecewise of ltv_i_r[1] (loan-to-value)	median(0,ltv_i_r-92,95-92)	0.0986	0.0036	0.0000
vltv_CCXS_pw7			Variate piecewise of ltv_i_r[1] (loan-to-value)	max(0,ltv_i_r-95)	-0.0101	0.0049	0.0385
vloanraw_ccxs_pw1			Variate piecewise of loansize_raw	median(0,loansize_raw-0,57000-0)	0.0000	0.0000	0.0003
vloanraw_ccxs_pw2			Variate piecewise of loansize_raw	median(0,loansize_raw-57000,159000-57000)	0.0000	0.0000	0.0000
vloanraw_ccxs_pw3			Variate piecewise of loansize_raw	median(0,loansize_raw-159000,345000-159000)	0.0000	0.0000	0.0000

Current Transition Model Parameters – FRM30SR C_D

The model parameters for the FRM30SR current to default transition are shown below.

Table 35: Current to Default Transition FRM30SR Model Parameters

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept					-4.9553	0.0606	0.0000
mseason	1		Categorical of season	season = "winter"	-0.2214	0.0026	0.0000
mseason	2		Categorical of season	season = "spring"	-0.3425	0.0027	0.0000
mseason	3		Categorical of season	season = "summer"	-0.1756	0.0026	0.0000
mseason	4		Categorical of season	base level: else			
mjudicial	1		Categorical of judicial (judicial state)	judicial = 1	0.0151	0.0021	0.0000
mjudicial	2		Categorical of judicial (judicial state)	base level: else			
mycslope_CD	L01		Categorical of ycslope_r[1] (yield curve slope)	1 <= ycslope <= 2	0.0811	0.0027	0.0000
mycslope_CD	Z00		Categorical of ycslope_r[1] (yield curve slope)	base level: else			
mcalperiod	L200104		Categorical of period (calendar period)	period < 200104	-1.2117	0.0061	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mcalperiod	L200604		Categorical of period (calendar period)	period < 200604	-0.5885	0.0044	0.0000
mcalperiod	Z201800		Categorical of period (calendar period)	base level: else			
mperiodnbr_CD	L02		Categorical of period number (quarters since origination)	period_number = 2	-0.3621	0.0063	0.0000
mperiodnbr_CD	L03		Categorical of period number (quarters since origination)	period_number = 3	-0.1300	0.0055	0.0000
mperiodnbr_CD	Z00		Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_CD_pw1			Variate piecewise of period number (quarters since origination)	median(0,period_number-3,40-3)	-0.0143	0.0002	0.0000
vperiodnbr_CD_pw2			Variate piecewise of period number (quarters since origination)	median(0,period_number-40,53-40)	-0.0074	0.0005	0.0000
vperiodnbr_CD_pw3			Variate piecewise of period number (quarters since origination)	median(0,period_number-53,68-53)	-0.0184	0.0008	0.0000
vperiodnbr_CD_pw4			Variate piecewise of period number (quarters since origination)	median(0,period_number-68,108-68)	-0.0058	0.0007	0.0000
Mcredit_score	L00		Categorical of credit_score	credit_score = 0	-0.3563	0.0385	0.0000
Mcredit_score	Z00		Categorical of credit_score	base level: else			
vcredit_CD_pw1			Variate piecewise of credit_score	median(0,credit_score-450,500-450)	0.0026	0.0008	0.0010
vcredit_CD_pw3			Variate piecewise of credit_score	median(0,credit_score-600,630-600)	-0.0029	0.0004	0.0000
vcredit_CD_pw4			Variate piecewise of credit_score	median(0,credit_score-630,680-630)	-0.0069	0.0003	0.0000
vcredit_CD_pw5			Variate piecewise of credit_score	median(0,credit_score-680,720-680)	-0.0109	0.0004	0.0000
vcredit_CD_pw6			Variate piecewise of credit_score	median(0,credit_score-720,745-720)	-0.0026	0.0010	0.0068
vcredit_CD_pw7			Variate piecewise of credit_score	median(0,credit_score-745,800-745)	-0.0159	0.0007	0.0000
vdeltaue_CD_pw1			Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-0,90-0)	0.0046	0.0001	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaue_CD_pw2			Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-90,97-90)	-0.0089	0.0008	0.0000
vdeltaue_CD_pw3			Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-97,100-97)	0.0238	0.0022	0.0000
vdeltaue_CD_pw4			Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-100,110-100)	0.0100	0.0007	0.0000
vdeltaue_CD_pw5			Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-110,140-110)	0.0006	0.0002	0.0094
vdeltaue_CD_pw6			Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-140,175-140)	-0.0008	0.0002	0.0000
vdeltaue_CD_pw7			Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	max(0,deltaUEinit_r-175)	0.0005	0.0001	0.0000
mRatioTmpTei	L00		Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei = 0	0.4541	0.0120	0.0000
mRatioTmpTei	Z01		Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_CD_pw1			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,24-0)	0.0152	0.0006	0.0000
vratiotmptei_CD_pw2			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-24,36-24)	0.0087	0.0006	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L01	Interaction of categorical of prior_default_cnt	prior_default_cnt = 1; cx_time <= 1	2.2680	0.0091	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
			and categorical of cx_time[3]				
mpriordef_CD*mtimesinceD_CD	L01	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 2	2.0280	0.0096	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 3	1.8347	0.0102	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L04	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 4	1.5405	0.0111	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L05	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 5	1.3670	0.0122	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L06	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 6	1.2359	0.0132	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L07	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 7	1.1508	0.0142	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L08	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 8	0.9894	0.0158	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L09	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 9	0.9260	0.0170	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L10	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 10	0.8478	0.0185	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L11	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 11	0.7919	0.0199	0.0000
mpriordef_CD*mtimesinceD_CD	L01	L12	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 12	0.8155	0.0216	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_CD*mtimesinceD_CD	L01	L13	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time > 12	0.7465	0.0155	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time <= 1	2.7863	0.0113	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 2	2.5321	0.0120	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 3	2.3686	0.0128	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L04	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 4	2.0572	0.0144	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L05	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 5	1.8656	0.0160	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L06	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 6	1.6690	0.0180	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L07	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 7	1.6210	0.0194	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L08	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 8	1.4518	0.0220	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L09	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 9	1.3335	0.0246	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L10	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 10	1.2429	0.0271	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L11	Interaction of categorical of prior_default_cnt	prior_default_cnt = 2; cx_time = 11	1.1950	0.0294	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
			and categorical of cx_time3				
mpriordef_CD*mtimesinceD_CD	L02	L12	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt = 2; cx_time = 12	1.1109	0.0328	0.0000
mpriordef_CD*mtimesinceD_CD	L02	L13	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt = 2; cx_time > 12	1.0146	0.0198	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time <= 1	2.9462	0.0097	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 2	2.6881	0.0101	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 3	2.4876	0.0107	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L04	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 4	2.1402	0.0117	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L05	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 5	1.9458	0.0129	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L06	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 6	1.7490	0.0143	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L07	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 7	1.6434	0.0157	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L08	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 8	1.4375	0.0179	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L09	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 9	1.3293	0.0198	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_CD*mtimesinceD_CD	L03	L10	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt >= 3; cx_time = 10	1.2309	0.0219	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L11	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt >= 3; cx_time = 11	1.1404	0.0241	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L12	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt >= 3; cx_time = 12	0.9892	0.0276	0.0000
mpriordef_CD*mtimesinceD_CD	L03	L13	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt >= 3; cx_time > 12	0.8921	0.0178	0.0000
mpriordef_CD*mtimesinceD_CD	Z00	Z00	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	base level: else			
vtimesinced_CD_pw1			Variate piecewise of cx_time[3]	median(0,cx_time-12,24-12)	-0.0352	0.0019	0.0000
vtimesinced_CD_pw2			Variate piecewise of cx_time[3]	median(0,cx_time-24,40-24)	-0.0131	0.0030	0.0000
vtimesinced_CD_pw3			Variate piecewise of cx_time[3]	median(0,cx_time-40,41-40)	-0.4415	0.0679	0.0000
vpriordef_CD_pw1			Variate piecewise of prior_default_cnt	median(0,prior_default_cnt-2,10-2)	0.1116	0.0010	0.0000
Mcredit_score*mpriordef_CD	L00	L01	Interaction of categorical of credit score and the categorical of prior_default_cnt	credit_score = 0; prior_default_cnt = 1	0.2585	0.0089	0.0000
Mcredit_score*mpriordef_CD	L00	L02	Interaction of categorical of credit score and the categorical of prior_default_cnt	credit_score = 0; prior_default_cnt = 2	0.2327	0.0111	0.0000
Mcredit_score*mpriordef_CD	L00	L03	Interaction of categorical of credit score and the categorical of prior_default_cnt	credit_score = 0; prior_default_cnt >= 3	0.2652	0.0093	0.0000
Mcredit_score*mpriordef_CD	Z00	Z00	Interaction of categorical of credit score and the categorical of prior_default_cnt	base level: else			
vsato_cd_pw1			Variate piecewise of sato (spread at origination)	min(0,sato-(-.1))	-0.0471	0.0060	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vsato_cd_pw2			Variate piecewise of sato (spread at origination)	median(sato-(-.1),0,.7-(-.1))	0.2390	0.0042	0.0000
vsato_cd_pw3			Variate piecewise of sato (spread at origination)	max(sato-.7,0)	0.3118	0.0100	0.0000
vdeltaUEpr3_cd_pw1			Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	min(0,delta_ue_sa_st_r-(-20))	-0.0001	0.0000	0.0042
vdeltaUEpr3_cd_pw3			Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	max(delta_ue_sa_st_r-10,0)	0.0009	0.0000	0.0000
vUEblend_CD_pw2			Variate piecewise of ue_blended_r[5] (change in unemployment rate)	median(0,ue_blended_r-420,820-420)	0.0001	0.0000	0.0000
vUEblend_CD_pw3			Variate piecewise of ue_blended_r[5] (change in unemployment rate)	max(0,ue_blended_r-820)	0.0000	0.0000	0.0396
mltv_i	Miss		Categorical of ltv_i_r[6] (loan-to-value)	ltv_i = .	0.2181	0.0208	0.0000
mltv_i	z00		Categorical of ltv_i_r[6] (loan-to-value)	base level: else			
vltv_CD_pw1			Variate piecewise of ltv_i_r[6] (loan-to-value)	median(0,ltv_i_r-0,70-0)	0.0029	0.0003	0.0000
vltv_CD_pw3			Variate piecewise of ltv_i_r[6] (loan-to-value)	median(0,ltv_i_r-78,85-78)	0.0057	0.0005	0.0000
vltv_CD_pw5			Variate piecewise of ltv_i_r[6] (loan-to-value)	median(0,ltv_i_r-88,92-88)	0.0380	0.0010	0.0000
vltv_CD_pw6			Variate piecewise of ltv_i_r[6] (loan-to-value)	median(0,ltv_i_r-92,95-92)	0.0752	0.0017	0.0000
vltv_CD_pw7			Variate piecewise of ltv_i_r[6] (loan-to-value)	median(0,ltv_i_r-95,97-95)	0.0491	0.0032	0.0000
vltv_CD_pw8			Variate piecewise of ltv_i_r[6] (loan-to-value)	max(0,ltv_i_r-97)	0.0426	0.0041	0.0000
vhpa2yb_CD_pw1			Variate piecewise of hpa2y_blended_r[7]	median(0,hpa2y_blended_r-0,85-0)	0.0087	0.0005	0.0000
vhpa2yb_CD_pw2			Variate piecewise of hpa2y_blended_r[7]	median(0,hpa2y_blended_r-85,95-85)	-0.0160	0.0006	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vhpa2yb_CD_pw3			Variate piecewise of hpa2y_blended_r[7]	median(0,hpa2y_blended_r-95,113-95)	-0.0230	0.0003	0.0000
vhpa2yb_CD_pw4			Variate piecewise of hpa2y_blended_r[7]	median(0,hpa2y_blended_r-113,120-113)	-0.0038	0.0006	0.0000
vhpa2yb_CD_pw5			Variate piecewise of hpa2y_blended_r[7]	max(0,hpa2y_blended_r-120)	-0.0052	0.0003	0.0000

Current Transition Model Parameters – FRM30SR C_END

The model parameters for the FRM30SR current to end (refinance or payoff) transition are shown below.

Table 36: Current to End Transition FRM30SR Model Parameters

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept					-4.7707	0.0494	0.0000
mseason	1		Categorical of season	season = "winter"	-0.1600	0.0022	0.0000
mseason	2		Categorical of season	season = "spring"	0.0399	0.0021	0.0000
mseason	3		Categorical of season	season = "summer"	0.0298	0.0022	0.0000
mseason	4		Categorical of season	base level: else			
mcalperiod	L200104		Categorical of period (calendar period)	period < 200104	0.2289	0.0036	0.0000
mcalperiod	L200604		Categorical of period (calendar period)	period < 200604	0.7450	0.0031	0.0000
mcalperiod	Z201800		Categorical of period (calendar period)	base level: else			
mycslope_CEND	L01		Categorical of ycslope_r[1] (yield curve slope)	yclslope >= 9	-0.6867	0.0028	0.0000
mycslope_CEND	Z00		Categorical of ycslope_r[1] (yield curve slope)	base level: else			
mfrst_tm_by	1		Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	0.1449	0.0165	0.0000
mfrst_tm_by	2		Categorical of frst_tm_by (first-time buyer)	base level: else			
mperiodnbr_cend	L02		Categorical of period number (quarters since origination)	period_number = 2	-0.9590	0.0058	0.0000
mperiodnbr_cend	L03		Categorical of period number (quarters since origination)	period_number = 3	-0.2933	0.0046	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mperiodnbr_cend	L04		Categorical of period number (quarters since origination)	period_number = 4	-0.0295	0.0043	0.0000
mperiodnbr_cend	L05		Categorical of period number (quarters since origination)	period_number = 5	0.0325	0.0043	0.0000
mperiodnbr_cend	L06		Categorical of period number (quarters since origination)	period_number = 6	0.0353	0.0043	0.0000
mperiodnbr_cend	L07		Categorical of period number (quarters since origination)	period_number = 7	0.0513	0.0044	0.0000
mperiodnbr_cend	Z08		Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_cend_pw1			Variate piecewise of period number (quarters since origination)	median(0,period_number-8,14-8)	0.0102	0.0007	0.0000
vperiodnbr_cend_pw2			Variate piecewise of period number (quarters since origination)	median(0,period_number-14,17-14)	0.0112	0.0016	0.0000
vperiodnbr_cend_pw3			Variate piecewise of period number (quarters since origination)	median(0,period_number-17,19-17)	-0.0070	0.0023	0.0026
vperiodnbr_cend_pw4			Variate piecewise of period number (quarters since origination)	median(0,period_number-19,31-19)	-0.0204	0.0004	0.0000
vperiodnbr_cend_pw5			Variate piecewise of period number (quarters since origination)	median(0,period_number-31,40-31)	0.0204	0.0007	0.0000
vperiodnbr_cend_pw6			Variate piecewise of period number (quarters since origination)	median(0,period_number-40,49-40)	-0.0722	0.0009	0.0000
vperiodnbr_cend_pw7			Variate piecewise of period number (quarters since origination)	median(0,period_number-49,62-49)	0.0169	0.0009	0.0000
vperiodnbr_cend_pw8			Variate piecewise of period number (quarters since origination)	median(0,period_number-62,85-62)	0.0093	0.0009	0.0000
vperiodnbr_cend_pw9			Variate piecewise of period number (quarters since origination)	median(0,period_number-85,108-85)	-0.0275	0.0019	0.0000
vrefiincent_cend_pw1			Variate piecewise of refi_incent2_r² (refinance incentive)	median(0,refi_incent2_r-0,100-0)	0.0030	0.0002	0.0000
vrefiincent_cend_pw2			Variate piecewise of refi_incent2_r² (refinance incentive)	median(0,refi_incent2_r-100,120-100)	0.0454	0.0001	0.0000
vrefiincent_cend_pw3			Variate piecewise of refi_incent2_r²	median(0,refi_incent2_r-120,135-120)	0.0084	0.0002	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
			(refinance incentive)				
vrefiincent_cend_pw4			Variate piecewise of refi_incent2_r² (refinance incentive)	median(0,refi_incent2_r-135,155-135)	0.0087	0.0003	0.0000
vrefiincent_cend_pw5			Variate piecewise of refi_incent2_r² (refinance incentive)	max(0,refi_incent2_r-155)	-0.0037	0.0002	0.0000
mcredit_score	L00		Categorical of credit score	credit_score = 0	0.3294	0.0241	0.0000
mcredit_score	Z00		Categorical of credit_score	base level: else			
vcredit_cend_pw2			Variate piecewise of credit_score	median(0,credit_score-500,600-500)	0.0034	0.0003	0.0000
vcredit_cend_pw3			Variate piecewise of credit_score	median(0,credit_score-600,630-600)	-0.0043	0.0007	0.0000
vcredit_cend_pw4			Variate piecewise of credit_score	median(0,credit_score-630,680-630)	0.0021	0.0002	0.0000
vcredit_cend_pw8			Variate piecewise of credit_score	max(0,credit_score-800)	-0.0081	0.0024	0.0007
mpriordef_CEND*mtimesinceD_CEND	L01	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 1; cx_time <= 1	-0.6044	0.0101	0.0000
mpriordef_CEND*mtimesinceD_CEND	L01	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 1; cx_time = 2	-0.6187	0.0116	0.0000
mpriordef_CEND*mtimesinceD_CEND	L01	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 1; cx_time = 3	-0.5308	0.0124	0.0000
mpriordef_CEND*mtimesinceD_CEND	L01	L04	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 1; cx_time = 4	-0.3024	0.0122	0.0000
mpriordef_CEND*mtimesinceD_CEND	L01	L05	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 1; cx_time = 5	-0.2772	0.0130	0.0000
mpriordef_CEND*mtimesinceD_CEND	L01	L06	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 1; cx_time = 6	-0.3179	0.0142	0.0000
mpriordef_CEND*mtimesinceD_CEND	L01	L07	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 1; cx_time = 7	-0.2905	0.0149	0.0000
mpriordef_CEND*mtimesinceD_CEND	L01	L08	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 1; cx_time = 8	-0.2528	0.0155	0.0000
mpriordef_CEND*mtimesinceD_CEND	L01	L09	Interaction of categorical of prior_default_cnt	prior_default_cnt = 1; cx_time >= 9	-0.2701	0.0087	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
			and categorical of cx_time³				
mpriordef_CEND*mtimesinceD_CEND	L02	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 2; cx_time <= 1	-1.0178	0.0167	0.0000
mpriordef_CEND*mtimesinceD_CEND	L02	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 2; cx_time = 2	-1.0033	0.0199	0.0000
mpriordef_CEND*mtimesinceD_CEND	L02	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 2; cx_time = 3	-0.8734	0.0217	0.0000
mpriordef_CEND*mtimesinceD_CEND	L02	L04	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 2; cx_time = 4	-0.5430	0.0209	0.0000
mpriordef_CEND*mtimesinceD_CEND	L02	L05	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 2; cx_time = 5	-0.4744	0.0223	0.0000
mpriordef_CEND*mtimesinceD_CEND	L02	L06	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 2; cx_time = 6	-0.5215	0.0249	0.0000
mpriordef_CEND*mtimesinceD_CEND	L02	L07	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 2; cx_time = 7	-0.4636	0.0262	0.0000
mpriordef_CEND*mtimesinceD_CEND	L02	L08	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 2; cx_time = 8	-0.4180	0.0276	0.0000
mpriordef_CEND*mtimesinceD_CEND	L02	L09	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 2; cx_time >= 9	-0.4621	0.0121	0.0000
mpriordef_CEND*mtimesinceD_CEND	L03	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 3; cx_time <= 1	-1.3522	0.0240	0.0000
mpriordef_CEND*mtimesinceD_CEND	L03	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 3; cx_time = 2	-1.2145	0.0278	0.0000
mpriordef_CEND*mtimesinceD_CEND	L03	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time³	prior_default_cnt = 3; cx_time = 3	-1.0915	0.0311	0.0000
mpriordef_CEND*mtimesinceD_CEND	L03	L04	Interaction of categorical of prior_default_cnt	prior_default_cnt = 3; cx_time = 4	-0.6553	0.0290	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
			and categorical of cx_time3				
mpriordef_CEND*mtimesinceD_CEND	L03	L05	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt = 3; cx_time = 5	-0.5672	0.0311	0.0000
mpriordef_CEND*mtimesinceD_CEND	L03	L06	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt = 3; cx_time = 6	-0.6021	0.0348	0.0000
mpriordef_CEND*mtimesinceD_CEND	L03	L07	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt = 3; cx_time = 7	-0.6203	0.0382	0.0000
mpriordef_CEND*mtimesinceD_CEND	L03	L08	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt = 3; cx_time = 8	-0.6213	0.0413	0.0000
mpriordef_CEND*mtimesinceD_CEND	L03	L09	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt = 3; cx_time >= 9	-0.5225	0.0161	0.0000
mpriordef_CEND*mtimesinceD_CEND	L04	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 4; cx_time <= 1	-1.5706	0.0178	0.0000
mpriordef_CEND*mtimesinceD_CEND	L04	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 4; cx_time = 2	-1.3581	0.0207	0.0000
mpriordef_CEND*mtimesinceD_CEND	L04	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 4; cx_time = 3	-1.1244	0.0227	0.0000
mpriordef_CEND*mtimesinceD_CEND	L04	L04	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 4; cx_time = 4	-0.7109	0.0220	0.0000
mpriordef_CEND*mtimesinceD_CEND	L04	L05	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 4; cx_time = 5	-0.5618	0.0233	0.0000
mpriordef_CEND*mtimesinceD_CEND	L04	L06	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 4; cx_time = 6	-0.5918	0.0266	0.0000
mpriordef_CEND*mtimesinceD_CEND	L04	L07	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 4; cx_time = 7	-0.6579	0.0303	0.0000
mpriordef_CEND*mtimesinceD_CEND	L04	L08	Interaction of categorical of prior_default_cnt	prior_default_cnt >= 4; cx_time = 8	-0.6137	0.0327	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
			and categorical of cx_time[3]				
mpriordef_CEND*mtimesinceD_CEND	L04	L09	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt >= 4; cx_time >= 9	-0.5607	0.0144	0.0000
mpriordef_CEND*mtimesinceD_CEND	Z00	Z00	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	base level: else			
vtimesinced_cend_pw1			Variate piecewise of cx_time[3]	median(0,cx_time-8,24-8)	0.0061	0.0010	0.0000
vtimesinced_cend_pw2			Variate piecewise of cx_time[3]	median(0,cx_time-24,40-24)	0.0063	0.0020	0.0020
vtimesinced_cend_pw3			Variate piecewise of cx_time[3]	median(0,cx_time-40,41-40)	-0.1914	0.0437	0.0000
vhpa2yb_cend_pw1			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-0,90-0)	-0.0073	0.0003	0.0000
vhpa2yb_cend_pw2			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-90,106-90)	0.0133	0.0003	0.0000
vhpa2yb_cend_pw3			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-106,111-106)	0.0270	0.0007	0.0000
vhpa2yb_cend_pw4			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-111,114-111)	0.0524	0.0012	0.0000
vhpa2yb_cend_pw5			Variate piecewise of hpa2y_blended_r[4]	median(0,hpa2y_blended_r-114,119-114)	0.0087	0.0007	0.0000
vhpa2yb_cend_pw6			Variate piecewise of hpa2y_blended_r[4]	max(0,hpa2y_blended_r-119)	0.0111	0.0001	0.0000
mRatioTmpTei	L00		Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei = 0	-0.1153	0.0249	0.0000
mRatioTmpTei	Z00		Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_cend_pw1			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,12-0)	-0.0168	0.0022	0.0000
vratiotmptei_cend_pw2			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-12,35-12)	-0.0046	0.0003	0.0000
vratiotmptei_cend_pw3			Variate piecewise of ratio_tmp_tei (front-end ratio)	max(0,ratio_tmp_tei-35)	0.0009	0.0002	0.0000
vdeltaue_cend_pw1			Variate piecewise of DeltaUEInit_r[5] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-0,65-0)	-0.0028	0.0002	0.0000
vdeltaue_cend_pw3			Variate piecewise of DeltaUEInit_r[5] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-78,90-78)	-0.0041	0.0003	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaue_cend_pw4			Variate piecewise of DeltaUEInit_r[5] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-90,97-90)	0.0184	0.0005	0.0000
vdeltaue_cend_pw5			Variate piecewise of DeltaUEInit_r[5] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-97,126-97)	0.0072	0.0001	0.0000
vloanraw_cend_pw1			Variate piecewise of loansize_raw	median(0,loansize_raw-0,57000-0)	0.0000	0.0000	0.0000
vloanraw_cend_pw2			Variate piecewise of loansize_raw	median(0,loansize_raw-57000,159000-57000)	0.0000	0.0000	0.0000
vloanraw_cend_pw3			Variate piecewise of loansize_raw	median(0,loansize_raw-159000,345000-159000)	0.0000	0.0000	0.0000
vloanraw_cend_pw4			Variate piecewise of loansize_raw	max(0,loansize_raw-345000)	0.0000	0.0000	0.0000
vltv_cend_pw1			Variate piecewise of ltv_i_r[6] (loan-to-value)	median(0,ltv_i_r-0,78-0)	-0.0030	0.0000	0.0000
vltv_cend_pw2			Variate piecewise of ltv_i_r[6] (loan-to-value)	median(0,ltv_i_r-78,84-78)	0.0180	0.0007	0.0000
vltv_cend_pw3			Variate piecewise of ltv_i_r[6] (loan-to-value)	median(0,ltv_i_r-84,85-84)	-0.0407	0.0051	0.0000
vltv_cend_pw4			Variate piecewise of ltv_i_r[6] (loan-to-value)	median(0,ltv_i_r-85,87-85)	-0.0154	0.0027	0.0000
vltv_cend_pw5			Variate piecewise of ltv_i_r[6] (loan-to-value)	median(0,ltv_i_r-87,91-87)	0.0408	0.0012	0.0000
vltv_cend_pw6			Variate piecewise of ltv_i_r[6] (loan-to-value)	median(0,ltv_i_r-91,94-91)	-0.0230	0.0015	0.0000
vltv_cend_pw7			Variate piecewise of ltv_i_r[6] (loan-to-value)	median(0,ltv_i_r-94,97-94)	0.0452	0.0017	0.0000
vltv_cend_pw8			Variate piecewise of ltv_i_r[6] (loan-to-value)	max(0,ltv_i_r-97)	-0.0537	0.0038	0.0000

Current Transition Model Parameters – FRM15 C_SR

The model parameters for the FRM15 current to streamlined refinance transition are shown below.

Table 37: Current to Streamlined Refinance Transition FRM15 Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-6.4609	0.0741	0.0000
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1 (judicial state)	0.0342	0.0087	0.0001

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mjudicial	2	Categorical of judicial (judicial state)	base level: else (non-judicial state)			
mseason	1	Categorical of season	season = "winter"	0.0390	0.0118	0.0010
mseason	2	Categorical of season	season = "spring"	0.0797	0.0118	0.0000
mseason	3	Categorical of season	season = "summer"	-0.0952	0.0122	0.0000
mseason	4	Categorical of season	base level: else			
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	-0.4783	0.0188	0.0000
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else			
mdpa_comb13	2	Categorical of dpa (down payment assistance)	dpa = "nonprof"	0.6294	0.0375	0.0000
mdpa_comb13	3	Categorical of dpa (down payment assistance)	dpa = "govt" or dpa = "relative"	-0.1766	0.0349	0.0000
mdpa_comb13	4	Categorical of dpa (down payment assistance)	base level: dpa = "na_other"			
mpriordef_CSR	L01	Categorical of prior default count	prior_default_cnt = 1	-0.1650	0.0193	0.0000
mpriordef_CSR	L02	Categorical of prior default count	prior_default_cnt = 2	-0.3962	0.0361	0.0000
mpriordef_CSR	L03	Categorical of prior default count	prior_default_cnt >= 3	-0.3632	0.0362	0.0000
mpriordef_CSR	Z00	Categorical of prior default count	base level: prior_default_cnt = 0			
mcred_subs_coht_CSR	L01	Categorical of Credit Subsidy Cohort Yr	credit_subsidy_cohort <= 1995	-2.8378	0.1652	0.0000
mcred_subs_coht_CSR	z02	Categorical of Credit Subsidy Cohort Yr	base level: else			
mperiodnbr_CSR	L02	Categorical of period_number	period_number = 2	-0.6502	0.0368	0.0000
mperiodnbr_CSR	L03	Categorical of period_number	period_number = 3	0.3026	0.0281	0.0000
mperiodnbr_CSR	L04	Categorical of period_number	period_number = 4	0.7450	0.0254	0.0000
mperiodnbr_CSR	L05	Categorical of period_number	period_number = 5	0.7270	0.0244	0.0000
mperiodnbr_CSR	L06	Categorical of period_number	period_number = 6	0.6920	0.0244	0.0000
mperiodnbr_CSR	L07	Categorical of period_number	period_number = 7	0.6259	0.0243	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mperiodnbr_CSR	L08	Categorical of period_number	period_number = 8	0.5227	0.0245	0.0000
mperiodnbr_CSR	L09	Categorical of period_number	period_number = 9	0.5082	0.0246	0.0000
mperiodnbr_CSR	L10	Categorical of period_number	period_number = 10	0.4441	0.0252	0.0000
mperiodnbr_CSR	L11	Categorical of period_number	period_number = 11	0.3345	0.0259	0.0000
mperiodnbr_CSR	L12	Categorical of period_number	period_number = 12	0.1535	0.0270	0.0000
mperiodnbr_CSR	L13	Categorical of period_number	period_number = 13	0.0695	0.0277	0.0122
mperiodnbr_CSR	Z14	Categorical of period_number	base level: else			
vperiodnbr_CSR_pw1		Variate piecewise of period_number	median(0,period_number-13,24-13)	-0.0592	0.0026	0.0000
vperiodnbr_CSR_pw2		Variate piecewise of period_number	median(0,period_number-24,43-24)	-0.0746	0.0026	0.0000
vperiodnbr_CSR_pw3		Variate piecewise of period_number	median(0,period_number-43,56-43)	-0.0442	0.0087	0.0000
vcredit_CSR_pw1		Variate piecewise of credit_score	median(0,credit_score-500,650-500)	0.0024	0.0001	0.0000
vcredit_CSR_pw2		Variate piecewise of credit_score	median(0,credit_score-650,770-650)	-0.0018	0.0001	0.0000
vcredit_CSR_pw3		Variate piecewise of credit_score	max(0,credit_score-770)	-0.0069	0.0008	0.0000
mtreasury_yr30_CSR	L01	Categorical of 30 yr Treasury	treasury_yr_30 >=5	0.2836	0.0181	0.0000
mtreasury_yr30_CSR	z00	Categorical of 30 yr Treasury	base level: else			
vdeltaue_CSR_pw2		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_R-63,91-63)	0.0091	0.0008	0.0000
vdeltaue_CSR_pw3		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_R-91,99-91)	-0.0273	0.0026	0.0000
vdeltaue_CSR_pw4		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_R-99,104-99)	0.0827	0.0040	0.0000
vratiotmptei_CSR_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,11-0)	-0.0131	0.0023	0.0000
vratiotmptei_CSR_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-11,16-11)	0.0248	0.0046	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vratiotmptei_CSR_pw3		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-16,36-16)	0.0119	0.0009	0.0000
vratiotmptei_CSR_pw4		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-36,50-36)	-0.0108	0.0030	0.0003
vltv_CSR_pw1		Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_R-0,39-0)	-0.0080	0.0009	0.0000
vltv_CSR_pw2		Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_R-39,90-39)	0.0064	0.0004	0.0000
vltv_CSR_pw3		Variate piecewise of ltv_i_r[2] (loan-to-value)	max(0,ltv_i_R-90)	0.0387	0.0045	0.0000
vloanraw_CSR_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-0,62400-0)	0.0000	0.0000	0.0000
vloanraw_CSR_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-62400,124000-62400)	0.0000	0.0000	0.0000
vloanraw_CSR_pw3		Variate piecewise of loansize_raw	max(0,loansize_raw-124000)	0.0000	0.0000	0.0000
vhpa2yb_CSR_pw1		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_R-88,105-88)	0.0091	0.0012	0.0000
vhpa2yb_CSR_pw2		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_R-105,112-105)	0.0192	0.0025	0.0000
vhpa2yb_CSR_pw3		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_R-112,117-112)	-0.0162	0.0034	0.0000
vsato_csr_pw1		Variate piecewise of sato (spread at origination)	min(0,sato-.4)	0.9991	0.0122	0.0000
vsato_csr_pw2		Variate piecewise of sato (spread at origination)	max(sato-.4,0)	0.2070	0.0387	0.0000
vDeltaTY1_CSR_pw1		Variate piecewise of DeltaTy1Init_r[4] (change in 1-year Treasury rate from policy inception to current)	median(0,DeltaTy1Init_R-0,73-0)	-0.0172	0.0003	0.0000
vDeltaTY1_CSR_pw2		Variate piecewise of DeltaTy1Init_r[4] (change in 1-year Treasury rate from policy inception to current)	max(0,DeltaTy1Init_R-73)	0.0006	0.0000	0.0000
mdeltaTy10Init_csr	L01	Categorical of DeltaTy10Init_r[5] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r >109	-0.8494	0.0136	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdeltaTy10Init_csr	Z00	Categorical of DeltaTy10Init_r[5] (change in 10-year Treasury rate from policy inception to current)	base level: else			

Current Transition Model Parameters – FRM15 C_D

The model parameters for the FRM15 current to default transition are shown below.

Table 38: Current to Default Transition FRM15 Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-3.4573	0.0465	0.0000
mseason	1	Categorical of season	season = "winter"	-0.2352	0.0061	0.0000
mseason	2	Categorical of season	season = "spring"	-0.3147	0.0061	0.0000
mseason	3	Categorical of season	season = "summer"	-0.1741	0.0060	0.0000
mseason	4	Categorical of season	base level: else			
mdpa	1	Categorical of dpa (down payment assistance)	dpa = "govt"	0.1625	0.0479	0.0007
mdpa	2	Categorical of dpa (down payment assistance)	dpa= "nonprof"	0.3093	0.0141	0.0000
mdpa	3	Categorical of dpa (down payment assistance)	dpa = "relative"	0.1169	0.0128	0.0000
mdpa	4	Categorical of dpa (down payment assistance)	base level:dpa = "na_other"			
mpriordef_CD	L01	Categorical of prior default count	prior_default_cnt = 1	2.1129	0.0064	0.0000
mpriordef_CD	L02	Categorical of prior default count	prior_default_cnt = 2	2.8132	0.0078	0.0000
mpriordef_CD	L03	Categorical of prior default count	prior_default_cnt >= 3	3.2295	0.0078	0.0000
mpriordef_CD	Z00	Categorical of prior default count	prior_default_cnt = 0			
vpriordef_CD_pw1		Variate piecewise of prior default count	median(0,prior_default_cnt-3,26-3)	0.1726	0.0020	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mcred_subs_coht_CD	L01	Categorical of Credit Subsidy Cohort Yr	credit_subsidy_cohort < 2000	0.3809	0.0108	0.0000
mcred_subs_coht_CD	z02	Categorical of Credit Subsidy Cohort Yr	base level: else			
mperiodnbr_CD	L02	Categorical of period_number	period_number = 2	-0.5190	0.0178	0.0000
mperiodnbr_CD	L03	Categorical of period_number	period_number = 3	-0.2948	0.0159	0.0000
mperiodnbr_CD	L04	Categorical of period_number	period_number = 4	-0.2022	0.0150	0.0000
mperiodnbr_CD	Z05	Categorical of period_number	base level: else			
vperiodnbr_CD_pw1		Variate piecewise of period_number	median(0,period_number-4,24-4)	-0.0353	0.0006	0.0000
vperiodnbr_CD_pw2		Variate piecewise of period_number	median(0,period_number-24,50-24)	-0.0211	0.0005	0.0000
vperiodnbr_CD_pw3		Variate piecewise of period_number	median(0,period_number-50,57-50)	0.0200	0.0031	0.0000
vperiodnbr_CD_pw4		Variate piecewise of period_number	max(0,period_number-57)	-0.0939	0.0117	0.0000
mcredit_score	L00	Categorical of credit_score	credit_score = 0	-0.4844	0.0130	0.0000
mcredit_score	Z00	Categorical of credit_score	base level: else			
vcredit_CD_pw1		Variate piecewise of credit_score	median(0,credit_score-500,650-500)	-0.0031	0.0001	0.0000
vcredit_CD_pw2		Variate piecewise of credit_score	median(0,credit_score-650,800-650)	-0.0106	0.0001	0.0000
mtreasury_yr30_CD	L01	Categorical of 30 yr Treasury	treasury_yr_30 >=5	-0.9559	0.0130	0.0000
mtreasury_yr30_CD	z00	Categorical of 30 yr Treasury	base level: else			
vdeltaue_CD_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_R-0,63-0)	0.0043	0.0005	0.0000
vdeltaue_CD_pw2		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_R-63,97-63)	-0.0010	0.0002	0.0000
vdeltaue_CD_pw3		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	max(0,DeltaUEInit_R-97)	0.0013	0.0001	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vratiotmptei_CD_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-3,11-3)	-0.0040	0.0010	0.0000
vratiotmptei_CD_pw3		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-11,37-11)	0.0132	0.0004	0.0000
vratiotmptei_CD_pw4		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-37,55-37)	-0.0086	0.0017	0.0000
mltv_i	Miss	Categorical of ltv_i_r[2] (loan-to-value)	ltv_i_r = .	0.2100	0.0225	0.0000
mltv_i	z00	Categorical of ltv_i_r[2] (loan-to-value)	base level: else			
vltv_CD_pw1		Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_R-0,39-0)	0.0088	0.0006	0.0000
vltv_CD_pw2		Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_R-39,90-39)	0.0094	0.0002	0.0000
vltv_CD_pw3		Variate piecewise of ltv_i_r[2] (loan-to-value)	max(0,ltv_i_R-90)	0.0589	0.0032	0.0000
vloanraw_CD_pw1		Variate piecewise of Loansize Raw	median(0,loansize_raw-0,62400-0)	0.0000	0.0000	0.0000
vloanraw_CD_pw2		Variate piecewise of Loansize Raw	median(0,loansize_raw-62400,124000-62400)	0.0000	0.0000	0.0000
vloanraw_CD_pw3		Variate piecewise of Loansize Raw	max(0,loansize_raw-124000)	0.0000	0.0000	0.0000
vhpa2yb_CD_pw1		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_R-88,105-88)	-0.0231	0.0006	0.0000
vhpa2yb_CD_pw2		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_R-105,112-105)	-0.0535	0.0013	0.0000
vhpa2yb_CD_pw3		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_R-112,117-112)	0.0133	0.0021	0.0000
vhpa2yb_CD_pw4		Variate piecewise of hpa2y_blended_r[3]	max(0,hpa2y_blended_R-117)	-0.0201	0.0009	0.0000

Current Transition Model Parameters – FRM15 C_CXS

The model parameters for the FRM15 current to self-cure transition are shown below.

Table 39: Current to Self-Cure Transition FRM15 Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-4.6370	0.1765	0.0000
mseason	1	Categorical of season	season = "winter"	0.2427	0.0118	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mseason	2	Categorical of season	season = "spring"	-0.0303	0.0124	0.0150
mseason	3	Categorical of season	season = "summer"	0.1926	0.0120	0.0000
mseason	4	Categorical of season	base level: else			
mrfnc_ind	1	Categorical of rfnc_ind (refinanced loan indicator)	refinanced, non-streamlined	-0.0444	0.0134	0.0009
mrfnc_ind	2	Categorical of rfnc_ind (refinanced loan indicator)	streamlined refinanced	-0.2900	0.0200	0.0000
mrfnc_ind	3	Categorical of rfnc_ind (refinanced loan indicator)	base level: else			
mpriordef_CCXS	L01	Categorical of prior default count	prior_default_cnt = 1	1.8241	0.0123	0.0000
mpriordef_CCXS	L02	Categorical of prior default count	prior_default_cnt = 2	2.4102	0.0147	0.0000
mpriordef_CCXS	L10	Categorical of prior default count	prior_default_cnt >= 10	2.6513	0.0484	0.0000
mpriordef_CCXS	PW1	Categorical of prior default count	else	2.5405	0.0175	0.0000
mpriordef_CCXS	Z00	Categorical of prior default count	base level: prior_default_cnt = 0			
vpriordef_CCXS_pw1		Variate piecewise of prior default count	median(0,prior_default_cnt-2,10-2)	0.1748	0.0047	0.0000
mperiodnbr_CCXS	L02	Categorical of period_number	period_number = 2	-0.2397	0.0339	0.0000
mperiodnbr_CCXS	L03	Categorical of period_number	period_number = 3	-0.1891	0.0329	0.0000
mperiodnbr_CCXS	Z04	Categorical of period_number	base level: else			
vperiodnbr_CCXS_pw1		Variate piecewise of period_number	median(0,period_number-3,16-3)	-0.0149	0.0017	0.0000
vperiodnbr_CCXS_pw2		Variate piecewise of period_number	median(0,period_number-16,30-16)	-0.0294	0.0014	0.0000
vperiodnbr_CCXS_pw3		Variate piecewise of period_number	median(0,period_number-30,41-30)	-0.0310	0.0020	0.0000
vperiodnbr_CCXS_pw4		Variate piecewise of period_number	median(0,period_number-41,60-41)	-0.0053	0.0024	0.0238
vcredit_CCXS_pw1		Variate piecewise of credit score	median(0,credit_score-500,643-500)	-0.0008	0.0001	0.0000
vcredit_CCXS_pw2		Variate piecewise of credit score	median(0,credit_score-643,800-643)	-0.0085	0.0002	0.0000
vhpa2yb_CCXS_pw1		Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_R-0,100-0)	-0.0072	0.0009	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vhpa2yb_CCXS_pw3		Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_R-106,115-106)	-0.0197	0.0013	0.0000
vdeltaue_CCXS_pw1		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_R-0,45-0)	0.0088	0.0030	0.0034
vdeltaue_CCXS_pw3		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	max(0,DeltaUEInit_R-150)	0.0005	0.0002	0.0277
mratio_tmp_tei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei = 0	0.1722	0.0251	0.0000
mratio_tmp_tei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_CCXS_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-9,16-9)	0.0133	0.0033	0.0001
vratiotmptei_CCXS_pw3		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-16,36-16)	0.0067	0.0008	0.0000
vltv_CCXS_pw1		Variate piecewise of ltv_i_r[3] (loan-to-value)	median(0,ltv_i_R-0,40-0)	0.0045	0.0012	0.0001
vltv_CCXS_pw2		Variate piecewise of ltv_i_r[3] (loan-to-value)	median(0,ltv_i_R-40,88-40)	0.0059	0.0005	0.0000
vltv_CCXS_pw3		Variate piecewise of ltv_i_r[3] (loan-to-value)	max(0,ltv_i_R-88)	0.0246	0.0048	0.0000
vloanraw_CCXS_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-0,40000-0)	0.0000	0.0000	0.0000
vloanraw_CCXS_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-40000,150000-40000)	0.0000	0.0000	0.0000
mperiod_CCXS	L01	Categorical version of period	period < 200604	-2.1091	0.0410	0.0000
mperiod_CCXS	Z01	Categorical version of period	base level: else			
mltv_i	Miss	Categorical of ltv_i_r[3] (loan-to-value)	ltv_i = .	0.6020	0.0410	0.0000
mltv_i	z00	Categorical of ltv_i_r[3] (loan-to-value)	base level: else			
mtreasury_yr30_CCXS	L01	Categorical of 30 yr Treasury	treasury_yr_30 >=5	-0.3497	0.0552	0.0000
mtreasury_yr30_CCXS	z00	Categorical of 30 yr Treasury	base level: else			

Current Transition Model Parameters – FRM15 C_PRE

The model parameters for the FRM15 current to prepayment transition are shown below.

Table 40: Current to Prepayment Transition FRM15 Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-4.0536	0.0517	0.0000
mjudicial	1	Categorical of judicial state	judicial = 1 , judicial state	0.0091	0.0037	0.0133
mjudicial	2	Categorical of judicial state	base level: else, non-judicial state			
mseason	1	Categorical of season	season = "winter"	-0.0760	0.0051	0.0000
mseason	2	Categorical of season	season = "spring"	0.0501	0.0049	0.0000
mseason	3	Categorical of season	season = "summer"	0.0504	0.0050	0.0000
mseason	4	Categorical of season	base level: else			
mdpa_comb13	2	Categorical of dpa (down payment assistance)	dpa = "nonprof"	-0.1766	0.0326	0.0000
mdpa_comb13	3	Categorical of dpa (down payment assistance)	dpa = "govt" or dpa = "relative"	0.1144	0.0128	0.0000
mdpa_comb13	4	Categorical of dpa (down payment assistance)	base level: dpa = "na_other"			
mpriordef_CPRE	L01	Categorical of prior default count	prior_default_cnt = 1	-0.1527	0.0076	0.0000
mpriordef_CPRE	L02	Categorical of prior default count	prior_default_cnt = 2	-0.3162	0.0130	0.0000
mpriordef_CPRE	L03	Categorical of prior default count	prior_default_cnt >= 3	-0.4584	0.0141	0.0000
mpriordef_CPRE	Z00	Categorical of prior default count	prior_default_cnt = 0			
vpriordef_CPRE_pw1		Variate piecewise Prior_Default_Cnt	median(0,prior_default_cnt-3,26-3)	-0.0273	0.0048	0.0000
mcred_subs_coht_CPRE	L01	Categorical of Credit Subsidy Cohort Yr	credit_subsidy_cohort < 2000	0.1649	0.0064	0.0000
mcred_subs_coht_CPRE	z02	Categorical of Credit Subsidy Cohort Yr	base level: else			
mperiodnbr_CPRE	L02	Categorical of period_number	period_number = 2	-2.0776	0.0250	0.0000
mperiodnbr_CPRE	L03	Categorical of period_number	period_number = 3	-1.3132	0.0176	0.0000
mperiodnbr_CPRE	L04	Categorical of period_number	period_number = 4	-0.9047	0.0146	0.0000
mperiodnbr_CPRE	L05	Categorical of period_number	period_number = 5	-0.6205	0.0129	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mperiodnbr_CPRE	L06	Categorical of period_number	period_number = 6	-0.4322	0.0120	0.0000
mperiodnbr_CPRE	L07	Categorical of period_number	period_number = 7	-0.3199	0.0115	0.0000
mperiodnbr_CPRE	L08	Categorical of period_number	period_number = 8	-0.2214	0.0113	0.0000
mperiodnbr_CPRE	L09	Categorical of period_number	period_number = 9	-0.1215	0.0110	0.0000
mperiodnbr_CPRE	L10	Categorical of period_number	period_number = 10	-0.0901	0.0110	0.0000
mperiodnbr_CPRE	L11	Categorical of period_number	period_number = 11	-0.0765	0.0111	0.0000
mperiodnbr_CPRE	L12	Categorical of period_number	period_number = 12	-0.0822	0.0112	0.0000
mperiodnbr_CPRE	Z13	Categorical of period_number	base level: else			
vperiodnbr_CPRE_pw2		Variate piecewise of period_number	median(0,period_number-34,42-34)	0.0175	0.0010	0.0000
vperiodnbr_CPRE_pw3		Variate piecewise of period_number	median(0,period_number-42,56-42)	0.0156	0.0010	0.0000
vperiodnbr_CPRE_pw4		Variate piecewise of period_number	max(0,period_number-56)	0.3822	0.0037	0.0000
mcredit_score	L00	Categorical of credit_score	credit_score = 0	0.5951	0.0251	0.0000
mcredit_score	Z00	Categorical of credit_score	base level: else			
vcredit_CPRE_pw1		Variate piecewise of credit_score	median(0,credit_score-500,650-500)	0.0022	0.0002	0.0000
vcredit_CPRE_pw2		Variate piecewise of credit_score	median(0,credit_score-650,800-650)	0.0009	0.0001	0.0000
mtreasury_yr30_CPRE	L01	Categorical of 30 yr Treasury	treasury_yr_30 >=5	0.2870	0.0060	0.0000
mtreasury_yr30_CPRE	z00	Categorical of 30 yr Treasury	base level: else			
vdeltaue_CPRE_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_R-0,63-0)	-0.0033	0.0004	0.0000
vdeltaue_CPRE_pw2		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_R-63,97-63)	0.0038	0.0002	0.0000
vdeltaue_CPRE_pw3		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	max(0,DeltaUEInit_R-97)	0.0003	0.0001	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mratio_tmp_tei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei = 0	-0.2707	0.0332	0.0000
mratio_tmp_tei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_CPRE_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,11-0)	-0.0136	0.0034	0.0001
vratiotmptei_CPRE_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-11,16-11)	-0.0046	0.0019	0.0166
vratiotmptei_CPRE_pw3		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-16,36-16)	-0.0054	0.0004	0.0000
vratiotmptei_CPRE_pw4		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-36,50-36)	-0.0052	0.0015	0.0005
mltv_i	Miss	Categorical of ltv_i_r[2] (loan-to-value)	ltv_i_r = .	-0.3496	0.0136	0.0000
mltv_i	z00	Categorical of ltv_i_r[2] (loan-to-value)	base level: else			
vltv_CPRE_pw1		Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_R-0,39-0)	-0.0172	0.0004	0.0000
vltv_CPRE_pw2		Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_R-39,90-39)	0.0018	0.0002	0.0000
vltv_CPRE_pw3		Variate piecewise of ltv_i_r[2] (loan-to-value)	max(0,ltv_i_R-90)	-0.0710	0.0045	0.0000
vloanraw_CPRE_pw1		Variate piecewise of Loansize Raw	median(0,loansize_raw-0,62400-0)	0.0000	0.0000	0.0001
vloanraw_CPRE_pw2		Variate piecewise of Loansize Raw	median(0,loansize_raw-62400,124000-62400)	0.0000	0.0000	0.0000
vloanraw_CPRE_pw3		Variate piecewise of Loansize Raw	max(0,loansize_raw-124000)	0.0000	0.0000	0.0000
mhpa2yb_CPRE	L084	Categorical of hpa2y_blended_r[3]	0<hpa2y_blended_R <= 84	0.5260	0.0172	0.0000
mhpa2yb_CPRE	L088	Categorical of hpa2y_blended_r[3]	hpa2y_blended_R <= 88	0.2358	0.0198	0.0000
mhpa2yb_CPRE	Z000	Categorical of hpa2y_blended_r[3]	base level: else			
vhpa2yb_CPRE_pw1		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_R-88,105-88)	0.0410	0.0008	0.0000
vhpa2yb_CPRE_pw2		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_R-105,112-105)	0.0131	0.0010	0.0000
vhpa2yb_CPRE_pw3		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_R-112,117-112)	0.0258	0.0014	0.0000
vhpa2yb_CPRE_pw4		Variate piecewise of hpa2y_blended_r[3]	max(0,hpa2y_blended_R-117)	0.0117	0.0003	0.0000

Current Transition Model Parameters – ARM C_SR

The model parameters for the ARM current to streamlined refinance transition are shown below.

Table 41: Current to Streamlined Refinance Transition ARM Model Parameters

Variable	ClassVal0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
Intercept					-8.8703	0.2781	0.0000
mseason	1	Categorical of season	season = "winter"		0.1521	0.0110	0.0000
mseason	2	Categorical of season	season = "spring"		0.1205	0.0111	0.0000
mseason	3	Categorical of season	season = "summer"		-0.0087	0.0115	0.4491
mseason	4	Categorical of season	base level: else				
mjudicial	1	Categorical of judicial state	judicial = 1 , judicial state		-0.1643	0.0089	0.0000
mjudicial	2	Categorical of judicial state	base level: else, non-judicial state				
mdpa_nprof	LNPro	Categorical of dpa (down payment assistance)	dpa= "nonprof"		0.4655	0.0168	0.0000
mdpa_nprof	Zothr	Categorical of dpa (down payment assistance)	base level: else				
mdpa_rel	LRela	Categorical of dpa (down payment assistance)	dpa = "relative"		-0.0548	0.0138	0.0001
mdpa_rel	Zothr	Categorical of dpa (down payment assistance)	base level: else				
mycslope	L01	Categorical of Yield Curve Slope	1<=ycslope<=2		-0.0997	0.0104	0.0000
mycslope	Z00	Categorical of Yield Curve Slope	base level: else				
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"		-0.0412	0.0121	0.0006
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else				
mrfnc_ind	2	Categorical of rfnc_ind (refinanced loan indicator)	frnc_ind = "Y"		0.1566	0.0153	0.0000
mrfnc_ind	3	Categorical of rfnc_ind (refinanced loan indicator)	base level: else				
mperiodnbr_CSR	L02	Categorical of period_number	period_number = 2		-1.0627	0.0257	0.0000
mperiodnbr_CSR	L03	Categorical of period_number	period_number = 3		-0.0864	0.0179	0.0000
mperiodnbr_CSR	L04	Categorical of period_number	period_number = 4		0.2892	0.0159	0.0000
mperiodnbr_CSR	L05	Categorical of period_number	period_number = 5		0.3808	0.0158	0.0000
mperiodnbr_CSR	L06	Categorical of period_number	period_number = 6		0.1266	0.0176	0.0000

Variable	ClassVal0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
mperiodnbr_CSR	L07	Categorical of period_number	period_number = 7		-0.1616	0.0200	0.0000
mperiodnbr_CSR	Z08	Categorical of period_number	base level: else				
vperiodnbr_CSR_pw1		Variate piecewise of period_number	median(0,period_number-8,40-8)		-0.0642	0.0009	0.0000
vperiodnbr_CSR_pw2		Variate piecewise of period_number	median(0,period_number-40,53-40)		-0.0396	0.0045	0.0000
vperiodnbr_CSR_pw4		Variate piecewise of period_number	median(0,period_number-68,108-68)		-0.0303	0.0049	0.0000
mperiodnbr_CSR*mdpa_nprof	L02	Interaction of Categorical of period_number and Categorical of dpa	period_number = 2; dpa= "nonprof"	LNPro	-0.3964	0.0745	0.0000
mperiodnbr_CSR*mdpa_nprof	L03	Interaction of Categorical of period_number and Categorical of dpa	period_number = 3; dpa= "nonprof"	LNPro	-0.4692	0.0492	0.0000
mperiodnbr_CSR*mdpa_nprof	L04	Interaction of Categorical of period_number and Categorical of dpa	period_number = 4; dpa= "nonprof"	LNPro	-0.6652	0.0462	0.0000
mperiodnbr_CSR*mdpa_nprof	L05	Interaction of Categorical of period_number and Categorical of dpa	period_number = 5; dpa= "nonprof"	LNPro	-0.3227	0.0410	0.0000
mperiodnbr_CSR*mdpa_nprof	L06	Interaction of Categorical of period_number and Categorical of dpa	period_number = 6; dpa= "nonprof"	LNPro	-0.1577	0.0444	0.0004
mperiodnbr_CSR*mdpa_nprof	L07	Interaction of Categorical of period_number and Categorical of dpa	period_number = 7; dpa= "nonprof"	LNPro	-0.1454	0.0513	0.0045
mperiodnbr_CSR*mdpa_nprof	Z08	Interaction of Categorical of period_number and Categorical of dpa	base level: else; base level: else	Zothr			
vcredit_CSR_pw1		Variate piecewise of credit_score	0<credit_score<=450		-0.9503	0.2790	0.0007
vcredit_CSR_pw6		Variate piecewise of credit_score	median(0,credit_score-680,720-680)		-0.0078	0.0004	0.0000
vdeltaue_CSR_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-0,90-0)		-0.0080	0.0006	0.0000
vdeltaue_CSR_pw2		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-90,97-90)		-0.0157	0.0028	0.0000
vdeltaue_CSR_pw3		Variate piecewise of DeltaUEInit_r[1] (change in	median(0,deltaUEinit_r-97,100-97)		0.0984	0.0060	0.0000

Variable	ClassVal0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
		unemployment rate from policy inception to current)					
vdeltaue_CSR_pw5		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-110,140-110)		0.0076	0.0007	0.0000
vdeltaue_CSR_pw6		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-140,175-140)		-0.0022	0.0007	0.0018
vdeltaue_CSR_pw7		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	max(0,deltaUEinit_r-175)		0.0014	0.0004	0.0001
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0		0.6984	0.0330	0.0000
mRatioTmpTei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else				
vratiotmptei_CSR_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,24-0)		0.0178	0.0015	0.0000
vratiotmptei_CSR_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-24,36-24)		0.0041	0.0011	0.0003
vperiodnbr_CSR_pw1*mpriordef_ind	L01	Interaction of variate of piecewise of period_number and categorical of prior_default_cnt	median(0,period_number-8,40-8); prior_default_cnt ne 0		0.0146	0.0018	0.0000
vperiodnbr_CSR_pw1*mpriordef_ind	Z00	Interaction of variate of piecewise of period_number and categorical of prior_default_cnt	base level: else; base level: else				
vperiodnbr_CSR_pw2*mpriordef_ind	L01	Interaction of variate of piecewise of period_number and categorical of prior_default_cnt	median(0,period_number-40,53-40); prior_default_cnt ne 0		0.0482	0.0057	0.0000
vperiodnbr_CSR_pw2*mpriordef_ind	Z00	Interaction of variate of piecewise of period_number and categorical of prior_default_cnt	base level: else; base level: else				
vsato_csr_pw1		Variate piecewise of sato (spread at origination)	min(0,sato-(-.1))		0.3593	0.0074	0.0000

Variable	ClassVal0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
vsato_csr_pw2		Variate piecewise of sato (spread at origination)	median(sato+.1,0,.7+.1)		0.8716	0.0477	0.0000
vdeltaUEpr3_csr_pw1		Variate piecewise of deltauepr3_r[2] (change in unemployment from 3 quarters prior)	min(0,delta_ue_sa_st_r-(-20))		0.0026	0.0003	0.0000
vdeltaUEpr3_csr_pw2		Variate piecewise of deltauepr3_r[2] (change in unemployment from 3 quarters prior)	median(delta_ue_sa_st_r-(-20),0,10-(-20))		0.0100	0.0004	0.0000
vdeltaUEpr3_csr_pw3		Variate piecewise of deltauepr3_r[2] (change in unemployment from 3 quarters prior)	max(delta_ue_sa_st_r-10,0)		0.0018	0.0001	0.0000
vUEblend_CSR_pw1		Variate piecewise of ue_blended_r[3] (change in unemployment rate)	median(0,ue_blended_r-0,420-0)		0.0017	0.0002	0.0000
vUEblend_CSR_pw2		Variate piecewise of ue_blended_r[3] (change in unemployment rate)	median(0,ue_blended_r-420,820-420)		-0.0012	0.0000	0.0000
vUEblend_CSR_pw3		Variate piecewise of ue_blended_r[3] (change in unemployment rate)	max(0,ue_blended_r-820)		-0.0004	0.0001	0.0000
vltv_CSR_pw1		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-0,70-0)		0.0083	0.0012	0.0000
vltv_CSR_pw2		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-70,80-70)		0.0135	0.0029	0.0000
vltv_CSR_pw3		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-80,94-80)		0.0130	0.0012	0.0000
vhpa2yb_CSR_pw1		Variate piecewise of hpa2y_blended_r[5]	median(0,hpa2y_blended_r-0,85-0)		0.0211	0.0023	0.0000
vhpa2yb_CSR_pw2		Variate piecewise of hpa2y_blended_r[5]	median(0,hpa2y_blended_r-85,95-85)		-0.0289	0.0022	0.0000
vhpa2yb_CSR_pw3		Variate piecewise of hpa2y_blended_r[5]	median(0,hpa2y_blended_r-95,113-95)		-0.0236	0.0010	0.0000
vhpa2yb_CSR_pw4		Variate piecewise of hpa2y_blended_r[5]	median(0,hpa2y_blended_r-113,120-113)		0.0355	0.0022	0.0000
vhpa2yb_CSR_pw5		Variate piecewise of hpa2y_blended_r[5]	max(0,hpa2y_blended_r-120)		-0.0120	0.0008	0.0000
mpriordef_C*mtimesinceD_CSR	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time <= 1	L01	-0.8947	0.0438	0.0000

Variable	ClassVal0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
mpriordef_C*mtimesinceD_CSR	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 2	L02	-0.7930	0.0508	0.0000
mpriordef_C*mtimesinceD_CSR	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 3	L03	-0.5445	0.0535	0.0000
mpriordef_C*mtimesinceD_CSR	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; else	L04	-0.1502	0.0311	0.0000
mpriordef_C*mtimesinceD_CSR	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 2; cx_time <= 1	L01	-1.3649	0.0773	0.0000
mpriordef_C*mtimesinceD_CSR	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 2; cx_time = 2	L02	-1.0290	0.0854	0.0000
mpriordef_C*mtimesinceD_CSR	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 2; cx_time = 3	L03	-0.9043	0.0982	0.0000
mpriordef_C*mtimesinceD_CSR	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 2; else	L04	-0.1654	0.0449	0.0002
mpriordef_C*mtimesinceD_CSR	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time <= 1	L01	-1.5754	0.0782	0.0000
mpriordef_C*mtimesinceD_CSR	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 2	L02	-1.4675	0.0981	0.0000
mpriordef_C*mtimesinceD_CSR	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 3	L03	-1.1407	0.1055	0.0000
mpriordef_C*mtimesinceD_CSR	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; else	L04	-0.1203	0.0486	0.0133
mpriordef_C*mtimesinceD_CSR	Z00	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	base level prior_default_cnt = 0; base level prior_default_cnt = 0	Z00			
vloanraw_CSR_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-0,64000-0)		0.0000	0.0000	0.0000
vloanraw_CSR_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-64000,157000-64000)		0.0000	0.0000	0.0000
vloanraw_CSR_pw3		Variate piecewise of loansize_raw	max(0,loansize_raw-157000)		0.0000	0.0000	0.0000

Current Transition Model Parameters – ARM C_CXS

The model parameters for the ARM current to self-cure transition are shown below.

Table 42: Current to Self-Cure Transition ARM Model Parameters

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept					-4.8942	0.0720	0.0000
mseason	1		Categorical of season	season = "winter"	0.3499	0.0126	0.0000
mseason	2		Categorical of season	season = "spring"	-0.0552	0.0137	0.0001
mseason	3		Categorical of season	season = "summer"	0.1288	0.0133	0.0000
mseason	4		Categorical of season	base level: else			
mrfnc_ind	2		Categorical of rfnc_ind (refinanced loan indicator)	frnc_ind = "Y"	-0.0893	0.0138	0.0000
mrfnc_ind	3		Categorical of rfnc_ind (refinanced loan indicator)	base level: else			
mdpa_rel	LRela		Categorical of dpa (down payment assistance)	dpa = "relative"	0.0604	0.0139	0.0000
mdpa_rel	Zothr		Categorical of dpa (down payment assistance)	base level: else			
mcalperiod	L200104		Categorical of Calendar Period	period < 200604	-1.5565	0.0186	0.0000
mcalperiod	L200604		Categorical of Calendar Period	period = 200604	0.9225	0.0272	0.0000
mcalperiod	L200701		Categorical of Calendar Period	period = 200701	0.7963	0.0255	0.0000
mcalperiod	L200702		Categorical of Calendar Period	period = 200702	0.2964	0.0329	0.0000
mcalperiod	L200703		Categorical of Calendar Period	period = 200703	0.2183	0.0311	0.0000
mcalperiod	Z201800		Categorical of Calendar Period	base level: else			
vpriordef_CCXS_pw1			Categorical of prior_default_cnt	median(0,prior_default_cnt-3,15-3)	0.1052	0.0025	0.0000
mperiodnbr_CCXS	L02		Categorical of period_number	period_number = 2	-0.1769	0.0436	0.0000
mperiodnbr_CCXS	L03		Categorical of period_number	period_number = 3	0.1098	0.0375	0.0034
mperiodnbr_CCXS	L04		Categorical of period_number	period_number = 4	0.1294	0.0364	0.0004
mperiodnbr_CCXS	L05		Categorical of period_number	period_number = 5	0.1090	0.0362	0.0026
mperiodnbr_CCXS	L06		Categorical of period_number	period_number = 6	0.1903	0.0343	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mperiodnbr_CCXS	L07		Categorical of period_number	period_number = 7	0.1242	0.0342	0.0003
mperiodnbr_CCXS	Z08		Categorical of period_number	base level: else			
vperiodnbr_CCXS_pw1			Variate piecewise of period_number	median(0,period_number-8,36-8)	-0.0113	0.0008	0.0000
vperiodnbr_CCXS_pw2			Variate piecewise of period_number	median(0,period_number-36,53-36)	-0.0090	0.0011	0.0000
vperiodnbr_CCXS_pw3			Variate piecewise of period_number	median(0,period_number-53,76-53)	-0.0103	0.0011	0.0000
vperiodnbr_CCXS_pw4			Variate piecewise of period_number	median(0,period_number-76,108-76)	-0.0120	0.0016	0.0000
vcredit_CCXS_pw5			Variate piecewise of credit_score	median(0,credit_score-630,680-630)	-0.0023	0.0005	0.0000
vcredit_CCXS_pw6			Variate piecewise of credit_score	median(0,credit_score-680,720-680)	-0.0084	0.0011	0.0000
vcredit_CCXS_pw7			Variate piecewise of credit_score	median(0,credit_score-720,745-720)	-0.0065	0.0024	0.0075
vcredit_CCXS_pw8			Variate piecewise of credit_score	median(0,credit_score-745,800-745)	-0.0095	0.0017	0.0000
mRatioTmpTei	L00		Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	0.2840	0.0448	0.0000
mRatioTmpTei	Z01		Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_CCXS_pw1			Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,19-0)	0.0165	0.0023	0.0000
vdeltaue_CCXS_pw6			Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-126,200-126)	-0.0016	0.0002	0.0000
vhpa2yb_CCXS_pw2			Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-100,104-100)	-0.0393	0.0029	0.0000
mpriordef_C*mtimesinceD_CCXS	L01	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time <= 1	2.2482	0.0206	0.0000
mpriordef_C*mtimesinceD_CCXS	L01	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 2	2.0435	0.0261	0.0000
mpriordef_C*mtimesinceD_CCXS	L01	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 3	1.8162	0.0326	0.0000
mpriordef_C*mtimesinceD_CCXS	L01	L04	Interaction of categorical of prior_default_cnt	prior_default_cnt = 1; cx_time = 4	1.7554	0.0371	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
			and categorical of cx_time[3]				
mpriordef_C*mtimesinceD_CCXS	L01	L05	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 5	1.3926	0.0485	0.0000
mpriordef_C*mtimesinceD_CCXS	L01	L06	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 6	1.3791	0.0522	0.0000
mpriordef_C*mtimesinceD_CCXS	L01	L07	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 7	1.1282	0.0624	0.0000
mpriordef_C*mtimesinceD_CCXS	L01	L08	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 8	1.1948	0.0642	0.0000
mpriordef_C*mtimesinceD_CCXS	L01	L09	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; cx_time = 9	1.0358	0.0739	0.0000
mpriordef_C*mtimesinceD_CCXS	L01	L10	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 1; else	0.6909	0.0276	0.0000
mpriordef_C*mtimesinceD_CCXS	L02	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time <= 1	2.6061	0.0220	0.0000
mpriordef_C*mtimesinceD_CCXS	L02	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 2	2.3578	0.0295	0.0000
mpriordef_C*mtimesinceD_CCXS	L02	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 3	2.1530	0.0376	0.0000
mpriordef_C*mtimesinceD_CCXS	L02	L04	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 4	2.0078	0.0458	0.0000
mpriordef_C*mtimesinceD_CCXS	L02	L05	Interaction of categorical of prior_default_cnt and categorical of cx_time[3]	prior_default_cnt = 2; cx_time = 5	1.6526	0.0607	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_C*mtimesinceD_CCXS	L02	L06	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt = 2; cx_time = 6	1.5966	0.0672	0.0000
mpriordef_C*mtimesinceD_CCXS	L02	L07	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt = 2; cx_time = 7	1.6170	0.0719	0.0000
mpriordef_C*mtimesinceD_CCXS	L02	L08	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt = 2; cx_time = 8	1.2803	0.0907	0.0000
mpriordef_C*mtimesinceD_CCXS	L02	L09	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt = 2; cx_time = 9	1.4579	0.0885	0.0000
mpriordef_C*mtimesinceD_CCXS	L02	L10	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt = 2; else	0.8940	0.0380	0.0000
mpriordef_C*mtimesinceD_CCXS	L03	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time <= 1	2.8491	0.0166	0.0000
mpriordef_C*mtimesinceD_CCXS	L03	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 2	2.5716	0.0197	0.0000
mpriordef_C*mtimesinceD_CCXS	L03	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 3	2.2903	0.0243	0.0000
mpriordef_C*mtimesinceD_CCXS	L03	L04	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 4	2.1584	0.0289	0.0000
mpriordef_C*mtimesinceD_CCXS	L03	L05	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 5	1.8037	0.0376	0.0000
mpriordef_C*mtimesinceD_CCXS	L03	L06	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 6	1.6822	0.0435	0.0000
mpriordef_C*mtimesinceD_CCXS	L03	L07	Interaction of categorical of prior_default_cnt	prior_default_cnt >= 3; cx_time = 7	1.5921	0.0494	0.0000

Variable	ClassVal0	ClassVal1	Description	Description Detail	Estimate	StdErr	ProbChiSq
			and categorical of cx_time3				
mpriordef_C*mtimesinceD_CCXS	L03	L08	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 8	1.4923	0.0559	0.0000
mpriordef_C*mtimesinceD_CCXS	L03	L09	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; cx_time = 9	1.3180	0.0657	0.0000
mpriordef_C*mtimesinceD_CCXS	L03	L10	Interaction of categorical of prior_default_cnt and categorical of cx_time3	prior_default_cnt >= 3; else	0.8798	0.0316	0.0000
mpriordef_C*mtimesinceD_CCXS	Z00	Z00	Interaction of categorical of prior_default_cnt and categorical of cx_time3	base level prior_default_cnt = 0; base level prior_default_cnt = 0			
vloanraw_CCXS_pw1			Variate piecewise of loansize_raw	median(0,loansize_raw-0,64000-0)	0.0000	0.0000	0.0000
vloanraw_CCXS_pw2			Variate piecewise of loansize_raw	median(0,loansize_raw-64000,157000-64000)	0.0000	0.0000	0.0000

Current Transition Model Parameters – ARM C_D

The model parameters for the ARM current to default transition are shown below.

Table 43: Current to Default Transition ARM Model Parameters

Variable	ClassVal 0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
Intercept					-4.3584	0.1650	0.0000
mseason	1	Categorical of season	season = "winter"		-0.1762	0.0058	0.0000
mseason	2	Categorical of season	season = "spring"		-0.3197	0.0060	0.0000
mseason	3	Categorical of season	season = "summer"		-0.1347	0.0058	0.0000
mseason	4	Categorical of season	base level: else				
mjudicial	1	Categorical of judicial state	judicial = 1 , judicial state		0.0259	0.0043	0.0000
mjudicial	2	Categorical of judicial state	base level: else, non-judicial state				
mdpa_govt	LGovt	Categorical of dpa (down payment assistance)	dpa = "govt"		0.1316	0.0227	0.0000
mdpa_govt	Zothr	Categorical of dpa (down payment assistance)	base level: else				

Variable	ClassVal 0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
mdpa_nprof	LNPro	Categorical of dpa (down payment assistance)	dpa= "nonprof"		0.2562	0.0108	0.0000
mdpa_nprof	Zothr	Categorical of dpa (down payment assistance)	base level: else				
mdpa_rel	LRela	Categorical of dpa (down payment assistance)	dpa = "relative"		0.0785	0.0068	0.0000
mdpa_rel	Zothr	Categorical of dpa (down payment assistance)	base level: else				
mycslope	L01	Categorical of Yield Curve Slope	1<=ycslope<=2		0.1582	0.0060	0.0000
mycslope	Z00	Categorical of Yield Curve Slope	base level: else				
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"		0.0401	0.0059	0.0000
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else				
mrfnc_ind	2	Categorical of rfnc_ind (refinanced loan indicator)	frnc_ind = "Y"		0.1175	0.0083	0.0000
mrfnc_ind	3	Categorical of rfnc_ind (refinanced loan indicator)	base level: else				
mcalperiod	L200104	Categorical of Calendar Period	period < 200604		-0.3895	0.0080	0.0000
mcalperiod	L200604	Categorical of Calendar Period	period = 200604		1.2562	0.0128	0.0000
mcalperiod	L200701	Categorical of Calendar Period	period = 200701		0.9032	0.0154	0.0000
mcalperiod	L200702	Categorical of Calendar Period	period = 200702		0.5876	0.0165	0.0000
mcalperiod	L200703	Categorical of Calendar Period	period = 200703		0.3333	0.0155	0.0000
mcalperiod	Z201800	Categorical of Calendar Period	base level: else				
mperiodnbr_CD	L02	Categorical of period_number	period_number = 2		-0.5041	0.0181	0.0000
mperiodnbr_CD	L03	Categorical of period_number	period_number = 3		-0.1160	0.0153	0.0000
mperiodnbr_CD	L04	Categorical of period_number	period_number = 4		0.0255	0.0144	0.0765
mperiodnbr_CD	L05	Categorical of period_number	period_number = 5		0.0818	0.0139	0.0000
mperiodnbr_CD	L06	Categorical of period_number	period_number = 6		0.1219	0.0136	0.0000
mperiodnbr_CD	L07	Categorical of period_number	period_number = 7		0.0986	0.0137	0.0000
mperiodnbr_CD	Z08	Categorical of period_number	base level: else				

Variable	ClassVal 0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
vperiodnbr_cd_pw2		Variate piecewise of period_number	median(0,period_number-40,53-40)		-0.0531	0.0014	0.0000
vperiodnbr_cd_pw3		Variate piecewise of period_number	median(0,period_number-53,68-53)		-0.0031	0.0009	0.0008
vperiodnbr_cd_pw*mdpa_nprof	Zothr	Interaction of variate piecewise of period_number and categorical of dpa	mdpa_nprof base level: else;				
vperiodnbr_cd_pw1*mdpa_nprof	LNPro	Interaction of variate piecewise of period_number and categorical of dpa	median(0,period_number-8,40-8); dpa= "nonprof"		-0.0107	0.0007	0.0000
vperiodnbr_cd_pw2*mdpa_nprof	LNPro	Interaction of variate piecewise of period_number and categorical of dpa	median(0,period_number-40,53-40); dpa= "nonprof"		0.0120	0.0022	0.0000
icredit_grp0_CD	L000	Categorical of credit_score	credit_score=0		-1.3137	0.1377	0.0000
icredit_grp0_CD	Z999	Categorical of credit_score	base level: else				
vcredit_cd_pw1		Variate piecewise of credit_score	0<credit_score<=450		-1.1833	0.2065	0.0000
vcredit_cd_pw2		Variate piecewise of credit_score	median(0,credit_score-450,500-450)		-0.0066	0.0028	0.0183
vcredit_cd_pw3		Variate piecewise of credit_score	median(0,credit_score-500,600-500)		-0.0050	0.0004	0.0000
vcredit_cd_pw4		Variate piecewise of credit_score	median(0,credit_score-600,630-600)		-0.0062	0.0008	0.0000
vcredit_cd_pw5		Variate piecewise of credit_score	median(0,credit_score-630,680-630)		-0.0114	0.0005	0.0000
vcredit_cd_pw6		Variate piecewise of credit_score	median(0,credit_score-680,720-680)		-0.0136	0.0007	0.0000
vcredit_cd_pw7		Variate piecewise of credit_score	median(0,credit_score-720,745-720)		-0.0052	0.0012	0.0000
vcredit_cd_pw8		Variate piecewise of credit_score	median(0,credit_score-745,800-745)		-0.0103	0.0010	0.0000
vcredit_cd_pw9		Variate piecewise of credit_score	max(0,credit_score-800)		0.0262	0.0070	0.0002
vdeltaue_cd_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-0,90-0)		0.0038	0.0002	0.0000
vdeltaue_cd_pw5		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-110,140-110)		0.0022	0.0003	0.0000
vdeltaue_cd_pw6		Variate piecewise of DeltaUEInit_r[1]	median(0,deltaUEinit_r-140,175-140)		-0.0008	0.0003	0.0051

Variable	ClassVal 0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
		(change in unemployment rate from policy inception to current)					
vdeltaue_cd_pw7		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	max(0,deltaUEinit_r-175)		0.0004	0.0001	0.0006
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0		0.3512	0.0162	0.0000
mRatioTmpTei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else				
vratiotmptei_cd_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,24-0)		0.0153	0.0007	0.0000
vratiotmptei_cd_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-24,36-24)		0.0089	0.0006	0.0000
vpriordef_cd_pw1		Variate piecewise of prior_default_cnt	median(0,prior_default_cnt-3,15-3)		0.0780	0.0015	0.0000
vperiodnbr_cd_pw1*mpriordef_ind	L01	Interaction of variate piecewise of period_number and categorical of prior default indicator	median(0,period_number-8,40-8); prior_default_cnt ne 0		-0.0052	0.0004	0.0000
vperiodnbr_cd_pw2*mpriordef_ind	L01	Interaction of variate piecewise of period_number and categorical of prior default indicator	median(0,period_number-40,53-40); prior_default_cnt ne 0		0.0501	0.0014	0.0000
vperiodnbr_cd_pw4*mpriordef_ind	L01	Interaction of variate piecewise of period_number and categorical of prior default indicator	median(0,period_number-68,108-68); prior_default_cnt ne 0		0.0063	0.0008	0.0000
vperiodnbr_cd_pw*mpriordef_ind	Z00	Interaction of variate piecewise of period_number and categorical of prior default indicator	mpriordef_ind base level: else				
mpriordef_ind*icredit_grp0_CD	L01	Interaction of categorical of prior default indicator and categorical of credit_score	prior_default_cnt ne 0; credit_score=0	L000	0.9085	0.0405	0.0000

Variable	ClassVal 0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
mpriordef_ind*icredit_grp0_CD	Z00	Interaction of categorical of prior default indicator and categorical of credit_score	base level: else; base level: else	Z999			
vcredit_cd_pw1*mpriordef_ind	L01	Interaction of variate piecewise of credit_score and categorical of prior default indicator	0<credit_score<=450; prior_default_cnt ne 0		0.9323	0.2012	0.0000
vcredit_cd_pw3*mpriordef_ind	L01	Interaction of variate piecewise of credit_score and categorical of prior default indicator	median(0,credit_score-500,600-500); prior_default_cnt ne 0		0.0041	0.0005	0.0000
vcredit_cd_pw4*mpriordef_ind	L01	Interaction of variate piecewise of credit_score and categorical of prior default indicator	median(0,credit_score-600,630-600); prior_default_cnt ne 0		0.0050	0.0010	0.0000
vcredit_cd_pw5*mpriordef_ind	L01	Interaction of variate piecewise of credit_score and categorical of prior default indicator	median(0,credit_score-630,680-630); prior_default_cnt ne 0		0.0078	0.0006	0.0000
vcredit_cd_pw6*mpriordef_ind	L01	Interaction of variate piecewise of credit_score and categorical of prior default indicator	median(0,credit_score-680,720-680); prior_default_cnt ne 0		0.0102	0.0008	0.0000
vcredit_cd_pw*mpriordef_ind	Z00	Interaction of variate piecewise of credit_score and categorical of prior default indicator	mpriordef_ind base level: else				
vsato_cd_pw1		Variate piecewise of sato (spread at origination)	min(0,sato-(-.1))		0.0452	0.0035	0.0000
vdeltaUEpr3_cd_pw1		Variate piecewise of deltauepr3_r[2] (change in unemployment from 3 quarters prior)	min(0, deltauepr3_r-(-20))		-0.0004	0.0001	0.0001
vdeltaUEpr3_cd_pw2		Variate piecewise of deltauepr3_r[2] (change in unemployment from 3 quarters prior)	median(deltauepr3_r-(-20),0,10-(-20))		0.0012	0.0002	0.0000

Variable	ClassVal 0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
vdeltaUEpr3_cd_pw3		Variate piecewise of deltauepr3_r[2] (change in unemployment from 3 quarters prior)	max(deltauepr3_r-10,0)		0.0006	0.0000	0.0000
vUEblend_cd_pw1		Variate piecewise of ue_blended_r[3] (change in unemployment rate)	median(0,ue_blended_r-0,420-0)		0.0002	0.0001	0.0058
vUEblend_cd_pw2		Variate piecewise of ue_blended_r[3] (change in unemployment rate)	median(0,ue_blended_r-420,820-420)		0.0004	0.0000	0.0000
vUEblend_cd_pw3		Variate piecewise of ue_blended_r[3] (change in unemployment rate)	max(0,ue_blended_r-820)		0.0001	0.0000	0.0104
vltv_cd_pw1		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-0,70-0)		0.0102	0.0005	0.0000
vltv_cd_pw2		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-70,80-70)		0.0053	0.0011	0.0000
vltv_cd_pw3		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-80,94-80)		0.0198	0.0007	0.0000
vhpa2yb_cd_pw1		Variate piecewise of hpa2y_blended_r[5]	median(0,hpa2y_blended_r-0,85-0)		0.0044	0.0009	0.0000
vhpa2yb_cd_pw2		Variate piecewise of hpa2y_blended_r[5]	median(0,hpa2y_blended_r-85,95-85)		-0.0097	0.0010	0.0000
vhpa2yb_cd_pw3		Variate piecewise of hpa2y_blended_r[5]	median(0,hpa2y_blended_r-95,113-95)		-0.0173	0.0005	0.0000
vhpa2yb_cd_pw5		Variate piecewise of hpa2y_blended_r[5]	max(0,hpa2y_blended_r-120)		-0.0087	0.0005	0.0000
mpriordef_C*mtimesinceD_CD	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time <= 1	L01	1.6054	0.0410	0.0000
mpriordef_C*mtimesinceD_CD	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 2	L02	1.4241	0.0415	0.0000
mpriordef_C*mtimesinceD_CD	L01	Interaction of categorical of	prior_default_cnt = 1; cx_time = 3	L03	1.2129	0.0423	0.0000

Variable	ClassVal 0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
		prior_default_cnt and categorical of cx_time[6]					
mpriordef_C*mtimesinceD_CD	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 4	L04	0.8750	0.0436	0.0000
mpriordef_C*mtimesinceD_CD	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 5	L05	0.7158	0.0448	0.0000
mpriordef_C*mtimesinceD_CD	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 6	L06	0.5500	0.0462	0.0000
mpriordef_C*mtimesinceD_CD	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 7	L07	0.4930	0.0473	0.0000
mpriordef_C*mtimesinceD_CD	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 8	L08	0.3323	0.0493	0.0000
mpriordef_C*mtimesinceD_CD	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 9	L09	0.2436	0.0510	0.0000
mpriordef_C*mtimesinceD_CD	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 10	L10	0.2100	0.0524	0.0001
mpriordef_C*mtimesinceD_CD	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 11	L11	0.1610	0.0540	0.0028
mpriordef_C*mtimesinceD_CD	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time >= 12	L12	0.0393	0.0450	0.3830
mpriordef_C*mtimesinceD_CD	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 2; cx_time <= 1	L01	2.0249	0.0415	0.0000
mpriordef_C*mtimesinceD_CD	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 2; cx_time = 2	L02	1.7674	0.0424	0.0000

Variable	ClassVal 0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
mpriordef_C*mtimesinceD_CD	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time6	prior_default_cnt = 2; cx_time = 3	L03	1.5726	0.0435	0.0000
mpriordef_C*mtimesinceD_CD	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time6	prior_default_cnt = 2; cx_time = 4	L04	1.2148	0.0455	0.0000
mpriordef_C*mtimesinceD_CD	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time6	prior_default_cnt = 2; cx_time = 5	L05	1.0414	0.0475	0.0000
mpriordef_C*mtimesinceD_CD	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time6	prior_default_cnt = 2; cx_time = 6	L06	0.8577	0.0498	0.0000
mpriordef_C*mtimesinceD_CD	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time6	prior_default_cnt = 2; cx_time = 7	L07	0.7682	0.0521	0.0000
mpriordef_C*mtimesinceD_CD	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time6	prior_default_cnt = 2; cx_time = 8	L08	0.6339	0.0553	0.0000
mpriordef_C*mtimesinceD_CD	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time6	prior_default_cnt = 2; cx_time = 9	L09	0.5047	0.0585	0.0000
mpriordef_C*mtimesinceD_CD	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time6	prior_default_cnt = 2; cx_time = 10	L10	0.5100	0.0604	0.0000
mpriordef_C*mtimesinceD_CD	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time6	prior_default_cnt = 2; cx_time = 11	L11	0.3196	0.0658	0.0000
mpriordef_C*mtimesinceD_CD	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time6	prior_default_cnt = 2; cx_time >= 12	L12	0.1852	0.0474	0.0001
mpriordef_C*mtimesinceD_CD	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time6	prior_default_cnt >= 3; cx_time <= 1	L01	2.3230	0.0412	0.0000
mpriordef_C*mtimesinceD_CD	L03	Interaction of categorical of prior_default_cnt	prior_default_cnt >= 3; cx_time = 2	L02	2.0383	0.0415	0.0000

Variable	ClassVal 0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
		and categorical of cx_time[6]					
mpriordef_C*mtimesinceD_CD	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 3	L03	1.8057	0.0420	0.0000
mpriordef_C*mtimesinceD_CD	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 4	L04	1.4728	0.0429	0.0000
mpriordef_C*mtimesinceD_CD	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 5	L05	1.2401	0.0440	0.0000
mpriordef_C*mtimesinceD_CD	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 6	L06	1.0766	0.0452	0.0000
mpriordef_C*mtimesinceD_CD	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 7	L07	0.9188	0.0468	0.0000
mpriordef_C*mtimesinceD_CD	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 8	L08	0.7288	0.0490	0.0000
mpriordef_C*mtimesinceD_CD	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 9	L09	0.5405	0.0518	0.0000
mpriordef_C*mtimesinceD_CD	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 10	L10	0.4878	0.0536	0.0000
mpriordef_C*mtimesinceD_CD	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 11	L11	0.4769	0.0553	0.0000
mpriordef_C*mtimesinceD_CD	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time >= 12	L12	0.1710	0.0460	0.0002
mpriordef_C*mtimesinceD_CD	Z00	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	base level prior_default_cnt = 0; base level prior_default_cnt = 0	Z00			

Variable	ClassVal 0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
vtimesinced_cd_pw1		Variate piecwise of cx_time[6]	median(0,cx_time-12,24-12)		-0.0433	0.0026	0.0000
vtimesinced_cd_pw2		Variate piecwise of cx_time[6]	median(0,cx_time-24,40-24)		-0.0154	0.0038	0.0001
vtimesinced_cd_pw3		Variate piecwise of cx_time[6]	median(0,cx_time-40,41-40)		-0.2313	0.0726	0.0014

Current Transition Model Parameters – ARM C_PRE

The model parameters for the ARM current to prepayment transition are shown below.

Table 44: Current to Prepayment Transition ARM Model Parameters

Variable	ClassVal0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
Intercept					-1.8035	0.1162	0.0000
mseason	1	Categorical of season	season = "winter"		-0.1400	0.0059	0.0000
mseason	2	Categorical of season	season = "spring"		0.0709	0.0056	0.0000
mseason	3	Categorical of season	season = "summer"		0.1127	0.0057	0.0000
mseason	4	Categorical of season	base level: else				
mjudicial	1	Categorical of judicial state	judicial = 1 , judicial state		-0.0725	0.0043	0.0000
mjudicial	2	Categorical of judicial state	base level: else, non-judicial state				
mdpa_govt	LGovt	Categorical of dpa (down payment assistance)	dpa = "govt"		-0.4047	0.0332	0.0000
mdpa_govt	Zothr	Categorical of dpa (down payment assistance)	base level: else				
mdpa_nprof	LNPro	Categorical of dpa (down payment assistance)	dpa= "nonprof"		-0.3149	0.0107	0.0000
mdpa_nprof	Zothr	Categorical of dpa (down payment assistance)	base level: else				
mycslope	L01	Categorical of Yield Curve Slope	1<=ycslope<=2		0.1263	0.0049	0.0000
mycslope	Z00	Categorical of Yield Curve Slope	base level: else				
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"		-0.0444	0.0051	0.0000
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else				
mrfnc_ind	2	Categorical of rfnc_ind (refinanced loan indicator)	frnc_ind = "Y"		-0.1494	0.0075	0.0000
mrfnc_ind	3	Categorical of rfnc_ind (refinanced loan indicator)	base level: else				

Variable	ClassVal0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
mcalperiod	L200104	Categorical of Calendar Period	period < 200604		1.0262	0.0082	0.0000
mcalperiod	L200604	Categorical of Calendar Period	period = 200604		1.1348	0.0149	0.0000
mcalperiod	L200701	Categorical of Calendar Period	period = 200701		1.1993	0.0164	0.0000
mcalperiod	L200702	Categorical of Calendar Period	period = 200702		1.2347	0.0161	0.0000
mcalperiod	L200703	Categorical of Calendar Period	period = 200703		0.8915	0.0177	0.0000
mcalperiod	Z201800	Categorical of Calendar Period	base level: else				
mperiodnbr_CPRE	L02	Categorical of period_number	period_number = 2		-1.8527	0.0229	0.0000
mperiodnbr_CPRE	L03	Categorical of period_number	period_number = 3		-1.0429	0.0157	0.0000
mperiodnbr_CPRE	L04	Categorical of period_number	period_number = 4		-0.6508	0.0132	0.0000
mperiodnbr_CPRE	L05	Categorical of period_number	period_number = 5		-0.3187	0.0116	0.0000
mperiodnbr_CPRE	L06	Categorical of period_number	period_number = 6		-0.2271	0.0113	0.0000
mperiodnbr_CPRE	L07	Categorical of period_number	period_number = 7		-0.2493	0.0115	0.0000
mperiodnbr_CPRE	Z08	Categorical of period_number	base level: else				
vperiodnbr_CPRE_pw1		Variate piecewise of period_number	median(0,period_number-8,40-8)		-0.0083	0.0003	0.0000
vperiodnbr_CPRE_pw2		Variate piecewise of period_number	median(0,period_number-40,53-40)		-0.0326	0.0012	0.0000
vperiodnbr_CPRE_pw3		Variate piecewise of period_number	median(0,period_number-53,68-53)		0.0187	0.0018	0.0000
vperiodnbr_CPRE_pw4		Variate piecewise of period_number	median(0,period_number-68,108-68)		-0.0095	0.0013	0.0000
mperiodnbr_CPRE*mdpa_nprof	L02	Interaction of Categorical of period_number and Categorical of dpa	period_number = 2; dpa= "nonprof"	LNPro	-0.6772	0.1062	0.0000
mperiodnbr_CPRE*mdpa_nprof	L03	Interaction of Categorical of period_number and Categorical of dpa	period_number = 3; dpa= "nonprof"	LNPro	-0.8418	0.0740	0.0000
mperiodnbr_CPRE*mdpa_nprof	L04	Interaction of Categorical of period_number and Categorical of dpa	period_number = 4; dpa= "nonprof"	LNPro	-0.5127	0.0527	0.0000
mperiodnbr_CPRE*mdpa_nprof	L05	Interaction of Categorical of period_number and Categorical of dpa	period_number = 5; dpa= "nonprof"	LNPro	-0.3540	0.0421	0.0000
mperiodnbr_CPRE*mdpa_nprof	L06	Interaction of Categorical of period_number and Categorical of dpa	period_number = 6; dpa= "nonprof"	LNPro	-0.1705	0.0380	0.0000
mperiodnbr_CPRE*mdpa_nprof	L07	Interaction of Categorical of period_number and Categorical of dpa	period_number = 7; dpa= "nonprof"	LNPro	-0.1271	0.0387	0.0010

Variable	ClassVal0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
mperiodnbr_CPRE*mdpa_nprof	Z08	Interaction of Categorical of period_number and Categorical of dpa	base level: else; base level: else	Zothr			
vcredit_CPRE_pw1		Variate piecewise of credit_score	0<credit_score<=450		-0.4255	0.1534	0.0055
vcredit_CPRE_pw2		Variate piecewise of credit_score	median(0,credit_score-450,500-450)		-0.0116	0.0008	0.0000
vcredit_CPRE_pw3		Variate piecewise of credit_score	median(0,credit_score-500,600-500)		0.0031	0.0005	0.0000
vcredit_CPRE_pw5		Variate piecewise of credit_score	median(0,credit_score-630,680-630)		0.0054	0.0003	0.0000
vcredit_CPRE_pw6		Variate piecewise of credit_score	median(0,credit_score-680,720-680)		0.0036	0.0004	0.0000
vcredit_CPRE_pw8		Variate piecewise of credit_score	median(0,credit_score-745,800-745)		0.0037	0.0004	0.0000
vdeltaue_CPRE_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-0,90-0)		-0.0033	0.0002	0.0000
vdeltaue_CPRE_pw2		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-90,97-90)		-0.0041	0.0015	0.0050
vdeltaue_CPRE_pw3		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-97,100-97)		-0.0210	0.0032	0.0000
vdeltaue_CPRE_pw7		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	max(0,deltaUEinit_r-175)		-0.0005	0.0002	0.0029
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0		-0.1694	0.0137	0.0000
mRatioTmpTei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else				
vratiotmptei_CPRE_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,24-0)		-0.0064	0.0006	0.0000
vratiotmptei_CPRE_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-24,36-24)		-0.0116	0.0006	0.0000
vpriordef_CPRE_pw1		Variate piecewise of prior_default_cnt	median(0,prior_default_cnt-3,15-3)		-0.0393	0.0050	0.0000
vperiodnbr_CPRE_pw1*mpriordef_ind	L01	Interaction of variate piecewise of period_number and categorical of prior default indicator	median(0,period_number-8,40-8); prior_default_cnt ne 0		0.0130	0.0007	0.0000

Variable	ClassVal0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
vperiodnbr_CPRE_pw2*mpriordef_ind	L01	Interaction of variate piecewise of period_number and categorical of prior default indicator	median(0,period_number-40,53-40); prior_default_cnt ne 0		0.0261	0.0020	0.0000
vperiodnbr_CPRE_pw3*mpriordef_ind	L01	Interaction of variate piecewise of period_number and categorical of prior default indicator	median(0,period_number-53,68-53); prior_default_cnt ne 0		-0.0316	0.0028	0.0000
vperiodnbr_CPRE_pw4*mpriordef_ind	L01	Interaction of variate piecewise of period_number and categorical of prior default indicator	median(0,period_number-68,108-68); prior_default_cnt ne 0		0.0058	0.0019	0.0017
vperiodnbr_CPRE_pw*mpriordef_ind	Z00	Interaction of variate piecewise of period_number and categorical of prior default indicator	mpriordef_ind base level: else				
vsato_CPre_pw1		Variate piecewise of sato (spread at origination)	min(0,sato-(-.1))		0.0721	0.0034	0.0000
vsato_CPre_pw2		Variate piecewise of sato (spread at origination)	median(sato-(-.1),0,.7-(-.1))		0.1136	0.0299	0.0001
vdeltaUEpr3_cpre_pw1		Variate piecewise of deltauepr3_r[2] (change in unemployment from 3 quarters prior)	min(0,deltauepr3_r-(-20))		0.0011	0.0001	0.0000
vdeltaUEpr3_cpre_pw2		Variate piecewise of deltauepr3_r[2] (change in unemployment from 3 quarters prior)	median(deltauepr3_r-(-20),0,10-(-20))		0.0049	0.0002	0.0000
vdeltaUEpr3_cpre_pw3		Variate piecewise of deltauepr3_r[2] (change in unemployment from 3 quarters prior)	max(deltauepr3_r-10,0)		0.0003	0.0001	0.0001
vUEblend_CPRE_pw1		Variate piecewise of ue_blended_r[3] (change in unemployment rate)	median(0,ue_blended_r-0,420-0)		-0.0023	0.0001	0.0000
vUEblend_CPRE_pw2		Variate piecewise of ue_blended_r[3] (change in unemployment rate)	median(0,ue_blended_r-420,820-420)		-0.0007	0.0000	0.0000
vUEblend_CPRE_pw3		Variate piecewise of ue_blended_r[3] (change in unemployment rate)	max(0,ue_blended_r-820)		-0.0015	0.0000	0.0000
vltv_CPRE_pw1		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-0,70-0)		-0.0060	0.0004	0.0000

Variable	ClassVal0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
vltv_CPRE_pw2		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-70,80-70)		0.0143	0.0011	0.0000
vltv_CPRE_pw3		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-80,94-80)		-0.0234	0.0007	0.0000
vltv_CPRE_pw4		Variate piecewise of ltv_i_r[4] (loan-to-value)	max(0,ltv_i_r-94)		-0.1436	0.0041	0.0000
vhpa2yb_CPRE_pw1		Variate piecewise of hpa2y_blended_r[5]	median(0,hpa2y_blended_r-0,85-0)		-0.0082	0.0013	0.0000
vhpa2yb_CPRE_pw2		Variate piecewise of hpa2y_blended_r[5]	median(0,hpa2y_blended_r-85,95-85)		-0.0251	0.0017	0.0000
vhpa2yb_CPRE_pw3		Variate piecewise of hpa2y_blended_r[5]	median(0,hpa2y_blended_r-95,113-95)		0.0172	0.0006	0.0000
vhpa2yb_CPRE_pw4		Variate piecewise of hpa2y_blended_r[5]	median(0,hpa2y_blended_r-113,120-113)		0.0263	0.0010	0.0000
vhpa2yb_CPRE_pw5		Variate piecewise of hpa2y_blended_r[5]	max(0,hpa2y_blended_r-120)		0.0131	0.0003	0.0000
mpriordef_C*mtimesinceD_CPRE	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time <= 1	L01	-0.7264	0.0232	0.0000
mpriordef_C*mtimesinceD_CPRE	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 2	L02	-0.7683	0.0269	0.0000
mpriordef_C*mtimesinceD_CPRE	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 3	L03	-0.7053	0.0293	0.0000
mpriordef_C*mtimesinceD_CPRE	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 4	L04	-0.5685	0.0301	0.0000
mpriordef_C*mtimesinceD_CPRE	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time = 5	L05	-0.4933	0.0311	0.0000
mpriordef_C*mtimesinceD_CPRE	L01	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 1; cx_time >= 6	L06	-0.4313	0.0180	0.0000
mpriordef_C*mtimesinceD_CPRE	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 2; cx_time <= 1	L01	-0.8584	0.0315	0.0000
mpriordef_C*mtimesinceD_CPRE	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 2; cx_time = 2	L02	-0.9055	0.0379	0.0000
mpriordef_C*mtimesinceD_CPRE	L02	Interaction of categorical of	prior_default_cnt = 2; cx_time = 3	L03	-0.7954	0.0413	0.0000

Variable	ClassVal0	Description	Description Detail	ClassVal1	Estimate	StdErr	ProbChiSq
		prior_default_cnt and categorical of cx_time[6]					
mpriordef_C*mtimesinceD_CPRE	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 2; cx_time = 4	L04	-0.5968	0.0421	0.0000
mpriordef_C*mtimesinceD_CPRE	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 2; cx_time = 5	L05	-0.5988	0.0460	0.0000
mpriordef_C*mtimesinceD_CPRE	L02	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt = 2; cx_time >= 6	L06	-0.5222	0.0226	0.0000
mpriordef_C*mtimesinceD_CPRE	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time <= 1	L01	-1.1770	0.0311	0.0000
mpriordef_C*mtimesinceD_CPRE	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 2	L02	-1.1153	0.0359	0.0000
mpriordef_C*mtimesinceD_CPRE	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 3	L03	-1.0195	0.0402	0.0000
mpriordef_C*mtimesinceD_CPRE	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 4	L04	-0.8139	0.0417	0.0000
mpriordef_C*mtimesinceD_CPRE	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time = 5	L05	-0.6778	0.0435	0.0000
mpriordef_C*mtimesinceD_CPRE	L03	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	prior_default_cnt >= 3; cx_time >= 6	L06	-0.6184	0.0242	0.0000
mpriordef_C*mtimesinceD_CPRE	Z00	Interaction of categorical of prior_default_cnt and categorical of cx_time[6]	base level prior_default_cnt = 0; base level prior_default_cnt = 0	Z00			
vloanraw_CPRE_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-0,64000-0)		0.0000	0.0000	0.0000
vloanraw_CPRE_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-64000,157000-64000)		0.0000	0.0000	0.0000
vloanraw_CPRE_pw3		Variate piecewise of loansize_raw	max(0,loansize_raw-157000)		0.0000	0.0000	0.0000

Default Transition Model Parameters – FRM30NSR D_CLM

The model parameters for the FRM30NSR default to claim transition are shown below.

Table 45: Default to Claim Transition FRM30NSR Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-6.0129	0.0425	0.0000
mrfnc_ind	2	Categorical of rfnc_ind (refinanced loan indicator)	rfnc_ind <> "N"	0.2010	0.0045	0.0000
mrfnc_ind	3	Categorical of rfnc_ind (refinanced loan indicator)	base level: else			
mseason	1	Categorical of season	season = "winter"	-0.0190	0.0031	0.0000
mseason	2	Categorical of season	season = "spring"	0.0092	0.0031	0.0031
mseason	3	Categorical of season	season = "summer"	0.0527	0.0031	0.0000
mseason	4	Categorical of season	base level: else			
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1	-0.1644	0.0023	0.0000
mjudicial	2	Categorical of judicial (judicial state)	base level: else			
mdpa	1	Categorical of dpa (down payment assistance)	dpa = "govt"	0.1284	0.0071	0.0000
mdpa	2	Categorical of dpa (down payment assistance)	dpa= "nonprof"	0.4250	0.0035	0.0000
mdpa	3	Categorical of dpa (down payment assistance)	dpa = "relative"	-0.0577	0.0035	0.0000
mdpa	4	Categorical of dpa (down payment assistance)	base level: else			
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	-0.1270	0.0031	0.0000
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else			
mhpa2yb_DCLM	L085	Categorical of hpa2y_blended_r[1]	hpa2y_blended_r <= 85	0.0612	0.0097	0.0000
mhpa2yb_DCLM	Z000	Categorical of hpa2y_blended_r[1]	base level: else			
vhpa2yb_DCLM_pw1		Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-85,98-85)	-0.0094	0.0007	0.0000
vhpa2yb_DCLM_pw2		Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-98,108-98)	0.0394	0.0005	0.0000
vhpa2yb_DCLM_pw3		Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-108,117-108)	-0.0017	0.0004	0.0001

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vhpa2yb_DCLM_pw4		Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-117,180-117)	-0.0094	0.0003	0.0000
mperiodnbr_DCLM	L02	Categorical of period number (quarters since origination)	period_number <= 2	-2.2602	0.1494	0.0000
mperiodnbr_DCLM	L03	Categorical of period number (quarters since origination)	period_number = 3	-1.2833	0.0436	0.0000
mperiodnbr_DCLM	L04	Categorical of period number (quarters since origination)	period_number = 4	-0.4682	0.0201	0.0000
mperiodnbr_DCLM	Z05	Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_DCLM_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-5,9-5)	0.0568	0.0022	0.0000
vperiodnbr_DCLM_pw2		Variate piecewise of period number (quarters since origination)	median(0,period_number-9,17-9)	0.0102	0.0007	0.0000
vperiodnbr_DCLM_pw3		Variate piecewise of period number (quarters since origination)	median(0,period_number-17,30-17)	0.0047	0.0004	0.0000
vperiodnbr_DCLM_pw4		Variate piecewise of period number (quarters since origination)	median(0,period_number-30,57-30)	-0.0089	0.0003	0.0000
vperiodnbr_DCLM_pw5		Variate piecewise of period number (quarters since origination)	median(0,period_number-57,86-57)	-0.0029	0.0007	0.0000
vperiodnbr_DCLM_pw6		Variate piecewise of period number (quarters since origination)	median(0,period_number-86,110-86)	-0.0108	0.0032	0.0007
mcredit_DCLM	L01	Categorical of credit_score	credit_score = 0	0.1048	0.0063	0.0000
mcredit_DCLM	L02	Categorical of credit_score	credit_score<525	-0.0605	0.0105	0.0000
mcredit_DCLM	Z00	Categorical of credit_score	base level: else			
vcredit_DCLM_pw1		Variate piecewise of credit_score	median(0,credit_score-525,635-525)	0.0002	0.0001	0.0081
vcredit_DCLM_pw2		Variate piecewise of credit_score	median(0,credit_score-635,780-635)	0.0044	0.0001	0.0000
mdurdefepi_DCLM	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	1.0438	0.0055	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdurdefepi_DCLM	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	1.6522	0.0053	0.0000
mdurdefepi_DCLM	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	1.9415	0.0054	0.0000
mdurdefepi_DCLM	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	2.0534	0.0056	0.0000
mdurdefepi_DCLM	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	2.0859	0.0059	0.0000
mdurdefepi_DCLM	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	2.0758	0.0062	0.0000
mdurdefepi_DCLM	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	2.0543	0.0066	0.0000
mdurdefepi_DCLM	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 9	2.0363	0.0070	0.0000
mdurdefepi_DCLM	L10	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 10	2.0276	0.0074	0.0000
mdurdefepi_DCLM	L11	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 11	2.0102	0.0061	0.0000
mdurdefepi_DCLM	Z01	Categorical of dur_def_episode (duration of default episode)	base level: else			
vdurdefepi_DCLM_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-10,30-10)	-0.0081	0.0005	0.0000
vdurdefepi_DCLM_pw2		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-30,40-30)	-0.0605	0.0024	0.0000
vdeltaue_DCLM_pw1		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-0,63-0)	-0.0019	0.0004	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaue_DCLM_pw2		Variate piecewise of DeltaUEInit_r^2 (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-63,100-63)	0.0021	0.0001	0.0000
vdeltaue_DCLM_pw3		Variate piecewise of DeltaUEInit_r^2 (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-100,116-100)	0.0014	0.0003	0.0000
vdeltaue_DCLM_pw4		Variate piecewise of DeltaUEInit_r^2 (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-116,218-116)	0.0018	0.0001	0.0000
vdeltaue_DCLM_pw5		Variate piecewise of DeltaUEInit_r^2 (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-218,330-218)	0.0029	0.0001	0.0000
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	0.3859	0.0102	0.0000
mRatioTmpTei	Z00	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_DCLM_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,24-0)	0.0067	0.0004	0.0000
vratiotmptei_DCLM_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-24,36-24)	0.0037	0.0003	0.0000
vratiotmptei_DCLM_pw3		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-36,50-36)	-0.0088	0.0007	0.0000
mpriordef_DCLM	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	-0.2437	0.0030	0.0000
mpriordef_DCLM	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	-0.4081	0.0040	0.0000
mpriordef_DCLM	L03	Categorical of prior_default_cnt	prior_default_cnt = 3	-0.5349	0.0052	0.0000
mpriordef_DCLM	L04	Categorical of prior_default_cnt	prior_default_cnt = 4	-0.6451	0.0065	0.0000
mpriordef_DCLM	L05	Categorical of prior_default_cnt	prior_default_cnt = 5	-0.7559	0.0083	0.0000
mpriordef_DCLM	L06	Categorical of prior_default_cnt	prior_default_cnt = 6	-0.8643	0.0106	0.0000
mpriordef_DCLM	L07	Categorical of prior_default_cnt	prior_default_cnt = 7	-0.9700	0.0138	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_DCLM	L08	Categorical of prior_default_cnt	prior_default_cnt = 8	-1.0537	0.0180	0.0000
mpriordef_DCLM	L09	Categorical of prior_default_cnt	prior_default_cnt = 9	-1.1452	0.0240	0.0000
mpriordef_DCLM	L10	Categorical of prior_default_cnt	prior_default_cnt = 10	-1.1808	0.0313	0.0000
mpriordef_DCLM	L11	Categorical of prior_default_cnt	prior_default_cnt = 11	-1.3093	0.0432	0.0000
mpriordef_DCLM	L12	Categorical of prior_default_cnt	prior_default_cnt >= 12	-1.5651	0.0432	0.0000
mpriordef_DCLM	Z00	Categorical of prior_default_cnt	base level: else			
vsato_DCLM_pw1		Variate piecewise of sato (spread at origination)	min(0,sato-(-.1))	0.0667	0.0038	0.0000
vsato_DCLM_pw3		Variate piecewise of sato (spread at origination)	max(sato-.7,0)	-0.0887	0.0061	0.0000
vdeltaUEpr3_DCLM_pw1		Variate piecewise of deltauepr3_r[3] (change in unemployment from 3 quarters prior)	min(0,deltauepr3_r-(-20))	0.0004	0.0001	0.0000
vdeltaUEpr3_DCLM_pw2		Variate piecewise of deltauepr3_r[3] (change in unemployment from 3 quarters prior)	median(deltauepr3_r-(-20),0,10-(-20))	-0.0035	0.0001	0.0000
vdeltaUEpr3_DCLM_pw3		Variate piecewise of deltauepr3_r[3] (change in unemployment from 3 quarters prior)	max(deltauepr3_r-10,0)	0.0001	0.0000	0.0001
vltv_DCLM_pw1		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-0,70-0)	0.0071	0.0005	0.0000
vltv_DCLM_pw2		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-70,81-70)	0.0262	0.0007	0.0000
vltv_DCLM_pw3		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-81,91-81)	0.0115	0.0005	0.0000
vltv_DCLM_pw4		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-91,94-91)	0.0572	0.0016	0.0000
vltv_DCLM_pw5		Variate piecewise of ltv_i_r[4] (loan-to-value)	max(0,ltv_i_r-94)	0.1187	0.0021	0.0000
vloanraw_DCLM_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-27000,68000-27000)	0.0000	0.0000	0.0000
vloanraw_DCLM_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-68000,120000-68000)	0.0000	0.0000	0.0000
vloanraw_DCLM_pw3		Variate piecewise of loansize_raw	median(0,loansize_raw-120000,200000-120000)	0.0000	0.0000	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vloanraw_DCLM_pw4		Variate piecewise of loansize_raw	median(0,loansize_raw-200000,500000-200000)	0.0000	0.0000	0.0000
mDeltaTY10_DCLM	L01	Categorical of DeltaTy10Init_r[5] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	0.0837	0.0035	0.0000
mDeltaTY10_DCLM	L02	Categorical of DeltaTy10Init_r[5] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r > 130	-0.5697	0.0092	0.0000
mDeltaTY10_DCLM	Z00	Categorical of DeltaTy10Init_r[5] (change in 10-year Treasury rate from policy inception to current)	base level: else			
mDeltaTm3_DCLM	L01	Categorical of DeltaTm3Init_r[6] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r > 600	-0.3992	0.0063	0.0000
mDeltaTm3_DCLM	Z00	Categorical of DeltaTm3Init_r[6] (change in 3-month Treasury rate from policy inception to current)	base level: else			
mprior3_ue_DCLM	L01	Categorical of prior3_ue_r[7] (change in prior-3 unemployment rate)	prior3_ue_r<1400	-0.3946	0.0164	0.0000
mprior3_ue_DCLM	Z00	Categorical of prior3_ue_r[7] (change in prior-3 unemployment rate)	base level: else			
vUEblend_DCLM_pw1		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-200,450-200)	0.0013	0.0000	0.0000
vUEblend_DCLM_pw2		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-450,850-450)	-0.0007	0.0000	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vUEblend_DCLM_pw3		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-850,1500-850)	0.0001	0.0000	0.0001

Default Transition Model Parameters – FRM30NSR D_CXM

The model parameters for the FRM30NSR default to modified cure transition are shown below.

Table 46: Default to Modified Cure Transition FRM30NSR Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-7.0373	0.0493	0.0000
mperiod_DCXM	0	Categorical of period (calendar period)	period < 200604	-6.5605	0.0545	0.0000
mperiod_DCXM	1	Categorical of period (calendar period)	base level: else			
mseason	1	Categorical of season	season = "winter"	-0.0678	0.0034	0.0000
mseason	2	Categorical of season	season = "spring"	0.0851	0.0033	0.0000
mseason	3	Categorical of season	season = "summer"	0.0848	0.0034	0.0000
mseason	4	Categorical of season	base level: else			
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1	-0.0563	0.0024	0.0000
mjudicial	2	Categorical of judicial (judicial state)	base level: else			
mdpa_govt	LGovt	Categorical of dpa (down payment assistance)	dpa = "govt"	-0.0708	0.0073	0.0000
mdpa_govt	ZOthr	Categorical of dpa (down payment assistance)	base level: else			
mdpa_rel	LRela	Categorical of dpa (down payment assistance)	dpa = "relative"	-0.0526	0.0033	0.0000
mdpa_rel	ZOthr	Categorical of dpa (down payment assistance)	base level: else			
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	0.0673	0.0029	0.0000
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else			

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mycslope_DCXM	L01	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r<=300	-0.0666	0.0041	0.0000
mycslope_DCXM	L02	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=900	-0.1873	0.0043	0.0000
mycslope_DCXM	L03	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=1500	-0.1387	0.0044	0.0000
mycslope_DCXM	Z00	Categorical of ycslope_r[1] (yield curve slope)	base level: else			
mhpa2yb_DCXM	L085	Categorical of hpa2y_blended_r[2]	hpa2y_blended_r <= 85	-0.0413	0.0066	0.0000
mhpa2yb_DCXM	Z000	Categorical of hpa2y_blended_r[2]	base level: else			
vhpa2yb_DCXM_pw2		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-106,111-106)	-0.0198	0.0009	0.0000
vhpa2yb_DCXM_pw3		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-111,121-111)	0.0091	0.0006	0.0000
vhpa2yb_DCXM_pw4		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-121,180-121)	-0.0032	0.0007	0.0000
mperiodnbr_DCXM	L02	Categorical of period number (quarters since origination)	period_number <= 2	-1.7175	0.1168	0.0000
mperiodnbr_DCXM	L03	Categorical of period number (quarters since origination)	period_number = 3	-0.5552	0.0338	0.0000
mperiodnbr_DCXM	Z04	Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_DCXM_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-4,9-4)	0.2183	0.0023	0.0000
vperiodnbr_DCXM_pw2		Variate piecewise of period number (quarters since origination)	median(0,period_number-9,15-9)	-0.0384	0.0010	0.0000
vperiodnbr_DCXM_pw3		Variate piecewise of period number (quarters since origination)	median(0,period_number-15,25-15)	0.0018	0.0005	0.0005
vperiodnbr_DCXM_pw4		Variate piecewise of period number (quarters since origination)	median(0,period_number-25,59-25)	-0.0075	0.0002	0.0000
vperiodnbr_DCXM_pw5		Variate piecewise of period number (quarters since origination)	median(0,period_number-59,90-59)	-0.0042	0.0006	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mcredit_DCXM	L01	Categorical of credit_score	credit_score = 0	-0.0223	0.0051	0.0000
mcredit_DCXM	Z00	Categorical of credit_score	base level: else			
vcredit_DCXM_pw1		Variate piecewise of credit_score	median(0,credit_score-530,640-530);	-0.0026	0.0001	0.0000
vcredit_DCXM_pw2		Variate piecewise of credit_score	median(0,credit_score-640,680-640)	-0.0025	0.0001	0.0000
vcredit_DCXM_pw3		Variate piecewise of credit_score	median(0,credit_score-680,780-680)	-0.0022	0.0001	0.0000
mdurdefepi_DCXM	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	0.7026	0.0038	0.0000
mdurdefepi_DCXM	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	0.9283	0.0040	0.0000
mdurdefepi_DCXM	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	0.9815	0.0043	0.0000
mdurdefepi_DCXM	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	0.9338	0.0048	0.0000
mdurdefepi_DCXM	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	0.8486	0.0055	0.0000
mdurdefepi_DCXM	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	0.7203	0.0063	0.0000
mdurdefepi_DCXM	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	0.6204	0.0072	0.0000
mdurdefepi_DCXM	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 9	0.4977	0.0083	0.0000
mdurdefepi_DCXM	L10	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 10	0.3684	0.0095	0.0000
mdurdefepi_DCXM	L11	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 11	0.1515	0.0077	0.0000
mdurdefepi_DCXM	Z01	Categorical of dur_def_episode (duration of default episode)	base level: else			
vdurdefepi_DCXM_pw1		Variate piecewise of dur_def_episode	median(0,dur_def_episode-11,23-11	-0.0525	0.0013	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(duration of default episode)				
vdurdefepi_DCXM_pw2		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-23,40-23)	0.0086	0.0019	0.0000
vdeltaue_DCXM_pw1		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-0,66-0)	0.0083	0.0003	0.0000
vdeltaue_DCXM_pw2		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-66,98-66)	-0.0037	0.0002	0.0000
vdeltaue_DCXM_pw3		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-98,116-98)	0.0060	0.0003	0.0000
vdeltaue_DCXM_pw4		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-116,240-116)	0.0002	0.0001	0.0002
vdeltaue_DCXM_pw5		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-240,330-240)	0.0005	0.0001	0.0006
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	0.9488	0.0335	0.0000
mRatioTmpTei	Z00	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_DCXM_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,14-0)	0.0436	0.0022	0.0000
vratiotmptei_DCXM_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-14,26-14)	0.0259	0.0004	0.0000
vratiotmptei_DCXM_pw3		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-26,44-26)	0.0067	0.0003	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vratiotmptei_DCXM_pw4		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-44,52-44)	-0.0210	0.0024	0.0000
mpriordef_DCXM	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	0.2230	0.0034	0.0000
mpriordef_DCXM	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	0.2844	0.0040	0.0000
mpriordef_DCXM	L03	Categorical of prior_default_cnt	prior_default_cnt = 3	0.3313	0.0046	0.0000
mpriordef_DCXM	L04	Categorical of prior_default_cnt	prior_default_cnt = 4	0.3488	0.0054	0.0000
mpriordef_DCXM	L05	Categorical of prior_default_cnt	prior_default_cnt = 5	0.3395	0.0063	0.0000
mpriordef_DCXM	L06	Categorical of prior_default_cnt	prior_default_cnt = 6	0.3062	0.0076	0.0000
mpriordef_DCXM	L07	Categorical of prior_default_cnt	prior_default_cnt = 7	0.2739	0.0092	0.0000
mpriordef_DCXM	L08	Categorical of prior_default_cnt	prior_default_cnt = 8	0.2407	0.0113	0.0000
mpriordef_DCXM	L09	Categorical of prior_default_cnt	prior_default_cnt = 9	0.1692	0.0143	0.0000
mpriordef_DCXM	L10	Categorical of prior_default_cnt	prior_default_cnt >= 10	0.1499	0.0155	0.0000
mpriordef_DCXM	Z00	Categorical of prior_default_cnt	base level: else			
vpriordef_DCXM_pw1		Variate piecewise of prior_default_cnt	median(0,prior_default_cnt-10,16-10)	-0.0680	0.0077	0.0000
vsato_DCXM_pw1		Variate piecewise of sato (spread at origination)	min(0,sato-(-.6))	0.2708	0.0103	0.0000
vsato_DCXM_pw2		Variate piecewise of sato (spread at origination)	median(sato-(-.6),0,.9-(-.6))	0.1169	0.0032	0.0000
vsato_DCXM_pw3		Variate piecewise of sato (spread at origination)	median(sato-.9,0,1.82-.9)	-0.0712	0.0116	0.0000
vdeltaUEpr3_DCXM_pw1		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	min(0,deltauepr3_r-(-20))	-0.0002	0.0001	0.0004
vdeltaUEpr3_DCXM_pw2		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	median(deltauepr3_r-(-20),0,10-(-20))	0.0011	0.0001	0.0000
vdeltaUEpr3_DCXM_pw3		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	max(deltauepr3_r-10,0)	-0.0004	0.0000	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vltv_DCXM_pw1		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-0,69-0)	0.0048	0.0005	0.0000
vltv_DCXM_pw2		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-69,80-69)	0.0046	0.0006	0.0000
vltv_DCXM_pw4		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-85,91-85)	0.0128	0.0008	0.0000
vltv_DCXM_pw5		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-91,94-91)	-0.0211	0.0020	0.0000
vltv_DCXM_pw6		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-94,99-94)	0.1085	0.0036	0.0000
vloanraw_DCXM_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-0,70000-0)	0.0000	0.0000	0.0000
vloanraw_DCXM_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-70000,98000-70000)	0.0000	0.0000	0.0000
vloanraw_DCXM_pw3		Variate piecewise of loansize_raw	median(0,loansize_raw-98000,180000-98000)	0.0000	0.0000	0.0000
vloanraw_DCXM_pw4		Variate piecewise of loansize_raw	median(0,loansize_raw-180000,500000-180000)	0.0000	0.0000	0.0000
mDeltaTY10_DCXM	L01	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	-0.1827	0.0036	0.0000
mDeltaTY10_DCXM	L02	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r > 108	-0.0615	0.0044	0.0000
mDeltaTY10_DCXM	Z00	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	base level: else			

Default Transition Model Parameters – FRM30NSR D_CXS

The model parameters for the FRM30NSR default to self-cure transition are shown below.

Table 47: Default to Self-Cure Transition FRM30NSR Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				0.3020	0.0160	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mseason	1	Categorical of season	season = "winter"	0.2468	0.0015	0.0000
mseason	2	Categorical of season	season = "spring"	0.2450	0.0015	0.0000
mseason	3	Categorical of season	season = "summer"	0.1011	0.0016	0.0000
mseason	4	Categorical of season	base level: else			
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1	-0.1090	0.0011	0.0000
mjudicial	2	Categorical of judicial (judicial state)	base level: else			
mdpa_rel	LRela	Categorical of dpa (down payment assistance)	dpa = "relative"	0.0792	0.0015	0.0000
mdpa_rel	ZOthr	Categorical of dpa (down payment assistance)	base level: else			
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	0.0458	0.0013	0.0000
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else			
mycslope_DCXS	L01	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r<=111	-0.2117	0.0023	0.0000
mycslope_DCXS	L02	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=875	0.1220	0.0020	0.0000
mycslope_DCXS	L03	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=2000	0.1138	0.0022	0.0000
mycslope_DCXS	Z00	Categorical of ycslope_r[1] (yield curve slope)	base level: else			
mhpa2yb_DCXS	L080	Categorical of hpa2y_blended_r[2]	hpa2y_blended_r <= 80	0.1451	0.0061	0.0000
mhpa2yb_DCXS	Z000	Categorical of hpa2y_blended_r[2]	base level: else			
vhpa2yb_DCXS_pw1		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-80,99-80);	0.0053	0.0002	0.0000
vhpa2yb_DCXS_pw2		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-99,105-99)	-0.0459	0.0004	0.0000
vhpa2yb_DCXS_pw3		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-105,115-105)	0.0067	0.0002	0.0000
vhpa2yb_DCXS_pw4		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-115,180-115)	0.0007	0.0001	0.0000
mperiodnbr_DCXS	L02	Categorical of period number	period_number <= 2	1.3440	0.0116	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(quarters since origination)				
mperiodnbr_DCXS	L03	Categorical of period number (quarters since origination)	period_number = 3	0.4699	0.0055	0.0000
mperiodnbr_DCXS	Z04	Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_DCXS_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-4,9-4)	-0.0861	0.0007	0.0000
vperiodnbr_DCXS_pw2		Variate piecewise of period number (quarters since origination)	median(0,period_number-9,17-9)	-0.0017	0.0003	0.0000
vperiodnbr_DCXS_pw3		Variate piecewise of period number (quarters since origination)	median(0,period_number-17,30-17)	0.0172	0.0002	0.0000
vperiodnbr_DCXS_pw4		Variate piecewise of period number (quarters since origination)	median(0,period_number-30,38-30)	0.0123	0.0004	0.0000
vperiodnbr_DCXS_pw5		Variate piecewise of period number (quarters since origination)	median(0,period_number-38,57-38)	0.0120	0.0002	0.0000
vperiodnbr_DCXS_pw6		Variate piecewise of period number (quarters since origination)	median(0,period_number-57,85-57)	0.0012	0.0002	0.0000
vperiodnbr_DCXS_pw7		Variate piecewise of period number (quarters since origination)	median(0,period_number-85,105-85)	-0.0041	0.0008	0.0000
mcredit_DCXS	L01	Categorical of credit_score	credit_score = 0	0.0694	0.0035	0.0000
mcredit_DCXS	Z00	Categorical of credit_score	base level: else			
vcredit_DCXS_pw1		Variate piecewise of credit_score	median(0,credit_score-500,625-500)	0.0032	0.0000	0.0000
vcredit_DCXS_pw2		Variate piecewise of credit_score	median(0,credit_score-625,680-625)	0.0033	0.0000	0.0000
mdurdefepi_DCXS	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	-0.6331	0.0014	0.0000
mdurdefepi_DCXS	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	-1.0268	0.0018	0.0000
mdurdefepi_DCXS	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	-1.4057	0.0023	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdurdefepi_DCXS	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	-1.6181	0.0028	0.0000
mdurdefepi_DCXS	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	-1.8291	0.0035	0.0000
mdurdefepi_DCXS	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	-2.0133	0.0042	0.0000
mdurdefepi_DCXS	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	-2.1784	0.0050	0.0000
mdurdefepi_DCXS	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 9	-2.2906	0.0057	0.0000
mdurdefepi_DCXS	L10	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 10	-2.4249	0.0066	0.0000
mdurdefepi_DCXS	L11	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 11	-2.5472	0.0072	0.0000
mdurdefepi_DCXS	Z01	Categorical of dur_def_episode (duration of default episode)	base level: else			
vdurdefepi_DCXS_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-10,16-10)	-0.0150	0.0017	0.0000
vdurdefepi_DCXS_pw2		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-16,30-16)	-0.0040	0.0008	0.0000
vdeltaue_DCXS_pw1		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-0,60-0)	0.0040	0.0002	0.0000
vdeltaue_DCXS_pw2		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-60,100-60)	-0.0030	0.0001	0.0000
vdeltaue_DCXS_pw3		Variate piecewise of DeltaUEInit_r[3]	median(0,DeltaUEInit_r-100,116-100)	-0.0070	0.0001	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(change in unemployment rate from policy inception to current)				
vdeltaue_DCXS_pw4		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-116,218-116)	-0.0023	0.0000	0.0000
vdeltaue_DCXS_pw5		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-218,330-218)	-0.0005	0.0001	0.0000
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	-0.7161	0.0057	0.0000
mRatioTmpTei	Z00	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_DCXS_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,24-0)	-0.0185	0.0002	0.0000
vratiotmptei_DCXS_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-24,36-24)	-0.0112	0.0002	0.0000
vratiotmptei_DCXS_pw3		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-36,50-36)	-0.0043	0.0003	0.0000
mpriordef_DCXS	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	-0.0719	0.0016	0.0000
mpriordef_DCXS	L02	Categorical of prior_default_cnt	prior_default_cnt >= 2	-0.1022	0.0018	0.0000
mpriordef_DCXS	Z00	Categorical of prior_default_cnt	base level: else			
vpriordef_DCXS_pw1		Variate piecewise of prior_default_cnt	median(0,prior_default_cnt-1,22-1)	0.0017	0.0004	0.0000
vsato_DCXS_pw1		Variate piecewise of sato (spread at origination)	min(0,sato-0)	0.0053	0.0019	0.0046
vsato_DCXS_pw2		Variate piecewise of sato (spread at origination)	median(sato-0,0,.6-0)	-0.1354	0.0028	0.0000
vsato_DCXS_pw3		Variate piecewise of sato (spread at origination)	median(sato-.6,0,1.82-.6)	-0.1506	0.0035	0.0000
vdeltaUEpr3_DCXS_pw1		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	min(0,deltauepr3_r-(-20))	0.0005	0.0000	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaUEpr3_DCXS_pw2		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	median(deltauepr3_r-(-20),0,10-(-20))	-0.0010	0.0001	0.0000
vdeltaUEpr3_DCXS_pw3		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	max(deltauepr3_r-10,0)	-0.0001	0.0000	0.0000
vltv_DCXS_pw1		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-0,71-0)	-0.0029	0.0002	0.0000
vltv_DCXS_pw2		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-71,81-71)	-0.0139	0.0003	0.0000
vltv_DCXS_pw4		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-85,92-85)	-0.0031	0.0003	0.0000
vltv_DCXS_pw5		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-92,95-92)	-0.0503	0.0009	0.0000
vltv_DCXS_pw6		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-95,99-95)	-0.1863	0.0020	0.0000
vloanraw_DCXS_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-27000,70000-27000)	0.0000	0.0000	0.0000
vloanraw_DCXS_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-70000,98000-70000)	0.0000	0.0000	0.0000
vloanraw_DCXS_pw3		Variate piecewise of loansize_raw	median(0,loansize_raw-98000,180000-98000)	0.0000	0.0000	0.0000
vloanraw_DCXS_pw4		Variate piecewise of loansize_raw	median(0,loansize_raw-180000,500000-180000)	0.0000	0.0000	0.0000
mDeltaTY10_DCXS	L01	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	0.0157	0.0018	0.0000
mDeltaTY10_DCXS	Z00	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	base level: else			
mDeltaTm3_DCXS	L01	Categorical of DeltaTm3Init_r[7] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r > 1000	0.1495	0.0022	0.0000
mDeltaTm3_DCXS	Z00	Categorical of DeltaTm3Init_r[7]	base level: else			

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(change in 3-month Treasury rate from policy inception to current)				
vUEblend_DCXS_pw2		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-480,800-480)	-0.0003	0.0000	0.0000
vUEblend_DCXS_pw3		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-800,1500-800)	-0.0004	0.0000	0.0000

Default Transition Model Parameters – FRM30NSR D_END

The model parameters for the FRM30NSR default to end (prepayment or refinance) transition are shown below.

Table 48: Default to End Transition FRM30NSR Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-2.1477	0.0544	0.0000
mseason	1	Categorical of season	season = "winter"	-0.1680	0.0050	0.0000
mseason	2	Categorical of season	season = "spring"	0.0128	0.0049	0.0094
mseason	3	Categorical of season	season = "summer"	0.0481	0.0051	0.0000
mseason	4	Categorical of season	base level: else			
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1	-0.1640	0.0037	0.0000
mjudicial	2	Categorical of judicial (judicial state)	base level: else			
mdpa	1	Categorical of dpa (down payment assistance)	dpa = "govt"	-0.2027	0.0137	0.0000
mdpa	2	Categorical of dpa (down payment assistance)	dpa= "nonprof"	-0.3709	0.0080	0.0000
mdpa	3	Categorical of dpa (down payment assistance)	dpa = "relative"	0.0957	0.0048	0.0000
mdpa	4	Categorical of dpa (down payment assistance)	base level: else			
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	-0.0542	0.0042	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else			
mycslope_DEND	L01	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r<=111	0.3057	0.0057	0.0000
mycslope_DEND	L02	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=875	-0.7162	0.0078	0.0000
mycslope_DEND	L03	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=2000	-0.5397	0.0087	0.0000
mycslope_DEND	Z00	Categorical of ycslope_r[1] (yield curve slope)	base level: else			
mhpa2yb_DEND	L085	Categorical of hpa2y_blended_r[2]	hpa2y_blended_r <= 85	0.0647	0.0143	0.0000
mhpa2yb_DEND	Z000	Categorical of hpa2y_blended_r[2]	base level: else			
vhpa2yb_DEND_pw1		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-85,105-85)	-0.0068	0.0006	0.0000
vhpa2yb_DEND_pw2		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-105,120-105)	0.0471	0.0004	0.0000
vhpa2yb_DEND_pw3		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-120,180-120)	0.0445	0.0003	0.0000
mperiodnbr_DEND	L02	Categorical of period number (quarters since origination)	period_number = 2	-0.5387	0.0498	0.0000
mperiodnbr_DEND	L03	Categorical of period number (quarters since origination)	period_number = 3	-0.2712	0.0224	0.0000
mperiodnbr_DEND	L04	Categorical of period number (quarters since origination)	period_number = 4	-0.2535	0.0170	0.0000
mperiodnbr_DEND	L05	Categorical of period number (quarters since origination)	period_number = 5	-0.2100	0.0147	0.0000
mperiodnbr_DEND	L06	Categorical of period number (quarters since origination)	period_number = 6	-0.2084	0.0134	0.0000
mperiodnbr_DEND	L07	Categorical of period number (quarters since origination)	period_number = 7	-0.2196	0.0125	0.0000
mperiodnbr_DEND	L08	Categorical of period number (quarters since origination)	period_number = 8	-0.2059	0.0120	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mperiodnbr_DEND	L09	Categorical of period number (quarters since origination)	period_number = 9	-0.0979	0.0114	0.0000
mperiodnbr_DEND	Z10	Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_DEND_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-10,26-10)	0.0165	0.0005	0.0000
vperiodnbr_DEND_pw2		Variate piecewise of period number (quarters since origination)	median(0,period_number-26,65-26)	0.0080	0.0003	0.0000
vperiodnbr_DEND_pw3		Variate piecewise of period number (quarters since origination)	median(0,period_number-65,90-65)	0.0068	0.0011	0.0000
vperiodnbr_DEND_pw4		Variate piecewise of period number (quarters since origination)	median(0,period_number-90,120-90)	0.0165	0.0031	0.0000
mcredit_DEND	L01	Categorical of credit_score	credit_score = 0	0.5000	0.0149	0.0000
mcredit_DEND	Z00	Categorical of credit_score	base level: else			
vcredit_DEND_pw1		Variate piecewise of credit_score	median(0,credit_score-500,625-500)	0.0013	0.0001	0.0000
vcredit_DEND_pw2		Variate piecewise of credit_score	median(0,credit_score-625,680-625)	0.0048	0.0002	0.0000
vcredit_DEND_pw3		Variate piecewise of credit_score	median(0,credit_score-680,780-680)	0.0025	0.0001	0.0000
mdurdefepi_DEND	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	-0.3297	0.0052	0.0000
mdurdefepi_DEND	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	-0.4859	0.0063	0.0000
mdurdefepi_DEND	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	-0.5932	0.0075	0.0000
mdurdefepi_DEND	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	-0.6869	0.0087	0.0000
mdurdefepi_DEND	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	-0.7417	0.0099	0.0000
mdurdefepi_DEND	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	-0.8222	0.0112	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdurdefepi_DEND	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	-0.8470	0.0123	0.0000
mdurdefepi_DEND	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 9	-0.8793	0.0136	0.0000
mdurdefepi_DEND	L10	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 10	-0.8567	0.0144	0.0000
mdurdefepi_DEND	L11	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 11	-0.9036	0.0095	0.0000
mdurdefepi_DEND	Z01	Categorical of dur_def_episode (duration of default episode)	base level: else			
vdurdefepi_DEND_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-10,30-10)	0.0103	0.0010	0.0000
vdurdefepi_DEND_pw2		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-30,40-30)	-0.0231	0.0033	0.0000
vdeltaue_DEND_pw1		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-0,63-0)	-0.0050	0.0004	0.0000
vdeltaue_DEND_pw2		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-63,100-63)	0.0013	0.0002	0.0000
vdeltaue_DEND_pw3		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-100,116-100)	0.0079	0.0005	0.0000
vdeltaue_DEND_pw4		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-116,218-116)	-0.0021	0.0001	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaue_DEND_pw5		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-218,330-218)	-0.0054	0.0003	0.0000
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	-0.5913	0.0277	0.0000
mRatioTmpTei	Z00	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_DEND_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,15-0)	-0.0293	0.0018	0.0000
vratiotmptei_DEND_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-15,24-15)	-0.0083	0.0007	0.0000
mpriordef_DEND	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	-0.2101	0.0048	0.0000
mpriordef_DEND	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	-0.4009	0.0063	0.0000
mpriordef_DEND	L03	Categorical of prior_default_cnt	prior_default_cnt = 3	-0.5693	0.0080	0.0000
mpriordef_DEND	L04	Categorical of prior_default_cnt	prior_default_cnt = 4	-0.7191	0.0099	0.0000
mpriordef_DEND	L05	Categorical of prior_default_cnt	prior_default_cnt = 5	-0.8595	0.0120	0.0000
mpriordef_DEND	L06	Categorical of prior_default_cnt	prior_default_cnt = 6	-0.9597	0.0144	0.0000
mpriordef_DEND	L07	Categorical of prior_default_cnt	prior_default_cnt = 7	-1.0286	0.0172	0.0000
mpriordef_DEND	L08	Categorical of prior_default_cnt	prior_default_cnt = 8	-1.1238	0.0208	0.0000
mpriordef_DEND	L09	Categorical of prior_default_cnt	prior_default_cnt = 9	-1.2052	0.0253	0.0000
mpriordef_DEND	L10	Categorical of prior_default_cnt	prior_default_cnt >= 10	-1.3423	0.0201	0.0000
mpriordef_DEND	Z00	Categorical of prior_default_cnt	base level: else			
vsato_DEND_pw1		Variate piecewise of sato (spread at origination)	min(0,sato-(-.4))	0.0383	0.0075	0.0000
vsato_DEND_pw2		Variate piecewise of sato (spread at origination)	median(sato-(-.4),0,.95-(-.4))	0.0621	0.0050	0.0000
vsato_DEND_pw3		Variate piecewise of sato (spread at origination)	median(sato-.95,0,1.82-.95)	0.0720	0.0172	0.0000
vdeltaUEpr3_DEND_pw1		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	min(0,deltauepr3_r-(-20))	0.0003	0.0001	0.0043

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaUEpr3_DEND_pw2		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	median(deltauepr3_r-(-20),0,10-(-20))	0.0026	0.0002	0.0000
vdeltaUEpr3_DEND_pw3		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	max(deltauepr3_r-10,0)	0.0013	0.0001	0.0000
vltv_DEND_pw1		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-0,55-0)	-0.0083	0.0007	0.0000
vltv_DEND_pw2		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-55,74-55)	-0.0234	0.0008	0.0000
vltv_DEND_pw3		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-74,84-74)	0.0059	0.0010	0.0000
vltv_DEND_pw4		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-84,90-84)	-0.0237	0.0012	0.0000
vltv_DEND_pw5		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-90,94-90)	-0.0319	0.0020	0.0000
vltv_DEND_pw6		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-94,99-94)	-0.1414	0.0043	0.0000
vloanraw_DEND_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-30000,70000-30000)	0.0000	0.0000	0.0000
vloanraw_DEND_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-70000,98000-70000)	0.0000	0.0000	0.0000
vloanraw_DEND_pw3		Variate piecewise of loansize_raw	median(0,loansize_raw-98000,180000-98000)	0.0000	0.0000	0.0000
vloanraw_DEND_pw4		Variate piecewise of loansize_raw	median(0,loansize_raw-180000,500000-180000)	0.0000	0.0000	0.0000
mDeltaTY10_DEND	L01	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	-0.3545	0.0074	0.0000
mDeltaTY10_DEND	Z00	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	base level: else			
mprior3_ue_DEND	L01	Categorical of prior3_ue_r[7] (change in prior-3 unemployment rate)	prior3_ue_r<1400	0.4299	0.0304	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mprior3_ue_DEND	Z00	Categorical of prior3_ue_r[7] (change in prior-3 unemployment rate)	base level: else			
vUEblend_DEND_pw1		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-0,450-0)	-0.0012	0.0000	0.0000
vUEblend_DEND_pw2		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-450,850-450)	-0.0008	0.0000	0.0000
vUEblend_DEND_pw3		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-850,1500-850)	-0.0007	0.0000	0.0000

Default Transition Model Parameters – FRM30SR D_CLM

The model parameters for the FRM30SR default to claim transition are shown below.

Table 49: Default to Claim Transition FRM30SR Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-4.5403	0.0772	0.0000
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1	-0.1898	0.0057	0.0000
mjudicial	2	Categorical of judicial (judicial state)	base level: else			
mcalperiod	L200104	Categorical of period (calendar period)	period < 200104	0.8136	0.0152	0.0000
mcalperiod	L200604	Categorical of period (calendar period)	period < 200604	-0.0522	0.0130	0.0001
mcalperiod	Z201800	Categorical of period (calendar period)	base level: else			
mycslope_DCLM	L01	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r<=141	-0.1589	0.0110	0.0000
mycslope_DCLM	Z00	Categorical of ycslope_r[1] (yield curve slope)	base level: else			
vycslope_DCLM_pw1		Variate piecewise of ycslope_r[1] (yield curve slope)	median(0,ycslope_r-141,478-141)	-0.0008	0.0000	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vycslope_DCLM_pw3		Variate piecewise of ycslope_r[1] (yield curve slope)	max(0,ycslope_r-1270)	0.0001	0.0000	0.0000
vhpa2yb_DCLM_pw1		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-93,107-93)	0.0372	0.0009	0.0000
vhpa2yb_DCLM_pw2		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-107,115-107)	-0.0041	0.0011	0.0002
vhpa2yb_DCLM_pw3		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-115,138-115)	0.0056	0.0008	0.0000
vhpa2yb_DCLM_pw4		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-138,180-138)	-0.0274	0.0021	0.0000
mperiodnbr_DCLM	L02	Categorical of period number (quarters since origination)	period_number <= 2	-1.7424	0.1869	0.0000
mperiodnbr_DCLM	L03	Categorical of period number (quarters since origination)	period_number = 3	-0.8304	0.0608	0.0000
mperiodnbr_DCLM	L04	Categorical of period number (quarters since origination)	period_number = 4	-0.3991	0.0364	0.0000
mperiodnbr_DCLM	Z00	Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_DCLM_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-4,9-4)	-0.0417	0.0041	0.0000
vperiodnbr_DCLM_pw4		Variate piecewise of period number (quarters since origination)	median(0,period_number-17,35-17)	-0.0030	0.0009	0.0005
vperiodnbr_DCLM_pw5		Variate piecewise of period number (quarters since origination)	median(0,period_number-35,59-35)	-0.0162	0.0021	0.0000
vcredit_DCLM_pw1		Variate piecewise of credit_score	median(0,credit_score-500,635-500)	-0.0008	0.0001	0.0000
vcredit_DCLM_pw2		Variate piecewise of credit_score	median(0,credit_score-635,780-635)	0.0048	0.0002	0.0000
mdurdefepi_DCLM	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	0.9037	0.0115	0.0000
mdurdefepi_DCLM	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	1.4794	0.0112	0.0000
mdurdefepi_DCLM	L04	Categorical of dur_def_episode	dur_def_episode = 4	1.7669	0.0115	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(duration of default episode)				
mdurdefepi_DCLM	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	1.8805	0.0120	0.0000
mdurdefepi_DCLM	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	1.8837	0.0129	0.0000
mdurdefepi_DCLM	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	1.8922	0.0137	0.0000
mdurdefepi_DCLM	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	1.8500	0.0147	0.0000
mdurdefepi_DCLM	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 9	1.8303	0.0158	0.0000
mdurdefepi_DCLM	L10	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 10	1.8353	0.0168	0.0000
mdurdefepi_DCLM	L11	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 11	1.7913	0.0182	0.0000
mdurdefepi_DCLM	L12	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 12	1.7835	0.0194	0.0000
mdurdefepi_DCLM	L13	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 13	1.7959	0.0207	0.0000
mdurdefepi_DCLM	L14	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 14	1.8057	0.0153	0.0000
mdurdefepi_DCLM	Z01	Categorical of dur_def_episode (duration of default episode)	base level: else			
vdurdefepi_DCLM_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-13,40-13)	-0.0156	0.0015	0.0000
vdeltaue_DCLM_pw1		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-0,53-0)	-0.0186	0.0011	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaue_DCLM_pw2		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-53,98-53)	-0.0097	0.0003	0.0000
vdeltaue_DCLM_pw3		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-98,142-98)	0.0022	0.0003	0.0000
vdeltaue_DCLM_pw4		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-142,220-142)	0.0016	0.0002	0.0000
vdeltaue_DCLM_pw5		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-220,330-220)	0.0014	0.0004	0.0018
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	0.1161	0.0358	0.0012
mRatioTmpTei	Z00	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_DCLM_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,24-0)	0.0097	0.0017	0.0000
vratiotmptei_DCLM_pw3		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-36,50-36)	-0.0091	0.0021	0.0000
mpriordef_DCLM	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	-0.4034	0.0070	0.0000
mpriordef_DCLM	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	-0.5951	0.0094	0.0000
mpriordef_DCLM	L03	Categorical of prior_default_cnt	prior_default_cnt = 3	-0.7594	0.0122	0.0000
mpriordef_DCLM	L04	Categorical of prior_default_cnt	prior_default_cnt = 4	-0.9113	0.0158	0.0000
mpriordef_DCLM	L05	Categorical of prior_default_cnt	prior_default_cnt = 5	-1.0303	0.0207	0.0000
mpriordef_DCLM	L06	Categorical of prior_default_cnt	prior_default_cnt = 6	-1.2081	0.0279	0.0000
mpriordef_DCLM	L07	Categorical of prior_default_cnt	prior_default_cnt = 7	-1.3019	0.0369	0.0000
mpriordef_DCLM	L08	Categorical of prior_default_cnt	prior_default_cnt = 8	-1.4652	0.0507	0.0000
mpriordef_DCLM	L09	Categorical of prior_default_cnt	prior_default_cnt = 9	-1.4957	0.0684	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_DCLM	L10	Categorical of prior_default_cnt	prior_default_cnt = 10	-1.6795	0.0975	0.0000
mpriordef_DCLM	L11	Categorical of prior_default_cnt	prior_default_cnt = 11	-1.5973	0.1235	0.0000
mpriordef_DCLM	L12	Categorical of prior_default_cnt	prior_default_cnt >= 12	-1.2202	0.2719	0.0000
mpriordef_DCLM	Z00	Categorical of prior_default_cnt	base level: else			
vpriordef_DCLM_pw1		Variate piecewise of prior_default_cnt	median(0,prior_default_cnt-11,15-11)	-0.3969	0.1493	0.0079
vdeltaUEpr3_DCLM_pw1		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	min(0,delta_ue_sa_st_r-(-20))	0.0004	0.0001	0.0007
vdeltaUEpr3_DCLM_pw2		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	median(delta_ue_sa_st_r-(-20),0,10-(-20))	-0.0059	0.0003	0.0000
vdeltaUEpr3_DCLM_pw3		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	max(delta_ue_sa_st_r-10,0)	0.0006	0.0001	0.0000
vltv_DCLM_pw2		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-70,81-70)	0.0304	0.0010	0.0000
vltv_DCLM_pw3		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-81,91-81)	0.0043	0.0011	0.0001
vltv_DCLM_pw4		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-91,94-91)	0.0151	0.0038	0.0001
vltv_DCLM_pw5		Variate piecewise of ltv_i_r[5] (loan-to-value)	max(0,ltv_i_r-94)	0.0602	0.0051	0.0000
vloanraw_DCLM_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-27000,60000-27000)	0.0000	0.0000	0.0000
vloanraw_DCLM_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-60000,200000-60000)	0.0000	0.0000	0.0003
vloanraw_DCLM_pw3		Variate piecewise of loansize_raw	median(0,loansize_raw-200000,500000-200000)	0.0000	0.0000	0.0000
mDeltaTY10_DCLM	L01	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	0.0623	0.0093	0.0000
mDeltaTY10_DCLM	L02	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate	DeltaTy10Init_r > 130	-0.1905	0.0146	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		from policy inception to current)				
mDeltaTY10_DCLM	Z00	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	base level: else			
mprior3_ue_DCLM	L01	Categorical of prior3_ue_r[7] (change in prior-3 unemployment rate)	prior3_ue_r<1400	0.1131	0.0356	0.0015
mprior3_ue_DCLM	Z00	Categorical of prior3_ue_r[7] (change in prior-3 unemployment rate)	base level: else			
mDeltaTm3_DCLM	L01	Categorical of DeltaTm3Init_r[8] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r < 1			
mDeltaTm3_DCLM	L02	Categorical of DeltaTm3Init_r[8] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r > 600	-0.1823	0.0135	0.0000
mDeltaTm3_DCLM	Z00	Categorical of DeltaTm3Init_r[8] (change in 3-month Treasury rate from policy inception to current)	base level: else			
vUEblend_DCLM_pw1		Variate piecewise of ue_blended_r[9] (change in unemployment rate)	median(0,ue_blended_r-200,550-200)	0.0034	0.0001	0.0000
vUEblend_DCLM_pw2		Variate piecewise of ue_blended_r[9] (change in unemployment rate)	median(0,ue_blended_r-550,850-550)	-0.0004	0.0000	0.0000
vUEblend_DCLM_pw3		Variate piecewise of ue_blended_r[9] (change in unemployment rate)	median(0,ue_blended_r-850,1500-850)	0.0004	0.0000	0.0000

Default Transition Model Parameters – FRM30SR D_CXM

The model parameters for the FRM30SR default to modified cure transition are shown below.

Table 50: Default to Modified Cure Transition FRM30SR Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-6.2768	0.1010	0.0000
mcalperiod	L200104	Categorical of period (calendar period)	period < 200104	-14.7749	19.6177	0.4514
mcalperiod	L200604	Categorical of period (calendar period)	period < 200604	-5.5068	0.1340	0.0000
mcalperiod	Z201800	Categorical of period (calendar period)	base level: else			
mseason	1	Categorical of season	season = "winter"	-0.0659	0.0079	0.0000
mseason	2	Categorical of season	season = "spring"	0.0698	0.0077	0.0000
mseason	3	Categorical of season	season = "summer"	0.0578	0.0079	0.0000
mseason	4	Categorical of season	base level: else			
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1	-0.0681	0.0061	0.0000
mjudicial	2	Categorical of judicial (judicial state)	base level: else			
mhpa2yb_DCXM	L083	Categorical of hpa2y_blended_r[1]	hpa2y_blended_r <= 83	-0.3222	0.0251	0.0000
mhpa2yb_DCXM	Z000	Categorical of hpa2y_blended_r[1]	base level: else			
vhpa2yb_DCXM_pw1		Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-83,94-83)	-0.0262	0.0016	0.0000
vhpa2yb_DCXM_pw3		Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-106,112-106)	-0.0193	0.0016	0.0000
vhpa2yb_DCXM_pw4		Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-112,150-112)	0.0043	0.0008	0.0000
mperiodnbr_DCXM	L02	Categorical of period number (quarters since origination)	period_number <= 2	-2.0498	0.2439	0.0000
mperiodnbr_DCXM	L03	Categorical of period number (quarters since origination)	period_number = 3	-1.0756	0.0826	0.0000
mperiodnbr_DCXM	L04	Categorical of period number (quarters since origination)	period_number = 4	-0.7332	0.0547	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mperiodnbr_DCXM	Z00	Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_DCXM_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-4,9-4)	0.1540	0.0058	0.0000
vperiodnbr_DCXM_pw2		Variate piecewise of period number (quarters since origination)	median(0,period_number-9,13-9)	-0.0429	0.0037	0.0000
vperiodnbr_DCXM_pw3		Variate piecewise of period number (quarters since origination)	median(0,period_number-13,21-13)	0.0270	0.0015	0.0000
vperiodnbr_DCXM_pw4		Variate piecewise of period number (quarters since origination)	median(0,period_number-21,59-21)	-0.0034	0.0005	0.0000
vperiodnbr_DCXM_pw5		Variate piecewise of period number (quarters since origination)	median(0,period_number-59,90-59)	-0.0079	0.0016	0.0000
mcredit_score	L00	Categorical of credit_score	credit_score = 0	-0.1704	0.0385	0.0000
mcredit_score	Z00	Categorical of credit_score	base level: else			
vcredit_DCXM_pw1		Variate piecewise of credit_score	median(0,credit_score-435,650-435)	-0.0009	0.0002	0.0001
vcredit_DCXM_pw2		Variate piecewise of credit_score	median(0,credit_score-650,680-650)	-0.0025	0.0010	0.0144
vcredit_DCXM_pw3		Variate piecewise of credit_score	median(0,credit_score-680,780-680)	-0.0021	0.0006	0.0010
mdurdefepi_DCXM	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	0.6882	0.0086	0.0000
mdurdefepi_DCXM	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	0.8412	0.0092	0.0000
mdurdefepi_DCXM	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	0.8509	0.0102	0.0000
mdurdefepi_DCXM	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	0.7663	0.0115	0.0000
mdurdefepi_DCXM	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	0.6946	0.0131	0.0000
mdurdefepi_DCXM	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	0.5858	0.0150	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdurdefepi_DCXM	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 8	0.4779	0.0141	0.0000
mdurdefepi_DCXM	Z01	Categorical of dur_def_episode (duration of default episode)	base level: else			
vdurdefepi_DCXM_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-7,23-7)	-0.0747	0.0022	0.0000
vdurdefepi_DCXM_pw2		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-23,40-23)	0.0239	0.0054	0.0000
vdeltaue_DCXM_pw1		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-0,66-0)	0.0070	0.0006	0.0000
vdeltaue_DCXM_pw2		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-66,90-66)	-0.0015	0.0005	0.0025
vdeltaue_DCXM_pw3		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-90,131-90)	0.0041	0.0003	0.0000
vdeltaue_DCXM_pw4		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-131,200-131)	0.0022	0.0002	0.0000
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	0.5658	0.0452	0.0000
mRatioTmpTei	Z00	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_DCXM_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,24-0)	0.0260	0.0022	0.0000
vratiotmptei_DCXM_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-24,36-24)	0.0159	0.0022	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vratiotmptei_DCXM_pw3		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-36,50-36)	-0.0083	0.0027	0.0019
mpriordef_DCXM	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	0.2301	0.0079	0.0000
mpriordef_DCXM	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	0.3121	0.0092	0.0000
mpriordef_DCXM	L03	Categorical of prior_default_cnt	prior_default_cnt = 3	0.3461	0.0106	0.0000
mpriordef_DCXM	L04	Categorical of prior_default_cnt	prior_default_cnt = 4	0.3731	0.0125	0.0000
mpriordef_DCXM	L05	Categorical of prior_default_cnt	prior_default_cnt = 5	0.3198	0.0151	0.0000
mpriordef_DCXM	L06	Categorical of prior_default_cnt	prior_default_cnt = 6	0.2999	0.0183	0.0000
mpriordef_DCXM	L07	Categorical of prior_default_cnt	prior_default_cnt = 7	0.2883	0.0223	0.0000
mpriordef_DCXM	L08	Categorical of prior_default_cnt	prior_default_cnt = 8	0.2005	0.0281	0.0000
mpriordef_DCXM	L09	Categorical of prior_default_cnt	prior_default_cnt >= 9	0.2982	0.0431	0.0000
mpriordef_DCXM	Z00	Categorical of prior_default_cnt	base level: else			
vpriordef_DCXM_pw1		Variate piecewise of prior_default_cnt	median(0,prior_default_cnt-8,14-8)	-0.1078	0.0167	0.0000
vsato_DCXM_pw2		Variate piecewise of sato (spread at origination)	median(sato-(-.6),0,.9-(-.6))	0.0603	0.0078	0.0000
vsato_DCXM_pw3		Variate piecewise of sato (spread at origination)	max(sato-.9,0)	0.1895	0.0549	0.0006
vdeltaUEpr3_DCXM_pw2		Variate piecewise of deltauepr3_r[3] (change in unemployment from 3 quarters prior)	median(delta_ue_sa_st_r-(-20),0,10-(-20))	-0.0006	0.0003	0.0127
vltv_DCXM_pw1		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-0,67-0)	0.0010	0.0003	0.0058
vltv_DCXM_pw2		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-67,79-67)	0.0063	0.0011	0.0000
vltv_DCXM_pw4		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-85,91-85)	0.0186	0.0015	0.0000
vltv_DCXM_pw6		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-95,99-95)	0.1102	0.0084	0.0000
vloanraw_DCXM_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-0,70000-0)	0.0000	0.0000	0.0000
vloanraw_DCXM_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-70000,98000-70000)	0.0000	0.0000	0.0000
vloanraw_DCXM_pw3		Variate piecewise of loansize_raw	median(0,loansize_raw-98000,180000-98000)	0.0000	0.0000	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vloanraw_DCXM_pw4		Variate piecewise of loansize_raw	median(0,loansize_raw-180000,500000-180000)	0.0000	0.0000	0.0000
mDeltaTY10_DCXM	L01	Categorical of DeltaTy10Init_r[5] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	-0.1787	0.0088	0.0000
mDeltaTY10_DCXM	Z00	Categorical of DeltaTy10Init_r[5] (change in 10-year Treasury rate from policy inception to current)	base level: else			
mDeltaTM3_DCXM	L01	Categorical of DeltaTm3Init_r[6] (change in 3-month Treasury rate from policy inception to current)	DeltaTM3Init_r < 3	-0.0487	0.0103	0.0000
mDeltaTM3_DCXM	L02	Categorical of DeltaTm3Init_r[6] (change in 3-month Treasury rate from policy inception to current)	DeltaTM3Init_r > 550	-0.3259	0.0112	0.0000
mDeltaTM3_DCXM	Z00	Categorical of DeltaTm3Init_r[6] (change in 3-month Treasury rate from policy inception to current)	base level: else			
vUEblend_DCXM_pw1		Variate piecewise of ue_blended_r[7] (change in unemployment rate)	median(0,ue_blended_r-200,420-200)	0.0009	0.0001	0.0000
vUEblend_DCXM_pw2		Variate piecewise of ue_blended_r[7] (change in unemployment rate)	median(0,ue_blended_r-420,940-420)	-0.0006	0.0000	0.0000
vUEblend_DCXM_pw3		Variate piecewise of ue_blended_r[7] (change in unemployment rate)	median(0,ue_blended_r-940,1500-940)	-0.0002	0.0000	0.0002

Default Transition Model Parameters – FRM30SR D_CXS

The model parameters for the FRM30SR default to self-cure transition are shown below.

Table 51: Default to Self-Cure Transition FRM30SR Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				0.4333	0.0358	0.0000
mcalperiod	L200104	Categorical of period (calendar period)	period < 200104	-1.1811	0.0089	0.0000
mcalperiod	L200604	Categorical of period (calendar period)	period < 200604	-0.6712	0.0065	0.0000
mcalperiod	Z201800	Categorical of period (calendar period)	base level: else			
mseason	1	Categorical of season	season = "winter"	0.1801	0.0037	0.0000
mseason	2	Categorical of season	season = "spring"	0.2159	0.0037	0.0000
mseason	3	Categorical of season	season = "summer"	0.0806	0.0039	0.0000
mseason	4	Categorical of season	base level: else			
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1	-0.0961	0.0028	0.0000
mjudicial	2	Categorical of judicial (judicial state)	base level: else			
mycslope_DCXS	L01	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r<=111	-0.0430	0.0058	0.0000
mycslope_DCXS	L02	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=875	-0.0622	0.0050	0.0000
mycslope_DCXS	L03	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=2000	-0.0590	0.0056	0.0000
mycslope_DCXS	Z00	Categorical of ycslope_r[1] (yield curve slope)	base level: else			
mhpa2yb_DCXS	L080	Categorical of hpa2y_blended_r[2]	hpa2y_blended_r <= 80	0.1778	0.0143	0.0000
mhpa2yb_DCXS	Z000	Categorical of hpa2y_blended_r[2]	base level: else			
vhpa2yb_DCXS_pw1		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-80,99-80)	0.0078	0.0006	0.0000
vhpa2yb_DCXS_pw2		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-99,105-99)	-0.0171	0.0010	0.0000
vhpa2yb_DCXS_pw3		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-105,116-105)	0.0088	0.0004	0.0000
mperiodnbr_DCXS	L02	Categorical of period number (quarters since origination)	period_number <= 2	1.2226	0.0240	0.0000
mperiodnbr_DCXS	L03	Categorical of period number	period_number = 3	0.4370	0.0129	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(quarters since origination)				
mperiodnbr_DCXS	Z04	Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_DCXS_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-3,9-3)	-0.0650	0.0017	0.0000
vperiodnbr_DCXS_pw2		Variate piecewise of period number (quarters since origination)	median(0,period_number-9,15-9)	-0.0152	0.0010	0.0000
vperiodnbr_DCXS_pw3		Variate piecewise of period number (quarters since origination)	median(0,period_number-15,25-15)	0.0085	0.0006	0.0000
vperiodnbr_DCXS_pw4		Variate piecewise of period number (quarters since origination)	median(0,period_number-25,45-25)	0.0022	0.0004	0.0000
vperiodnbr_DCXS_pw5		Variate piecewise of period number (quarters since origination)	median(0,period_number-45,57-45)	-0.0059	0.0008	0.0000
vperiodnbr_DCXS_pw6		Variate piecewise of period number (quarters since origination)	median(0,period_number-57,85-57)	0.0079	0.0007	0.0000
vperiodnbr_DCXS_pw7		Variate piecewise of period number (quarters since origination)	median(0,period_number-85,105-85)	-0.0134	0.0024	0.0000
mcredit_score	L00	Categorical of credit_score	credit_score = 0	0.1992	0.0192	0.0000
mcredit_score	Z00	Categorical of credit_score	base level: else			
vcredit_DCXS_pw1		Variate piecewise of credit_score	median(0,credit_score-480,625-480)	0.0013	0.0002	0.0000
vcredit_DCXS_pw2		Variate piecewise of credit_score	median(0,credit_score-625,680-625)	0.0012	0.0003	0.0000
vcredit_DCXS_pw3		Variate piecewise of credit_score	median(0,credit_score-680,780-680)	-0.0016	0.0003	0.0000
mdurdefepi_DCXS	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	-0.6927	0.0034	0.0000
mdurdefepi_DCXS	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	-1.0997	0.0044	0.0000
mdurdefepi_DCXS	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	-1.4703	0.0057	0.0000
mdurdefepi_DCXS	L05	Categorical of dur_def_episode	dur_def_episode = 5	-1.6625	0.0070	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(duration of default episode)				
mdurdefepi_DCXS	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	-1.8576	0.0085	0.0000
mdurdefepi_DCXS	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	-2.0702	0.0105	0.0000
mdurdefepi_DCXS	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	-2.2037	0.0124	0.0000
mdurdefepi_DCXS	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 9	-2.2759	0.0145	0.0000
mdurdefepi_DCXS	Z01	Categorical of dur_def_episode (duration of default episode)	base level: else			
vdurdefepi_DCXS_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-8,14-8)	-0.0721	0.0039	0.0000
vdurdefepi_DCXS_pw2		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-14,24-14)	0.0112	0.0027	0.0000
vdurdefepi_DCXS_pw3		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-24,35-24)	-0.0220	0.0040	0.0000
vdeltaue_DCXS_pw1		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-0,59-0)	0.0045	0.0004	0.0000
vdeltaue_DCXS_pw2		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-59,95-59)	-0.0006	0.0002	0.0008
vdeltaue_DCXS_pw3		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-95,104-95)	-0.0063	0.0006	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaue_DCXS_pw4		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-104,200-104)	-0.0014	0.0001	0.0000
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	-0.3162	0.0169	0.0000
mRatioTmpTei	Z00	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_DCXS_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,24-0)	-0.0121	0.0009	0.0000
vratiotmptei_DCXS_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-24,36-24)	-0.0098	0.0009	0.0000
mpriordef_DCXS	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	-0.0127	0.0038	0.0007
mpriordef_DCXS	L02	Categorical of prior_default_cnt	prior_default_cnt >= 2	-0.0261	0.0038	0.0000
mpriordef_DCXS	Z00	Categorical of prior_default_cnt	base level: else			
vsato_DCXS_pw1		Variate piecewise of sato (spread at origination)	min(0,sato-0)	-0.0664	0.0071	0.0000
vsato_DCXS_pw2		Variate piecewise of sato (spread at origination)	median(sato-0,0,.6-0)	-0.0954	0.0072	0.0000
vsato_DCXS_pw3		Variate piecewise of sato (spread at origination)	median(sato-.6,0,1.82-.6)	-0.1002	0.0118	0.0000
vdeltaUEpr3_DCXS_pw1		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	min(0,delta_ue_sa_st_r-(-20))	0.0006	0.0001	0.0000
vdeltaUEpr3_DCXS_pw2		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	median(delta_ue_sa_st_r-(-20),0,10-(-20))	0.0007	0.0001	0.0000
vdeltaUEpr3_DCXS_pw3		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	max(delta_ue_sa_st_r-10,0)	-0.0008	0.0000	0.0000
vltv_DCXS_pw2		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-69,81-69)	-0.0084	0.0004	0.0000
vltv_DCXS_pw4		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-85,92-85)	-0.0138	0.0007	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vltv_DCXS_pw5		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-92,95-92)	-0.0501	0.0023	0.0000
vltv_DCXS_pw6		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-95,99-95)	-0.0382	0.0038	0.0000
vloanraw_DCXS_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-27000,158000-27000)	0.0000	0.0000	0.0000
vloanraw_DCXS_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-158000,520000-158000)	0.0000	0.0000	0.0000
mDeltaTY10_DCXS	L01	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r > 127	0.1856	0.0050	0.0000
mDeltaTY10_DCXS	Z00	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	base level: else			
mDeltaTm3_DCXS	L01	Categorical of DeltaTm3Init_r[7] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r > 1000	0.1232	0.0054	0.0000
mDeltaTm3_DCXS	Z00	Categorical of DeltaTm3Init_r[7] (change in 3-month Treasury rate from policy inception to current)	base level: else			
vUEblend_DCXS_pw1		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-200,473-200)	-0.0006	0.0000	0.0000
vUEblend_DCXS_pw2		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-473,750-473)	-0.0005	0.0000	0.0000
vUEblend_DCXS_pw3		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-750,1500-750)	-0.0004	0.0000	0.0000

Default Transition Model Parameters – FRM30SR D_END

The model parameters for the FRM30SR default to end (prepayment or refinance) transition are shown below.

Table 52: Default to End Transition FRM30SR Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-2.9278	0.1262	0.0000
mseason	1	Categorical of season	season = "winter"	-0.0798	0.0121	0.0000
mseason	2	Categorical of season	season = "spring"	0.0825	0.0119	0.0000
mseason	3	Categorical of season	season = "summer"	0.1111	0.0124	0.0000
mseason	4	Categorical of season	base level: else			
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1	-0.1761	0.0094	0.0000
mjudicial	2	Categorical of judicial (judicial state)	base level: else			
mycslope_DEND	L01	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r<=125	0.2863	0.0119	0.0000
mycslope_DEND	L02	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=470	-0.6670	0.0175	0.0000
mycslope_DEND	L03	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=2200	-0.7201	0.0253	0.0000
mycslope_DEND	Z00	Categorical of ycslope_r[1] (yield curve slope)	base level: else			
vhpa2yb_DEND_pw1		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-85,102-85)	-0.0113	0.0016	0.0000
vhpa2yb_DEND_pw2		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-102,109-102)	0.0307	0.0027	0.0000
vhpa2yb_DEND_pw3		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-109,120-109)	0.0562	0.0014	0.0000
vhpa2yb_DEND_pw4		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-120,180-120)	0.0376	0.0007	0.0000
vperiodnbr_DEND_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-3,14-3)	0.0269	0.0024	0.0000
vperiodnbr_DEND_pw2		Variate piecewise of period number (quarters since origination)	median(0,period_number-14,17-14)	0.0254	0.0059	0.0000
vperiodnbr_DEND_pw3		Variate piecewise of period number	median(0,period_number-17,32-17)	0.0162	0.0013	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(quarters since origination)				
vperiodnbr_DEND_pw4		Variate piecewise of period number (quarters since origination)	median(0,period_number-32,57-32)	0.0110	0.0010	0.0000
vperiodnbr_DEND_pw5		Variate piecewise of period number (quarters since origination)	median(0,period_number-57,110-57)	0.0244	0.0013	0.0000
mcredit_score	L00	Categorical of credit_score	credit_score = 0	0.1666	0.0227	0.0000
mcredit_score	Z00	Categorical of credit_score	base level: else			
vcredit_DEND_pw1		Variate piecewise of credit_score	median(0,credit_score-642,780-642)	0.0036	0.0005	0.0000
mdurdefepi_DEND	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	-0.3368	0.0120	0.0000
mdurdefepi_DEND	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	-0.5278	0.0150	0.0000
mdurdefepi_DEND	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	-0.6249	0.0179	0.0000
mdurdefepi_DEND	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	-0.7052	0.0211	0.0000
mdurdefepi_DEND	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	-0.7704	0.0243	0.0000
mdurdefepi_DEND	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	-0.8659	0.0282	0.0000
mdurdefepi_DEND	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	-0.8924	0.0315	0.0000
mdurdefepi_DEND	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 9	-0.9648	0.0356	0.0000
mdurdefepi_DEND	L10	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 10	-1.0203	0.0394	0.0000
mdurdefepi_DEND	L11	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 11	-0.9500	0.0169	0.0000
mdurdefepi_DEND	Z01	Categorical of dur_def_episode	base level: else			

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(duration of default episode)				
vdeltaue_DEND_pw2		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-50,83-50)	0.0096	0.0006	0.0000
vdeltaue_DEND_pw3		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-83,98-83)	0.0035	0.0012	0.0026
vdeltaue_DEND_pw4		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-98,125-98)	0.0064	0.0007	0.0000
mpriordef_DEND	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	-0.2625	0.0116	0.0000
mpriordef_DEND	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	-0.4790	0.0157	0.0000
mpriordef_DEND	L03	Categorical of prior_default_cnt	prior_default_cnt = 3	-0.6930	0.0202	0.0000
mpriordef_DEND	L04	Categorical of prior_default_cnt	prior_default_cnt = 4	-0.8395	0.0248	0.0000
mpriordef_DEND	L05	Categorical of prior_default_cnt	prior_default_cnt = 5	-0.9715	0.0297	0.0000
mpriordef_DEND	L06	Categorical of prior_default_cnt	prior_default_cnt >= 6	-1.3247	0.0240	0.0000
mpriordef_DEND	Z00	Categorical of prior_default_cnt	base level: else			
vsato_DEND_pw2		Variate piecewise of sato (spread at origination)	median(sato-(-.4),0,.95-(-.4))	0.0466	0.0122	0.0001
vsato_DEND_pw3		Variate piecewise of sato (spread at origination)	median(sato-.95,0,1.82-.95)	-0.1676	0.0567	0.0031
vdeltaUEpr3_DEND_pw2		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	median(delta_ue_sa_st_r-(-20),0,10-(-20))	0.0016	0.0004	0.0001
vdeltaUEpr3_DEND_pw3		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	max(delta_ue_sa_st_r-10,0)	0.0027	0.0001	0.0000
mltv	L00	Categorical of ltv_i_r[5] (loan-to-value)	ltv_i_r=.	-0.9829	0.1183	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mltv	Z01	Categorical of ltv_i_r[5] (loan-to-value)	base level: else			
vltv_DEND_pw1		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-0,55-0)	-0.0160	0.0023	0.0000
vltv_DEND_pw2		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-55,83-55)	-0.0080	0.0010	0.0000
vltv_DEND_pw3		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-83,91-83)	-0.0060	0.0020	0.0031
vltv_DEND_pw5		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-93,96-93)	-0.0434	0.0086	0.0000
vltv_DEND_pw6		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-96,99-96)	0.0572	0.0214	0.0077
vloanraw_DEND_pw3		Variate piecewise of loansize_raw	median(0,loansize_raw-98000,180000-98000)	0.0000	0.0000	0.0000
vloanraw_DEND_pw4		Variate piecewise of loansize_raw	median(0,loansize_raw-180000,500000-180000)	0.0000	0.0000	0.0000
mDeltaTY10_DEND	L01	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	-0.3189	0.0190	0.0000
mDeltaTY10_DEND	Z00	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	base level: else			
mDeltaTM3_DEND	L01	Categorical of DeltaTm3Init_r[7] (change in 3-month Treasury rate from policy inception to current)	deltaTM3Init_r < 16	0.0512	0.0205	0.0125
mDeltaTM3_DEND	L02	Categorical of DeltaTm3Init_r[7] (change in 3-month Treasury rate from policy inception to current)	deltaTM3Init_r < 41	0.1434	0.0143	0.0000
mDeltaTM3_DEND	L03	Categorical of DeltaTm3Init_r[7] (change in 3-month Treasury rate from policy inception to current)	deltaTM3Init_r > 600	0.0091	0.0152	0.5471

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mDeltaTM3_DEND	Z00	Categorical of DeltaTm3Init_r[7] (change in 3-month Treasury rate from policy inception to current)	base level: else			
vUEblend_DEND_pw1		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-200,700-200)	-0.0015	0.0001	0.0000
vUEblend_DEND_pw2		Variate piecewise of ue_blended_r[8] (change in unemployment rate)	median(0,ue_blended_r-700,900-700)	-0.0030	0.0001	0.0000

Default Transition Model Parameters – FRM15 D_CLM

The model parameters for the FRM15 default to claim transition are shown below.

Table 53: Default to Claim Transition FRM15 Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-7.7648	0.2091	0.0000
mdpa	1	Categorical of dpa (down payment assistance)	dpa = "govt"	0.4041	0.1349	0.0027
mdpa	2	Categorical of dpa (down payment assistance)	dpa= "nonprof"	0.4208	0.0377	0.0000
mdpa	3	Categorical of dpa (down payment assistance)	dpa = "relative"	-0.1181	0.0507	0.0199
mdpa	4	Categorical of dpa (down payment assistance)	base level: else			
mcred_subs_coht_DCLM	L01	Categorical of credit_subsidy_cohort (credit subsidy cohort yr)	credit_subsidy_cohort < 2000	-0.8360	0.0525	0.0000
mcred_subs_coht_DCLM	Z02	Categorical of credit_subsidy_cohort (credit subsidy cohort yr)	base level: else			
mperiodnbr_DCLM	L04	Categorical of period number (quarters since origination)	period_number <= 4	-0.4244	0.1436	0.0031
mperiodnbr_DCLM	L08	Categorical of period number (quarters since origination)	period_number <= 8	0.1437	0.0538	0.0076

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mperiodnbr_DCLM	Z09	Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_DCLM_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-8,18-8)	0.0501	0.0062	0.0000
vperiodnbr_DCLM_pw2		Variate piecewise of period number (quarters since origination)	median(0,period_number-18,39-18)	0.0201	0.0029	0.0000
mcredit_score	L00	Categorical of credit_score	credit_score = 0	-0.2616	0.0872	0.0027
mcredit_score	Z00	Categorical of credit_score	base level: else			
vcredit_DCLM_pw1		Variate piecewise of credit_score	median(0,credit_score-465,550-465)	-0.0029	0.0011	0.0058
vcredit_DCLM_pw2		Variate piecewise of credit_score	median(0,credit_score-550,800-550)	0.0032	0.0003	0.0000
mdurdefepi_DCLM	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	1.4770	0.0556	0.0000
mdurdefepi_DCLM	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	2.0893	0.0551	0.0000
mdurdefepi_DCLM	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	2.5487	0.0549	0.0000
mdurdefepi_DCLM	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	2.7646	0.0562	0.0000
mdurdefepi_DCLM	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	2.8492	0.0586	0.0000
mdurdefepi_DCLM	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode <= 17	2.9893	0.0507	0.0000
mdurdefepi_DCLM	L18	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 18			
mdurdefepi_DCLM	Z01	Categorical of dur_def_episode (duration of default episode)	base level: else	2.9944	0.0640	0.0000
vdeltaue_DCLM_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-0,80-0)	-0.0039	0.0015	0.0082

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaue_DCLM_pw2		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-80,104-80)	-0.0037	0.0014	0.0066
vdeltaue_DCLM_pw4		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	max(0,DeltaUEInit_r-163)	0.0022	0.0006	0.0004
vratiotmptei_DCLM_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,20-0)	0.0135	0.0019	0.0000
vratiotmptei_DCLM_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-20,36-20)	0.0054	0.0022	0.0138
mpriordef_DCLM	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	-0.1655	0.0265	0.0000
mpriordef_DCLM	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	-0.3608	0.0352	0.0000
mpriordef_DCLM	L03	Categorical of prior_default_cnt	prior_default_cnt >= 3	-0.4708	0.0404	0.0000
mpriordef_DCLM	Z00	Categorical of prior_default_cnt	base level: else			
vpriordef_DCLM_pw1		Variate piecewise of prior_default_cnt	median(0,prior_default_cnt-3,26-3)	-0.1329	0.0182	0.0000
mltv_i	Miss	Categorical of ltv_i_r[2] (loan-to-value)	ltv_i = .	0.7936	0.1018	0.0000
mltv_i	Z00	Categorical of ltv_i_r[2] (loan-to-value)	base level: else			
vltv_DCLM_pw1		Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_r-0,65-0);	0.0256	0.0014	0.0000
vltv_DCLM_pw2		Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_r-65,76-65)	0.0248	0.0036	0.0000
vltv_DCLM_pw3		Variate piecewise of ltv_i_r[2] (loan-to-value)	max(0,ltv_i_r-76)	0.0652	0.0042	0.0000
vloanraw_DCLM_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-0,48000-0)	0.0000	0.0000	0.0000
vloanraw_DCLM_pw2		Variate piecewise of loansize_raw	max(0,loansize_raw-48000)	0.0000	0.0000	0.0000
mhpa2yb_DCLM	L085	Categorical of hpa2y_blended_r[3]	0<hpa2y_blended_r <= 85	0.5765	0.0938	0.0000
mhpa2yb_DCLM	Z000	Categorical of hpa2y_blended_r[3]	base level: else			
vhpa2yb_DCLM_pw1		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_r-85,104-85)	0.0534	0.0035	0.0000
vhpa2yb_DCLM_pw2		Variate piecewise of hpa2y_blended_r[3]	max(0,hpa2y_blended_r-104)	0.0042	0.0017	0.0117
vDeltaTY1_DCLM_pw2		Variate piecewise of DeltaTy1Init_r[4] (change in 1-year Treasury rate from policy inception to current)	max(0,DeltaTy1Init_r-87)	-0.0004	0.0000	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Mperiod_DCLM	L01	Categorical of period (calendar period)	period < 200603	0.3953	0.0476	0.0000
Mperiod_DCLM	Z01	Categorical of period (calendar period)	base level: else			

Default Transition Model Parameters – FRM15 D_CXM

The model parameters for the FRM15 default to modified cure transition are shown below.

Table 54: Default to Modified Cure Transition FRM15 Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-5.1400	0.1375	0.0000
mdpa_comb13	2	Categorical of dpa (down payment assistance)	dpa= "nonprof"	0.2458	0.0311	0.0000
mdpa_comb13	3	Categorical of dpa (down payment assistance)	dpa = "govt" or dpa = "relative"	0.0699	0.0399	0.0802
mdpa_comb13	4	Categorical of dpa (down payment assistance)	base level: else			
mhpa2yb_DCXM	L084	Categorical of hpa2y_blended_r[1]	hpa2y_blended_R <=84	-0.2794	0.0637	0.0000
mhpa2yb_DCXM	Z00	Categorical of hpa2y_blended_r[1]	base level: else			
vhpa2yb_DCXM_pw1		Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_R-84,100-84)	-0.0080	0.0027	0.0035
vhpa2yb_DCXM_pw2		Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_R-100,116-100)	-0.0135	0.0019	0.0000
mpriordef_DCXM	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	0.2631	0.0227	0.0000
mpriordef_DCXM	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	0.3388	0.0257	0.0000
mpriordef_DCXM	L07	Categorical of prior_default_cnt	prior_default_cnt >= 7	0.1879	0.0458	0.0000
mpriordef_DCXM	PW1	Categorical of prior_default_cnt	3 <= prior_default_cnt <= 6	0.3528	0.0245	0.0000
mpriordef_DCXM	Z00	Categorical of prior_default_cnt	base level: else			
mperiodnbr_DCXM	L03	Categorical of period number (quarters since origination)	period_number <= 3	-1.5440	0.1792	0.0000
mperiodnbr_DCXM	L04	Categorical of period number (quarters since origination)	period_number = 4	-1.1975	0.1337	0.0000
mperiodnbr_DCXM	L05	Categorical of period number	period_number = 5	-0.9410	0.1005	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(quarters since origination)				
mperiodnbr_DCXM	L06	Categorical of period number (quarters since origination)	period_number = 6	-0.5710	0.0753	0.0000
mperiodnbr_DCXM	L07	Categorical of period number (quarters since origination)	period_number = 7	-0.2740	0.0606	0.0000
mperiodnbr_DCXM	Z08	Categorical of period number (quarters since origination)	base level: else			
mcredit_score	L00	Categorical of credit_score	credit_score = 0	-0.4514	0.0779	0.0000
mcredit_score	Z00	Categorical of credit_score	base level: else			
vcredit_DCXM_pw1		Variate piecewise of credit_score	median(0,credit_score-450,545-450)	-0.0040	0.0009	0.0000
vcredit_DCXM_pw2		Variate piecewise of credit_score	median(0,credit_score-545,800-545)	-0.0019	0.0002	0.0000
mdurdefepi_DCXM	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	0.6906	0.0241	0.0000
mdurdefepi_DCXM	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	0.9266	0.0259	0.0000
mdurdefepi_DCXM	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	1.0344	0.0285	0.0000
mdurdefepi_DCXM	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	0.9012	0.0332	0.0000
mdurdefepi_DCXM	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	0.8879	0.0375	0.0000
mdurdefepi_DCXM	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	0.6495	0.0460	0.0000
mdurdefepi_DCXM	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 8	0.5359	0.0398	0.0000
mdurdefepi_DCXM	Z01	Categorical of dur_def_episode (duration of default episode)	base level: else			
vdurdefepi_DCXM_pw1		Variate piecewise of dur_def_episode	median(0,dur_def_episode-7,29-7)	-0.0493	0.0053	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(duration of default episode)				
vDeltaUE_DCXM_pw1		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_R-0,95-0)	-0.0017	0.0007	0.0156
vDeltaUE_DCXM_pw2		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_R-95,184-95)	0.0020	0.0004	0.0000
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	0.7780	0.0601	0.0000
mRatioTmpTei	Z00	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_DCXM_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,24-0)	0.0360	0.0028	0.0000
vratiotmptei_DCXM_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-24,50-24)	0.0105	0.0019	0.0000
vsato_DCXM_pw4		Variate piecewise of sato (spread at origination)	max(sato-.2,0)	-0.1773	0.0400	0.0000
vloanraw_DCXM_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-0,62000-0)	0.0000	0.0000	0.0000
vloanraw_DCXM_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-62000,97000-62000)	0.0000	0.0000	0.0000
vloanraw_DCXM_pw3		Variate piecewise of loansize_raw	max(0,loansize_raw-97000)	0.0000	0.0000	0.0000
vltv_DCXM_pw2		Variate piecewise of ltv_i_r[3] (loan-to-value)	median(0,ltv_i_r-20,86-20)	0.0096	0.0006	0.0000
vltv_DCXM_pw3		Variate piecewise of ltv_i_r[3] (loan-to-value)	max(0,ltv_i_r-86)	0.0927	0.0093	0.0000
muest_DCXM	L42	Categorical of ue_sa_st_r[4] (seasonally adjusted state unemployment)	ue_sa_st_r<=420	-0.0947	0.0294	0.0013
muest_DCXM	L79	Categorical of ue_sa_st_r[4] (seasonally adjusted state unemployment)	ue_sa_st_r>790	-0.1346	0.0217	0.0000
muest_DCXM	Z00	Categorical of ue_sa_st_r[4] (seasonally adjusted state unemployment)	base level: else			

Default Transition Model Parameters – FRM15 D_CXS

The model parameters for the FRM15 default to self-cure transition are shown below.

Table 55: Default to Self-Cure Transition FRM15 Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-0.5390	0.0721	0.0000
mseason	1	Categorical of season	season = "winter"	0.1513	0.0083	0.0000
mseason	2	Categorical of season	season = "spring"	0.1902	0.0085	0.0000
mseason	3	Categorical of season	season = "summer"	0.0718	0.0088	0.0000
mseason	4	Categorical of season	base level: else			
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1	-0.0908	0.0061	0.0000
mjudicial	2	Categorical of judicial (judicial state)	base level: else			
mdpa	1	Categorical of dpa (down payment assistance)	dpa = "govt"	-0.1680	0.0612	0.0061
mdpa	2	Categorical of dpa (down payment assistance)	dpa= "nonprof"	-0.4053	0.0180	0.0000
mdpa	3	Categorical of dpa (down payment assistance)	dpa = "relative"	-0.0290	0.0170	0.0870
mdpa	4	Categorical of dpa (down payment assistance)	base level: else			
mhpa2yb_DCXS	L085	Categorical of hpa2y_blended_r[1]	0<hpa2y_blended_r<= 85	0.0412	0.0181	0.0225
mhpa2yb_DCXS	L095	Categorical of hpa2y_blended_r[1]	85<=hpa2y_blended_r<=95	0.0264	0.0098	0.0072
mhpa2yb_DCXS	Z000	Categorical of hpa2y_blended_r[1]	base level: else			
mperiodnbr_DCXS	L02	Categorical of period number (quarters since origination)	period_number = 2	1.5207	0.0638	0.0000
mperiodnbr_DCXS	L03	Categorical of period number (quarters since origination)	period_number = 3	0.7587	0.0335	0.0000
mperiodnbr_DCXS	L04	Categorical of period number (quarters since origination)	period_number = 4	0.4408	0.0275	0.0000
mperiodnbr_DCXS	L05	Categorical of period number	period_number = 5	0.3069	0.0247	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(quarters since origination)				
mperiodnbr_DCXS	L06	Categorical of period number (quarters since origination)	period_number = 6	0.2558	0.0225	0.0000
mperiodnbr_DCXS	L07	Categorical of period number (quarters since origination)	period_number = 7	0.2036	0.0212	0.0000
mperiodnbr_DCXS	L08	Categorical of period number (quarters since origination)	period_number = 8	0.1017	0.0207	0.0000
mperiodnbr_DCXS	Z09	Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_DCXS_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-8,31-8)	0.0026	0.0007	0.0003
vperiodnbr_DCXS_pw3		Variate piecewise of period number (quarters since origination)	max(0,period_number-52)	0.0093	0.0035	0.0077
mpriordef_DCXS	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	-0.0976	0.0085	0.0000
mpriordef_DCXS	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	-0.1161	0.0100	0.0000
mpriordef_DCXS	L07	Categorical of prior_default_cnt	prior_default_cnt >= 7	-0.0862	0.0150	0.0000
mpriordef_DCXS	PW1	Categorical of prior_default_cnt	3 <= prior_default_cnt <= 6	-0.1080	0.0092	0.0000
mpriordef_DCXS	Z00	Categorical of prior_default_cnt	base level: else			
mcredit_score	L00	Categorical of credit_score	credit_score = 0	0.3175	0.0207	0.0000
mcredit_score	Z00	Categorical of credit_score	base level: else			
vcredit_DCXS_pw1		Variate piecewise of credit_score	median(0,credit_score-465,643-465)	0.0035	0.0001	0.0000
vcredit_DCXS_pw2		Variate piecewise of credit_score	median(0,credit_score-643,800-643)	0.0011	0.0001	0.0000
mdurdefepi_DCXS	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	-0.6603	0.0079	0.0000
mdurdefepi_DCXS	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	-0.9940	0.0101	0.0000
mdurdefepi_DCXS	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	-1.3712	0.0131	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdurdefepi_DCXS	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	-1.5320	0.0159	0.0000
mdurdefepi_DCXS	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	-1.7228	0.0194	0.0000
mdurdefepi_DCXS	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode <= 7	-2.0404	0.0181	0.0000
mdurdefepi_DCXS	Z01	Categorical of dur_def_episode (duration of default episode)	base level: else			
vdurdefepi_DCXS_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-6,20-6)	-0.0493	0.0025	0.0000
vdeltaue_DCXS_pw1		Variate piecewise of DeltaUEInit_r^2 (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-0,78-0)	0.0020	0.0004	0.0000
vdeltaue_DCXS_pw2		Variate piecewise of DeltaUEInit_r^2 (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-78,107-78)	-0.0029	0.0004	0.0000
vdeltaue_DCXS_pw4		Variate piecewise of DeltaUEInit_r^2 (change in unemployment rate from policy inception to current)	max(0,DeltaUEInit_r-125)	-0.0011	0.0001	0.0000
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	-0.1547	0.0553	0.0052
mRatioTmpTei	Z00	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_DCXS_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,12-0)	-0.0128	0.0048	0.0081
vratiotmptei_DCXS_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-12,28-12)	-0.0160	0.0008	0.0000
vratiotmptei_DCXS_pw3		Variate piecewise of ratio_tmp_tei (front-end ratio)	max(0,ratio_tmp_tei-28)	-0.0028	0.0009	0.0009

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vsato_DCXS_pw2		Variate piecewise of sato (spread at origination)	median(sato-(-.4),0,.14-(-.4))	-0.1070	0.0155	0.0000
vsato_DCXS_pw3		Variate piecewise of sato (spread at origination)	max(sato-.14,0)	-0.1050	0.0155	0.0000
vltv_DCXS_pw1		Variate piecewise of ltv_i_r[3] (loan-to-value)	median(0,ltv_i_r-0,19-0)	0.0236	0.0010	0.0000
vltv_DCXS_pw2		Variate piecewise of ltv_i_r[3] (loan-to-value)	median(0,ltv_i_r-19,83-19)	-0.0068	0.0003	0.0000
vltv_DCXS_pw3		Variate piecewise of ltv_i_r[3] (loan-to-value)	median(0,ltv_i_r-83,88-83)	-0.0269	0.0044	0.0000
vltv_DCXS_pw4		Variate piecewise of ltv_i_r[3] (loan-to-value)	median(0,ltv_i_r-88,91-88)	-0.0623	0.0100	0.0000
vDeltaTY1_DCXS_pw3		Variate piecewise of DeltaTy1Init_r[3] (change in 1-year Treasury rate from policy inception to current)	max(0,DeltaTy1Init_r-80)	0.0000	0.0000	0.0002
vUEblend_DCXS_pw2		Variate piecewise of ue_blended_r[4] (change in unemployment rate)	max(0,ue_blended_r-420)	-0.0001	0.0000	0.0000

Default Transition Model Parameters – FRM15 D_END

The model parameters for the fixed rate 15-year mortgage default to end transition are shown below.

Table 56: Default to End Transition FRM15 Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-1.2696	0.1866	0.0000
mseason	1	Categorical of season	season = "winter"	-0.0469	0.0239	0.0493
mseason	2	Categorical of season	season = "spring"	-0.0041	0.0241	0.8639
mseason	3	Categorical of season	season = "summer"	0.0923	0.0244	0.0002
mseason	4	Categorical of season	base level: else			
mdpa	1	Categorical of dpa (down payment assistance)	dpa = "govt"	-0.4067	0.2464	0.0989
mdpa	2	Categorical of dpa (down payment assistance)	dpa= "nonprof"	-0.2422	0.0670	0.0003

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdpa	3	Categorical of dpa (down payment assistance)	dpa = "relative"	0.0564	0.0544	0.2998
mdpa	4	Categorical of dpa (down payment assistance)	base level: else			
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	0.1100	0.0286	0.0001
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else			
vhpa2yb_DEND_pw1		Variate piecewise of hpa2y_blended_r[1]	median(0,hpa2y_blended_r-0,104-0)	-0.0098	0.0015	0.0000
vhpa2yb_DEND_pw2		Variate piecewise of hpa2y_blended_r[1]	max(0,hpa2y_blended_r-104)	0.0176	0.0012	0.0000
vperiodnbr_DEND_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-10,30-10)	0.0056	0.0020	0.0051
vperiodnbr_DEND_pw3		Variate piecewise of period number (quarters since origination)	max(0,period_number-52)	0.1989	0.0058	0.0000
mcredit_score	L00	Categorical of credit_score	credit_score = 0	0.6594	0.0500	0.0000
mcredit_score	Z00	Categorical of credit_score	base level: else			
vcredit_DEND_pw1		Variate piecewise of credit_score	median(0,credit_score-470,800-470)	0.0030	0.0002	0.0000
vdurdefepi_DEND_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode,12)	-0.1150	0.0030	0.0000
mpriordef_DEND	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	-0.3313	0.0234	0.0000
mpriordef_DEND	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	-0.4924	0.0289	0.0000
mpriordef_DEND	L03	Categorical of prior_default_cnt	prior_default_cnt >= 3	-0.7106	0.0291	0.0000
mpriordef_DEND	Z00	Categorical of prior_default_cnt	base level: else			
vpriordef_DEND_pw1		Variate piecewise of prior_default_cnt	max(0,prior_default_cnt-3)	-0.0587	0.0074	0.0000
mltv_i	Miss	Categorical of ltv_i_r[2] (loan-to-value)	ltv_i = .	-0.5056	0.0418	0.0000
mltv_i	Z00	Categorical of ltv_i_r[2] (loan-to-value)	base level: else			
vltv_DEND_pw1		Variate piecewise of ltv_i_r[2] (loan-to-value)	median(0,ltv_i_r-0,63-0)	-0.0191	0.0008	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vltv_DEND_pw2		Variate piecewise of ltv_i_r[2] (loan-to-value)	max(0,ltv_i_r-63)	-0.0126	0.0018	0.0000
vloanraw_DEND_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-0,55000-0)	0.0000	0.0000	0.0356
vloanraw_DEND_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-55000,120000-55000)	0.0000	0.0000	0.0000
vloanraw_DEND_pw3		Variate piecewise of loansize_raw	max(0,loansize_raw-120000)	0.0000	0.0000	0.0000
vDeltaTY1_DEND_pw2		Variate piecewise of DeltaTy1Init_r[3] (change in 1-year Treasury rate from policy inception to current)	median(0,DeltaTy1Init_R-6,200-6)	0.0004	0.0002	0.0265
Mperiod_DEND	L01	Categorical of period (calendar period)	period < 200603	0.5798	0.0301	0.0000
Mperiod_DEND	Z01	Categorical of period (calendar period)	base level: else			
vUEblend_DEND_pw1		Variate piecewise of ue_blended_r[4] (change in unemployment rate)	median(0,ue_blended_r-0,800-0)	-0.0012	0.0001	0.0000
vUEblend_DEND_pw2		Variate piecewise of ue_blended_r[4] (change in unemployment rate)	max(0,ue_blended_r-800)	-0.0008	0.0001	0.0000

Default Transition Model Parameters – ARM D_CLM

The model parameters for the ARM default to claim transition are shown below.

Table 57: Default to Claim Transition ARM Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-12.2296	1.3414	0.0000
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1	-0.1112	0.0103	0.0000
mjudicial	2	Categorical of judicial (judicial state)	base level: else			
mdpa	1	Categorical of dpa (down payment assistance)	dpa = "govt"	0.4439	0.0447	0.0000
mdpa	2	Categorical of dpa (down	dpa= "nonprof"	0.5450	0.0158	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		payment assistance)				
mdpa	3	Categorical of dpa (down payment assistance)	dpa = "relative"	0.0308	0.0168	0.0670
mdpa	4	Categorical of dpa (down payment assistance)	base level: else			
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	-0.2414	0.0126	0.0000
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else			
mycslope_D	L01	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r<=111	-0.0971	0.0166	0.0000
mycslope_D	L02	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=875	-0.2668	0.0200	0.0000
mycslope_D	L03	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=2000	0.1319	0.0222	0.0000
mycslope_D	Z00	Categorical of ycslope_r[1] (yield curve slope)	base level: else			
mperiodnbr_DCLM	L02	Categorical of period number (quarters since origination)	period_number <= 2	-1.2796	0.3977	0.0013
mperiodnbr_DCLM	L03	Categorical of period number (quarters since origination)	period_number = 3	-0.6893	0.1351	0.0000
mperiodnbr_DCLM	L04	Categorical of period number (quarters since origination)	period_number = 4	-0.3431	0.0829	0.0000
mperiodnbr_DCLM	Z05	Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_DCLM_pw2		Variate piecewise of period number (quarters since origination)	median(0,period_number-10,18-10)	0.0454	0.0028	0.0000
vperiodnbr_DCLM_pw3		Variate piecewise of period number (quarters since origination)	median(0,period_number-18,64-18)	-0.0199	0.0009	0.0000
vperiodnbr_DCLM_pw4		Variate piecewise of period number	median(0,period_number-64,109-64)	0.0187	0.0025	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(quarters since origination)				
mcredit_DCLM	L01	Categorical of credit_score	credit_score = 0	0.3707	0.0641	0.0000
mcredit_DCLM	Z00	Categorical of credit_score	base level: else			
vcredit_DCLM_pw1		Variate piecewise of credit_score	median(0,credit_score-300,720-300)	0.0011	0.0002	0.0000
vcredit_DCLM_pw2		Variate piecewise of credit_score	median(0,credit_score-720,800-720)	0.0073	0.0009	0.0000
mdurdefepi_DCLM	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	-3.5267	0.0448	0.0000
mdurdefepi_DCLM	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	-2.7778	0.0439	0.0000
mdurdefepi_DCLM	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	-2.4646	0.0440	0.0000
mdurdefepi_DCLM	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	-2.3897	0.0444	0.0000
mdurdefepi_DCLM	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	-2.3815	0.0451	0.0000
mdurdefepi_DCLM	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	-2.3757	0.0459	0.0000
mdurdefepi_DCLM	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	-2.4462	0.0470	0.0000
mdurdefepi_DCLM	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 9	-2.4804	0.0480	0.0000
mdurdefepi_DCLM	L10	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 10	-2.5116	0.0491	0.0000
mdurdefepi_DCLM	L11	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 11	-3.7707	0.0435	0.0000
mdurdefepi_DCLM	Z01	Categorical of dur_def_episode (duration of default episode)	base level: else			
vdurdefepi_DCLM_pw1		Variate piecewise of	median(0,dur_def_episode-10,30-10)	0.0816	0.0017	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		dur_def_episode (duration of default episode)				
vdurdefepi_DCLM_pw2		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-30,40-30)	-0.1432	0.0082	0.0000
vdeltaue_dclm_pw2		Variate piecewise of DeltaUEInit_r^2 (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-63,100-63)	-0.0021	0.0007	0.0017
vdeltaue_dclm_pw3		Variate piecewise of DeltaUEInit_r^2 (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-100,116-100)	0.0082	0.0012	0.0000
vdeltaue_dclm_pw4		Variate piecewise of DeltaUEInit_r^2 (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-116,218-116)	0.0014	0.0002	0.0000
vdeltaue_dclm_pw5		Variate piecewise of DeltaUEInit_r^2 (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-218,330-218)	0.0019	0.0004	0.0000
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	0.1682	0.0164	0.0000
mRatioTmpTei	Z00	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_DCLM_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-24,36-24)	0.0045	0.0015	0.0021
vratiotmptei_DCLM_pw3		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-36,50-36)	-0.0108	0.0031	0.0004
mpriordef_D	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	-0.3735	0.0131	0.0000
mpriordef_D	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	-0.5471	0.0174	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_D	L03	Categorical of prior_default_cnt	3 <= prior_default_cnt <= 8	-0.7914	0.0181	0.0000
mpriordef_D	L04	Categorical of prior_default_cnt	9 <= prior_default_cnt <= 13	-1.3607	0.0669	0.0000
mpriordef_D	L05	Categorical of prior_default_cnt	prior_default_cnt >= 14	-2.3812	0.3186	0.0000
mpriordef_D	Z00	Categorical of prior_default_cnt	base level: else			
vdeltaUEpr3_DCLM_pw1		Variate piecewise of deltauepr3_r[3] (change in unemployment from 3 quarters prior)	min(0,deltauepr3_r-(-20))	-0.0012	0.0002	0.0000
vdeltaUEpr3_DCLM_pw2		Variate piecewise of deltauepr3_r[3] (change in unemployment from 3 quarters prior)	median(deltauepr3_r-(-20),0,10-(-20))	-0.0026	0.0005	0.0000
vdeltaUEpr3_DCLM_pw3		Variate piecewise of deltauepr3_r[3] (change in unemployment from 3 quarters prior)	max(deltauepr3_r-10,0)	-0.0006	0.0001	0.0000
vltv_DCLM_pw1		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-0,70-0)	0.0197	0.0016	0.0000
vltv_DCLM_pw2		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-70,81-70)	0.0060	0.0024	0.0122
vltv_DCLM_pw3		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-81,91-81)	0.0169	0.0021	0.0000
vltv_DCLM_pw4		Variate piecewise of ltv_i_r[4] (loan-to-value)	max(0,ltv_i_r-91)	0.0515	0.0057	0.0000
vloanraw_DCLM_pw1		Variate piecewise of loansize_raw	median(0,loansize_raw-30000,109000-30000)	0.0000	0.0000	0.0000
vloanraw_DCLM_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-109000,143000-109000)	0.0000	0.0000	0.0000
vloanraw_DCLM_pw3		Variate piecewise of loansize_raw	median(0,loansize_raw-143000,200000-143000)	0.0000	0.0000	0.0000
vloanraw_DCLM_pw4		Variate piecewise of loansize_raw	max(0,loansize_raw-200000)	0.0000	0.0000	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mDeltaTY10	L01	Categorical of DeltaTy10Init_r[5] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	0.3299	0.0174	0.0000
mDeltaTY10	Z00	Categorical of DeltaTy10Init_r[5] (change in 10-year Treasury rate from policy inception to current)	base level: else			
vprior3uest_DCLM_pw1		Variate piecewise of prior3_ue_sa_st (change in prior-3 seasonally adjusted unemployment rate)	max(13.5, prior3_ue_sa_st)	0.6771	0.0986	0.0000
vUEblend_DCLM_pw1		Variate piecewise of ue_blended_r[6] (change in unemployment rate)	median(200,ue_blended_r,450)	0.0033	0.0002	0.0000
vUEblend_DCLM_pw2		Variate piecewise of ue_blended_r[6] (change in unemployment rate)	median(0,ue_blended_r-450,850-450)	-0.0002	0.0001	0.0032
vUEblend_DCLM_pw3		Variate piecewise of ue_blended_r[6] (change in unemployment rate)	median(0,ue_blended_r-850,1500-850)	0.0004	0.0001	0.0000

Default Transition Model Parameters – ARM D_CXM

The model parameters for the ARM default to modified cure transition are shown below.

Table 58: Default to Modified Cure Transition ARM Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-2.8977	0.1489	0.0000
mseason	1	Categorical of season	season = "winter"	-0.0724	0.0160	0.0000
mseason	2	Categorical of season	season = "spring"	0.0589	0.0156	0.0002

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mseason	3	Categorical of season	season = "summer"	-0.0039	0.0164	0.8133
mseason	4	Categorical of season	base level: else			
mdpa	1	Categorical of dpa (down payment assistance)	dpa = "govt"	0.2899	0.0547	0.0000
mdpa	2	Categorical of dpa (down payment assistance)	dpa= "nonprof"	0.4314	0.0182	0.0000
mdpa	3	Categorical of dpa (down payment assistance)	dpa = "relative"	0.1693	0.0192	0.0000
mdpa	4	Categorical of dpa (down payment assistance)	base level: else			
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	0.0573	0.0175	0.0011
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else			
mrfnc_ind	2	Categorical of rfnc_ind (refinanced loan indicator)	rfnc_ind <> "N"	0.2985	0.0238	0.0000
mrfnc_ind	3	Categorical of rfnc_ind (refinanced loan indicator)	base level: else			
mycslope_D	L01	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r<=111	0.4210	0.0218	0.0000
mycslope_D	L02	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=2000	0.3438	0.0215	0.0000
mycslope_D	L03	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=875	0.3674	0.0230	0.0000
mycslope_D	Z00	Categorical of ycslope_r[1] (yield curve slope)	base level: else			
mhpa2yb_D	L085	Categorical of hpa2y_blended_r[2]	hpa2y_blended_r <= 85	0.4248	0.0227	0.0000
mhpa2yb_D	Z000	Categorical of hpa2y_blended_r[2]	base level: else			
mperiodnbr_DCXM	L02	Categorical of period number (quarters since origination)	period_number <= 2	-1.4567	0.7155	0.0418

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mperiodnbr_DCXM	L03	Categorical of period number (quarters since origination)	period_number = 3	-0.9837	0.2608	0.0002
mperiodnbr_DCXM	L04	Categorical of period number (quarters since origination)	period_number = 4	-0.5427	0.1574	0.0006
mperiodnbr_DCXM	Z05	Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_DCXM_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-5,9-5)	0.2207	0.0151	0.0000
vperiodnbr_DCXM_pw3		Variate piecewise of period number (quarters since origination)	median(0,period_number-18,36-18)	-0.0199	0.0016	0.0000
vperiodnbr_DCXM_pw4		Variate piecewise of period number (quarters since origination)	median(0,period_number-36,50-36)	0.0453	0.0021	0.0000
mcredit_DCXM	L01	Categorical of credit_score	credit_score = 0	-0.5394	0.0309	0.0000
mcredit_DCXM	L02	Categorical of credit_score	credit_score<525	-0.1638	0.0552	0.0030
mcredit_DCXM	Z00	Categorical of credit_score	base level: else			
vcredit_DCXM_pw1		Variate piecewise of credit_score	median(0,credit_score-525,645-525)	-0.0013	0.0003	0.0000
vcredit_DCXM_pw2		Variate piecewise of credit_score	median(0,credit_score-645,800-645)	-0.0035	0.0004	0.0000
mdurdefepi_DCXM	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	-3.6453	0.0448	0.0000
mdurdefepi_DCXM	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	-3.4557	0.0451	0.0000
mdurdefepi_DCXM	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	-3.4643	0.0459	0.0000
mdurdefepi_DCXM	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 5	-4.2008	0.0444	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdurdefepi_DCXM	Z01	Categorical of dur_def_episode (duration of default episode)	base level: else			
vdurdefepi_DCXM_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-5,7-5)	0.2086	0.0098	0.0000
vdurdefepi_DCXM_pw2		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-7,100-7)	-0.0542	0.0023	0.0000
vdeltaue_DCXM_pw2		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-63,100-63)	-0.0065	0.0007	0.0000
vdeltaue_DCXM_pw3		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-100,116-100)	-0.0042	0.0015	0.0045
vdeltaue_DCXM_pw4		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-116,218-116)	0.0020	0.0003	0.0000
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	0.5549	0.0546	0.0000
mRatioTmpTei	Z00	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_DCXM_pw1		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-0,24-0)	0.0164	0.0024	0.0000
vratiotmptei_DCXM_pw2		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-24,36-24)	0.0057	0.0019	0.0024
vratiotmptei_DCXM_pw3		Variate piecewise of ratio_tmp_tei (front-end ratio)	median(0,ratio_tmp_tei-36,50-36)	0.0088	0.0031	0.0043

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mpriordef_D	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	0.4500	0.0174	0.0000
mpriordef_D	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	0.6260	0.0195	0.0000
mpriordef_D	L03	Categorical of prior_default_cnt	3 <= prior_default_cnt <= 8	0.8239	0.0193	0.0000
mpriordef_D	L04	Categorical of prior_default_cnt	9 <= prior_default_cnt <= 13	0.6818	0.0403	0.0000
mpriordef_D	L05	Categorical of prior_default_cnt	prior_default_cnt >= 14	0.4589	0.1143	0.0001
mpriordef_D	Z00	Categorical of prior_default_cnt	base level: else			
vdeltaUEpr3_DCXM_pw2		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	median(deltauepr3_r-(-20),0,10-(-20))	0.0063	0.0005	0.0000
vdeltaUEpr3_DCXM_pw3		Variate piecewise of deltauepr3_r[4] (change in unemployment from 3 quarters prior)	max(deltauepr3_r-10,0)	0.0018	0.0001	0.0000
mltv_i	Miss	Categorical of ltv_i_r[5] (loan-to-value)	ltv_i = .	-0.4518	0.0943	0.0000
mltv_i	Z00	Categorical of ltv_i_r[5] (loan-to-value)	base level: else			
vltv_DCXM_pw1		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-0,68-0)	0.0068	0.0017	0.0001
vltv_DCXM_pw2		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-68,81-68)	0.0162	0.0023	0.0000
vltv_DCXM_pw3		Variate piecewise of ltv_i_r[5] (loan-to-value)	median(0,ltv_i_r-81,91-81)	-0.0154	0.0027	0.0000
vltv_DCXM_pw4		Variate piecewise of ltv_i_r[5] (loan-to-value)	max(0,ltv_i_r-91)	-0.0305	0.0075	0.0000
vloanraw_DCXM_pw1		Variate piecewise of loansize_raw	median(30000,loansize_raw,109000)	0.0000	0.0000	0.0000
vloanraw_DCXM_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-109000,143000-109000)	0.0000	0.0000	0.0000
vloanraw_DCXM_pw3		Variate piecewise of loansize_raw	median(0,loansize_raw-143000,200000-143000)	0.0000	0.0000	0.0000
vloanraw_DCXM_pw4		Variate piecewise of loansize_raw	median(0,loansize_raw-200000,350000-200000)	0.0000	0.0000	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mDeltaTY10	L01	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	-0.1180	0.0166	0.0000
mDeltaTY10	Z00	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	base level: else			
vUEblend_DCXM_pw2		Variate piecewise of ue_blended_r[7] (change in unemployment rate)	median(0,ue_blended_r-450,850-450)	0.0004	0.0001	0.0000

Default Transition Model Parameters – ARM D_CXS

The model parameters for the ARM default to self-cure transition are shown below.

Table 59: Default to Self-Cure Transition ARM Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				4.5734	0.9609	0.0000
mseason	1	Categorical of season	season = "winter"	0.2483	0.0070	0.0000
mseason	2	Categorical of season	season = "spring"	0.2393	0.0071	0.0000
mseason	3	Categorical of season	season = "summer"	0.0825	0.0075	0.0000
mseason	4	Categorical of season	base level: else			
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1	-0.1484	0.0052	0.0000
mjudicial	2	Categorical of judicial (judicial state)	base level: else			
mdpa	1	Categorical of dpa (down payment assistance)	dpa = "govt"	-0.1834	0.0285	0.0000
mdpa	2	Categorical of dpa (down payment assistance)	dpa= "nonprof"	-0.2195	0.0091	0.0000
mdpa	3	Categorical of dpa (down payment assistance)	dpa = "relative"	0.0113	0.0083	0.1710

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdpa	4	Categorical of dpa (down payment assistance)	base level: else			
mrfnc_ind	2	Categorical of rfnc_ind (refinanced loan indicator)	rfnc_ind <> "N"	-0.0495	0.0068	0.0000
mrfnc_ind	3	Categorical of rfnc_ind (refinanced loan indicator)	base level: else			
mycslope_D	L01	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r<=111	-0.0899	0.0097	0.0000
mycslope_D	L02	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=875	0.1399	0.0096	0.0000
mycslope_D	L03	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=2000	0.1286	0.0121	0.0000
mycslope_D	Z00	Categorical of ycslope_r[1] (yield curve slope)	base level: else			
mhpa2yb_D	L085	Categorical of hpa2y_blended_r[2]	hpa2y_blended_r <= 85	0.1389	0.0120	0.0000
mhpa2yb_D	Z000	Categorical of hpa2y_blended_r[2]	base level: else			
mperiodnbr_DCXS	L02	Categorical of period number (quarters since origination)	period_number <= 2	2.0309	0.0849	0.0000
mperiodnbr_DCXS	L03	Categorical of period number (quarters since origination)	period_number = 3	0.9136	0.0370	0.0000
mperiodnbr_DCXS	L04	Categorical of period number (quarters since origination)	period_number = 4	0.3563	0.0302	0.0000
mperiodnbr_DCXS	Z05	Categorical of period number (quarters since origination)	base level: else			
vperiodnbr_DCXS_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-5,9-5)	-0.1226	0.0052	0.0000
vperiodnbr_DCXS_pw2		Variate piecewise of period number (quarters since origination)	median(0,period_number-9,18-9)	0.0083	0.0016	0.0000
vperiodnbr_DCXS_pw3		Variate piecewise of period number (quarters since origination)	median(0,period_number-18,36-18)	0.0152	0.0007	0.0000
vperiodnbr_DCXS_pw4		Variate piecewise of period number	median(0,period_number-36,50-36)	0.0114	0.0009	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(quarters since origination)				
vcredit_DCXS_pw1		Variate piecewise of credit_score	median(0,credit_score-525,645-525)	0.0024	0.0001	0.0000
vcredit_DCXS_pw2		Variate piecewise of credit_score	median(0,credit_score-645,800-645)	0.0011	0.0002	0.0000
vdurdefepi_DCXS_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-5,7-5)	-0.8143	0.0049	0.0000
vdurdefepi_DCXS_pw2		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-7,100-7)	-0.0141	0.0009	0.0000
vdeltaue_DCXS_pw1		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-0,63-0)	0.0023	0.0008	0.0054
vdeltaue_DCXS_pw2		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-63,100-63)	-0.0020	0.0003	0.0000
vdeltaue_DCXS_pw3		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-100,116-100)	-0.0048	0.0006	0.0000
vdeltaue_DCXS_pw4		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-116,218-116)	-0.0013	0.0001	0.0000
vdeltaue_DCXS_pw5		Variate piecewise of DeltaUEInit_r[3] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-218,330-218)	-0.0005	0.0002	0.0171
vpriordef_DCXS_pw1		Variate piecewise of prior_default_cnt	median(0,prior_default_cnt-14,29-14)	0.0228	0.0101	0.0239
vsato_DCXS_pw2		Variate piecewise of sato (spread at origination)	median(sato-(-.1),0,.7-(-.1))	-0.1070	0.0336	0.0014

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vltv_DCXS_pw1		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-0,68-0)	-0.0054	0.0004	0.0000
vltv_DCXS_pw2		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-68,81-68)	-0.0111	0.0010	0.0000
vltv_DCXS_pw3		Variate piecewise of ltv_i_r[4] (loan-to-value)	median(0,ltv_i_r-81,91-81)	-0.0049	0.0012	0.0001
vltv_DCXS_pw4		Variate piecewise of ltv_i_r[4] (loan-to-value)	max(0,ltv_i_r-91)	-0.0518	0.0034	0.0000
vloanraw_DCXS_pw1		Variate piecewise of loansize_raw	median(30000,loansize_raw,143000)	0.0000	0.0000	0.0000
vloanraw_DCXS_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-143000,200000-143000)	0.0000	0.0000	0.0000
vloanraw_DCXS_pw3		Variate piecewise of loansize_raw	median(0,loansize_raw-200000,350000-200000)	0.0000	0.0000	0.0002
vDeltaTY1_DCXS_pw1		Variate piecewise of DeltaTy1Init_r[5] (change in 1-year Treasury rate from policy inception to current)	median(0,DeltaTy1Init_r-0,22-0)	-0.0041	0.0007	0.0000
vDeltaTY1_DCXS_pw2		Variate piecewise of DeltaTy1Init_r[5] (change in 1-year Treasury rate from policy inception to current)	median(0,DeltaTy1Init_r-22,80-22)	0.0040	0.0002	0.0000
vDeltaTY1_DCXS_pw3		Variate piecewise of DeltaTy1Init_r[5] (change in 1-year Treasury rate from policy inception to current)	max(0,DeltaTy1Init_r-80)	0.0002	0.0000	0.0000
mDeltaTY10	L01	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	0.0867	0.0083	0.0000
mDeltaTY10	Z00	Categorical of DeltaTy10Init_r[6] (change in 10-year Treasury rate from policy inception to current)	base level: else			
vprior3uest_DCXS_pw1		Variate piecewise of prior3_ue_sa_st (change in prior-3 seasonally	max(13.5,prior3_ue_sa_st)	-0.3563	0.0711	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		adjusted unemployment rate)				
vUEblend_DCXS_pw1		Variate piecewise of ue_blended_r[7] (change in unemployment rate)	median(200,ue_blended_r,450)	-0.0005	0.0001	0.0000
vUEblend_DCXS_pw2		Variate piecewise of ue_blended_r[7] (change in unemployment rate)	median(0,ue_blended_r-450,850-450)	-0.0003	0.0000	0.0000
vUEblend_DCXS_pw3		Variate piecewise of ue_blended_r[7] (change in unemployment rate)	median(0,ue_blended_r-850,1500-850)	-0.0003	0.0000	0.0000

Default Transition Model Parameters – ARM D_END

The model parameters for the ARM default to end transition are shown below.

Table 60: Default to End Transition ARM Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-2.5053	0.2005	0.0000
mseason	1	Categorical of season	season = "winter"	-0.1490	0.0183	0.0000
mseason	2	Categorical of season	season = "spring"	-0.0436	0.0183	0.0171
mseason	3	Categorical of season	season = "summer"	-0.0423	0.0188	0.0244
mseason	4	Categorical of season	base level: else			
mjudicial	1	Categorical of judicial (judicial state)	judicial = 1	-0.2359	0.0139	0.0000
mjudicial	2	Categorical of judicial (judicial state)	base level: else			
mdpa	1	Categorical of dpa (down payment assistance)	dpa = "govt"	-0.5936	0.0978	0.0000
mdpa	2	Categorical of dpa (down payment assistance)	dpa= "nonprof"	-0.6585	0.0316	0.0000
mdpa	3	Categorical of dpa (down payment assistance)	dpa = "relative"	0.0787	0.0208	0.0002
mdpa	4	Categorical of dpa (down payment assistance)	base level: else			

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	0.1664	0.0153	0.0000
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else			
mycslope_D	L01	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r<=111	0.4153	0.0217	0.0000
mycslope_D	L02	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=875	-1.1507	0.0343	0.0000
mycslope_D	L03	Categorical of ycslope_r[1] (yield curve slope)	ycslope_r>=2000	-0.8391	0.0417	0.0000
mycslope_D	Z00	Categorical of ycslope_r[1] (yield curve slope)	base level: else			
mhpa2yb_D	L085	Categorical of hpa2y_blended_r[2]	hpa2y_blended_r <= 85	-0.2333	0.0352	0.0000
mhpa2yb_D	Z000	Categorical of hpa2y_blended_r[2]	base level: else			
vperiodnbr_DEND_pw1		Variate piecewise of period number (quarters since origination)	median(0,period_number-5,9-5)	-0.0506	0.0126	0.0001
vperiodnbr_DEND_pw2		Variate piecewise of period number (quarters since origination)	median(0,period_number-9,18-9)	-0.0114	0.0041	0.0056
vperiodnbr_DEND_pw3		Variate piecewise of period number (quarters since origination)	median(0,period_number-18,36-18)	0.0203	0.0017	0.0000
vperiodnbr_DEND_pw4		Variate piecewise of period number (quarters since origination)	median(0,period_number-36,50-36)	-0.0182	0.0021	0.0000
mcredit_DEND	L01	Categorical of credit_score	credit_score = 0	0.9322	0.0690	0.0000
mcredit_DEND	L02	Categorical of credit_score	credit_score<525	0.2885	0.1310	0.0277
mcredit_DEND	Z00	Categorical of credit_score	base level: else			
vcredit_DEND_pw1		Variate piecewise of credit_score	median(0,credit_score-525,645-525)	0.0054	0.0007	0.0000
vdurdefepi_DEND_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-5,7-5)	-0.1758	0.0097	0.0000
vdurdefepi_DEND_pw2		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-7,100-7)	-0.0108	0.0015	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaue_DEND_pw1		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-0,63-0)	0.0068	0.0021	0.0011
vdeltaue_DEND_pw2		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-63,100-63)	-0.0043	0.0008	0.0000
vdeltaue_DEND_pw3		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-100,116-100)	-0.0060	0.0015	0.0001
vdeltaue_DEND_pw4		Variate piecewise of DeltaUEInit_r[2] (change in unemployment rate from policy inception to current)	median(0,DeltaUEInit_r-116,218-116)	-0.0062	0.0004	0.0000
mpriordef_D	L01	Categorical of prior_default_cnt	prior_default_cnt = 1	-0.1275	0.0169	0.0000
mpriordef_D	L02	Categorical of prior_default_cnt	prior_default_cnt = 2	-0.2641	0.0221	0.0000
mpriordef_D	L03	Categorical of prior_default_cnt	3 <= prior_default_cnt <= 8	-0.6406	0.0232	0.0000
mpriordef_D	L04	Categorical of prior_default_cnt	9 <= prior_default_cnt <= 13	-1.2027	0.0587	0.0000
mpriordef_D	L05	Categorical of prior_default_cnt	prior_default_cnt >= 14	-1.4443	0.1398	0.0000
mpriordef_D	Z00	Categorical of prior_default_cnt	base level: else			
mltv_i	Miss	Categorical of ltv_i_r[3] (loan-to-value)	ltv_i = .	0.2171	0.0690	0.0017
mltv_i	Z00	Categorical of ltv_i_r[3] (loan-to-value)	base level: else			
vltv_DEND_pw1		Variate piecewise of ltv_i_r[3] (loan-to-value)	median(0,ltv_i_r-0,68-0)	-0.0103	0.0016	0.0000
vltv_DEND_pw3		Variate piecewise of ltv_i_r[3] (loan-to-value)	median(0,ltv_i_r-81,91-81)	-0.0119	0.0028	0.0000
vltv_DEND_pw4		Variate piecewise of ltv_i_r[3] (loan-to-value)	max(0,ltv_i_r-91)	-0.0920	0.0088	0.0000
vloanraw_DEND_pw1		Variate piecewise of loansize_raw	median(30000,loansize_raw,143000)	0.0000	0.0000	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
vloanraw_DEND_pw2		Variate piecewise of loansize_raw	median(0,loansize_raw-143000,200000-143000)	0.0000	0.0000	0.0000
vloanraw_DEND_pw3		Variate piecewise of loansize_raw	median(0,loansize_raw-200000,350000-200000)	0.0000	0.0000	0.0000
vDeltaTY1_DEND_pw1		Variate piecewise of DeltaTy1Init_r[4] (change in 1-year Treasury rate from policy inception to current)	median(0,DeltaTy1Init_r-0,22-0)	0.0097	0.0024	0.0000
vDeltaTY1_DEND_pw2		Variate piecewise of DeltaTy1Init_r[4] (change in 1-year Treasury rate from policy inception to current)	median(0,DeltaTy1Init_r-22,80-22)	-0.0065	0.0005	0.0000
vDeltaTY1_DEND_pw3		Variate piecewise of DeltaTy1Init_r[4] (change in 1-year Treasury rate from policy inception to current)	max(0,DeltaTy1Init_r-80)	-0.0002	0.0000	0.0000
mDeltaTY10	L01	Categorical of DeltaTy10Init_r[5] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	-0.3936	0.0301	0.0000
mDeltaTY10	Z00	Categorical of DeltaTy10Init_r[5] (change in 10-year Treasury rate from policy inception to current)	base level: else			
vUEblend_DEND_pw1		Variate piecewise of ue_blended_r[6] (change in unemployment rate)	median(200,ue_blended_r,450)	-0.0028	0.0002	0.0000
vUEblend_DEND_pw2		Variate piecewise of ue_blended_r[6] (change in unemployment rate)	median(0,ue_blended_r-450,850-450)	-0.0003	0.0001	0.0001
vUEblend_DEND_pw3		Variate piecewise of ue_blended_r[6] (change in unemployment rate)	median(0,ue_blended_r-850,1500-850)	-0.0012	0.0002	0.0000

Section 3: Model Validation

Model validation was accomplished by applying the model structure developed using the training set to the validation dataset. The application of the model to the validation data produces the probability of each type of transition. The actual target variable is then compared to the predicted target variable to ensure the model fits the transition process without over-fitting the actual data.

Specifically, for the final condition transition state, we calculate the actual transition rate and the predicted transition rate. The actual transition is 1.0 for the final transition state of the record and 0.0 for all other transition states. The probability of each final transition state for each record in the validation dataset is derived from the model parameters. The sum of all predicted final condition transition states' probabilities is 1.0 for each record.

Simple quantile plots are then created for each final condition transition state. All records are sorted, or ranked, in increasing order by the predicted probability. Ten equal sized decile groups are created with 10% of the records in each group. The sum of the actual probability and the sum of the predicted probability for each ending condition within each decile is calculated. The total number of actual and predicted transitions are compared for consistency. The objective of a model is to have a significant spread in predicted values while maintaining a close relationship between the resulting actual and predicted values.

The validation charts shown below show that the spread in prediction is consistent between the actual and predicted experience, and also the actual vs. predicted ratio for each decile are consistent as well.

Current FRM30NSR Transition Models

The validation charts by ending condition for the FRM30NSR models are shown below.

Figure 13: Current FRM30NSR Transition Model Validation - Ending Condition Streamlined Refinance

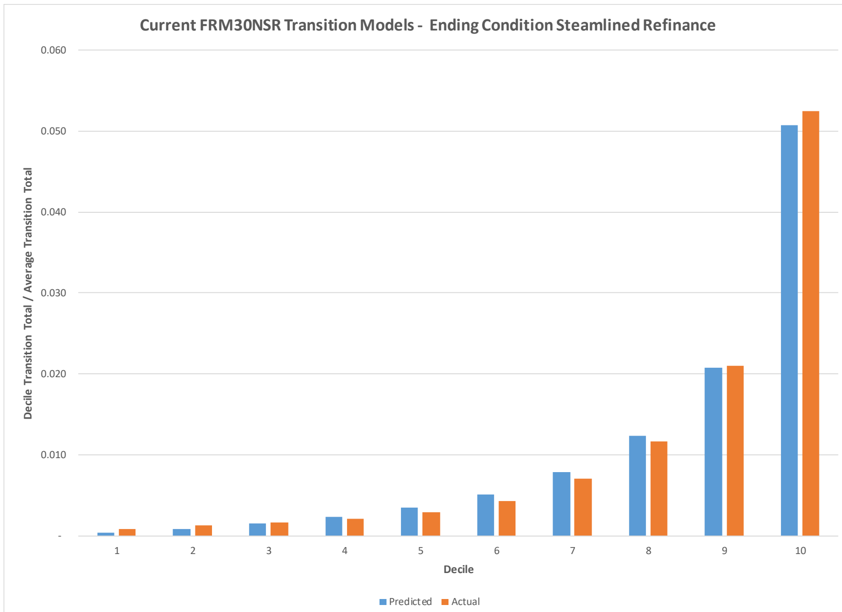


Figure 14: Current FRM30NSR Transition Model Validation - Ending Condition Prepayment

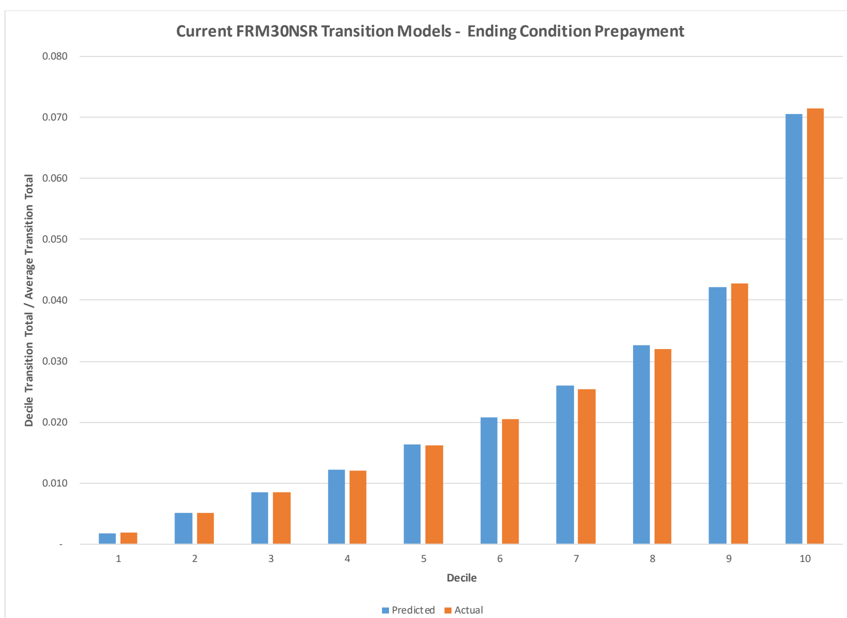


Figure 15: Current FRM30NSR Transition Model Validation - Ending Condition Self-Cure

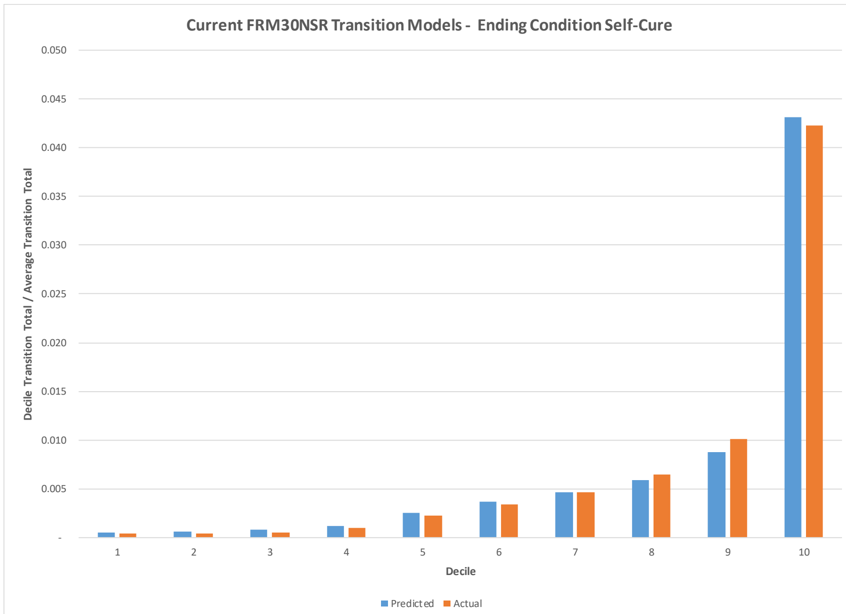
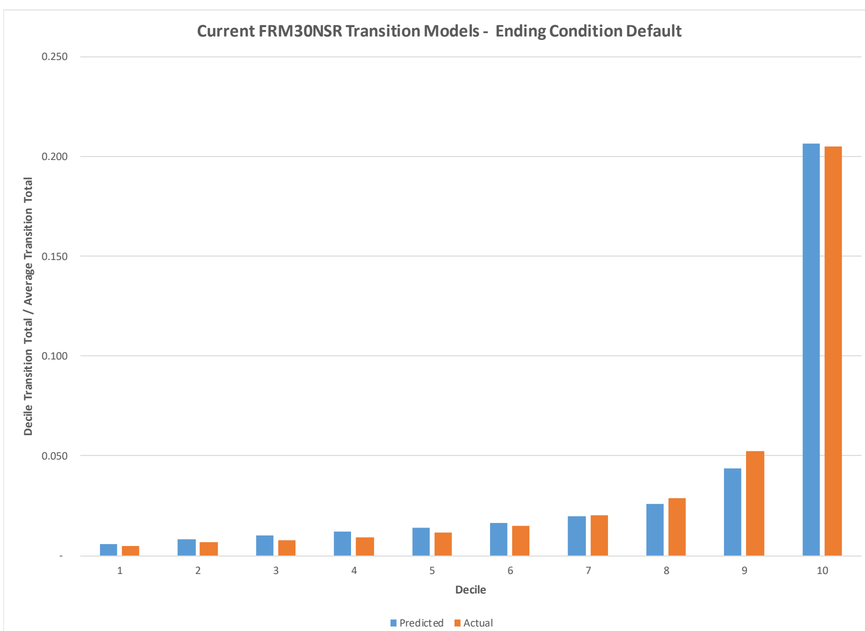


Figure 16: Current FRM30NSR Transition Model Validation - Ending Condition Default



Current FRM30SR Transition Models

The validation charts by ending condition for the FRM30SR models are shown below.

Figure 17: Current FRM30SR Transition Model Validation - Ending Condition Self-Cure

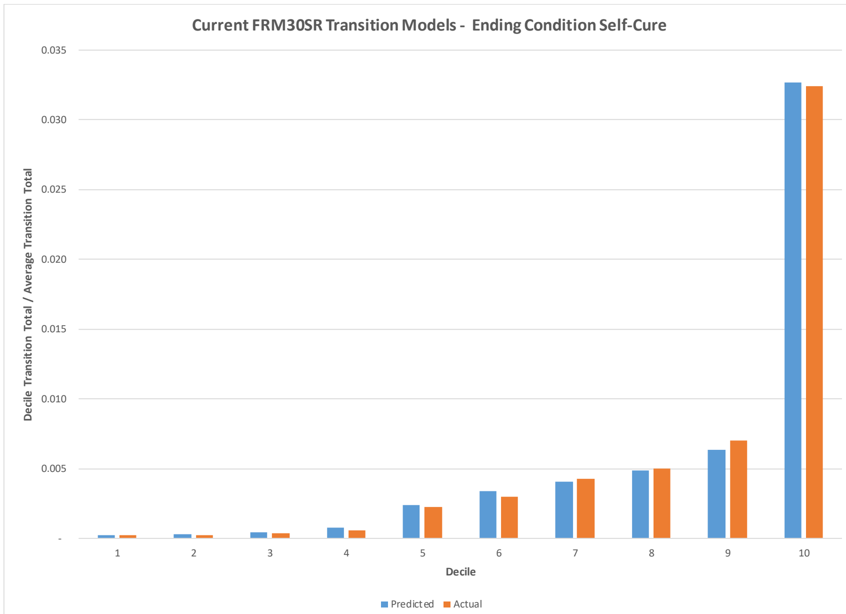


Figure 18: Current FRM30SR Transition Model Validation - Ending Condition Default

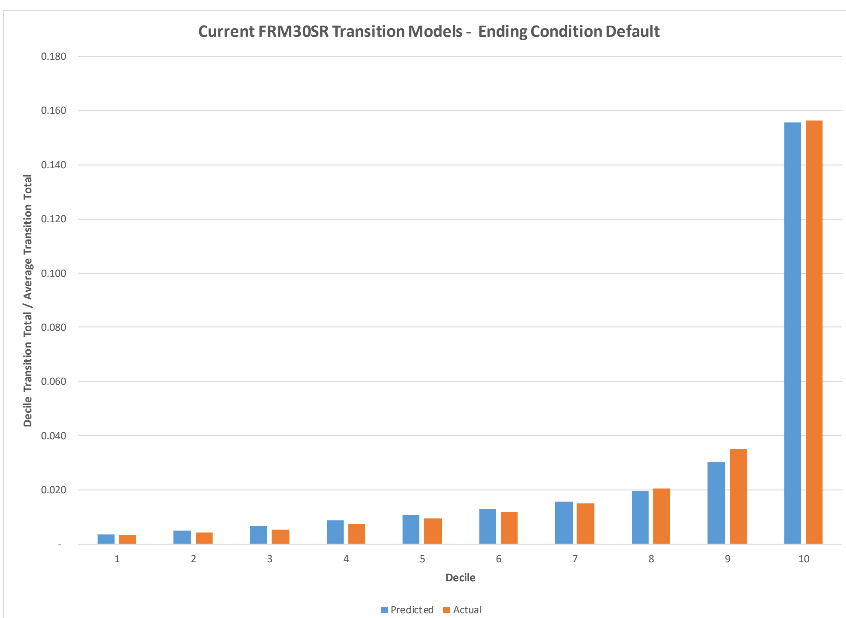
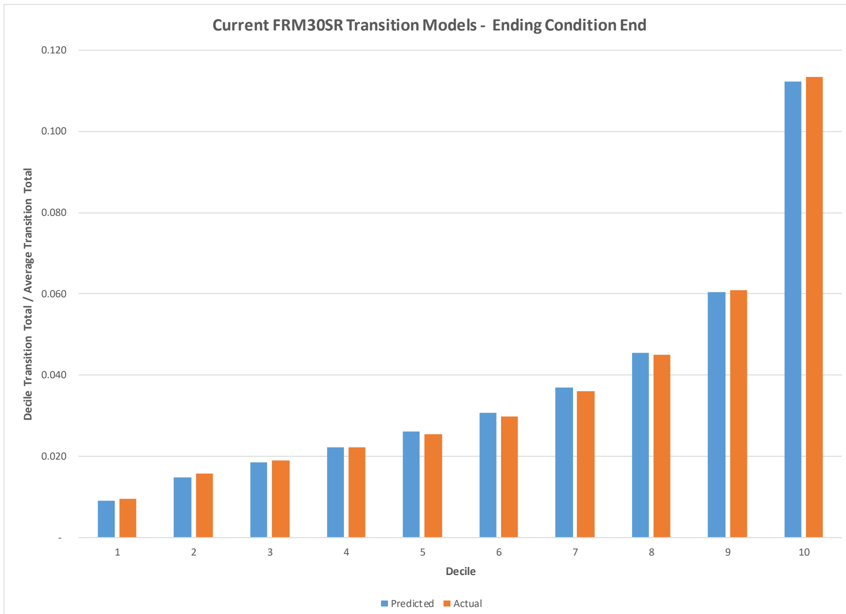


Figure 19: Current FRM30SR Transition Model Validation - Ending Condition End



Current FRM15 Transition Models

The validation charts by ending condition for the FRM15 models are shown below.

Figure 20: Current FRM15 Transition Model Validation - Ending Condition Streamlined Refinance

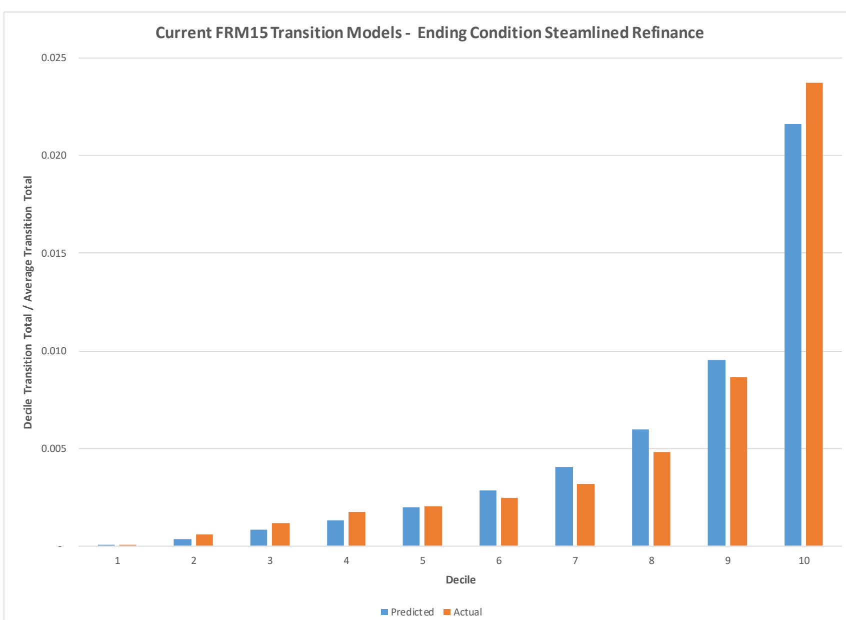


Figure 21: Current FRM15 Transition Model Validation - Ending Condition Default

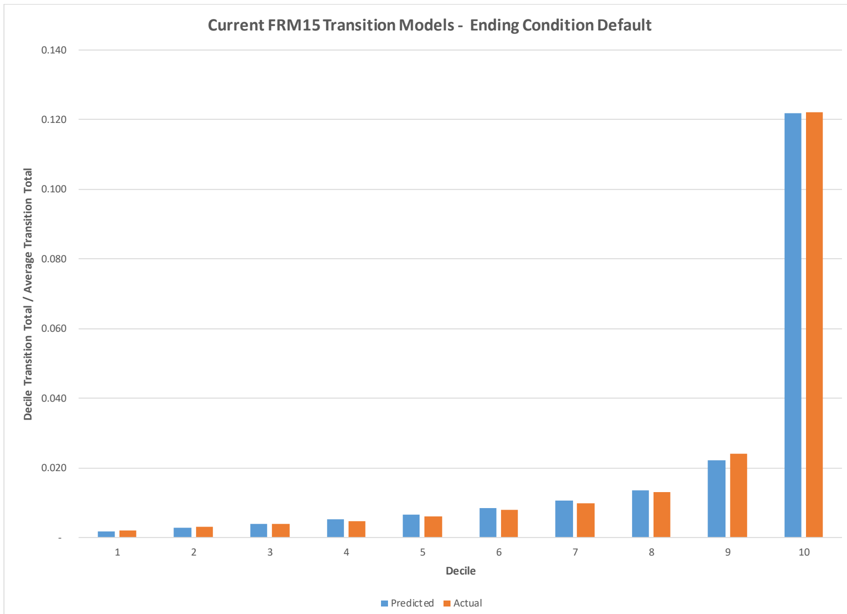


Figure 22: Current FRM15 Transition Model Validation - Ending Condition Self-Cure

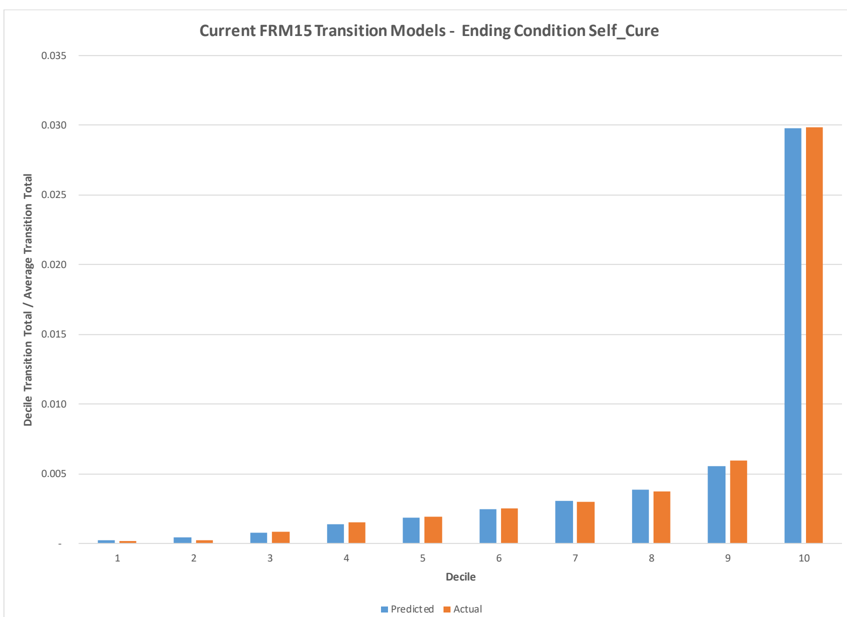
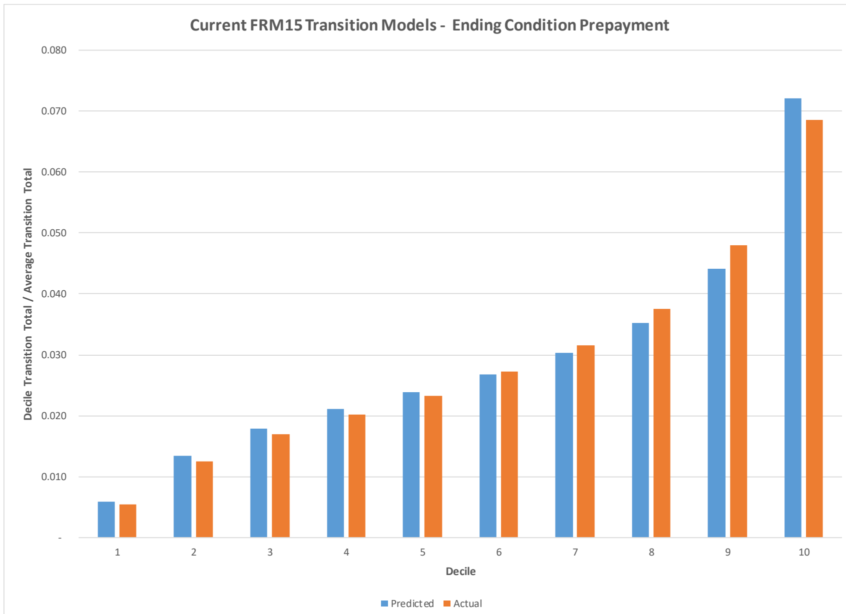


Figure 23: Current FRM15 Transition Model Validation - Ending Condition Prepayment



Current ARM Transition Models

The validation charts by ending condition for the ARM model are shown below.

Figure 24: Current ARM Transition Model Validation - Ending Condition Streamlined Refinance

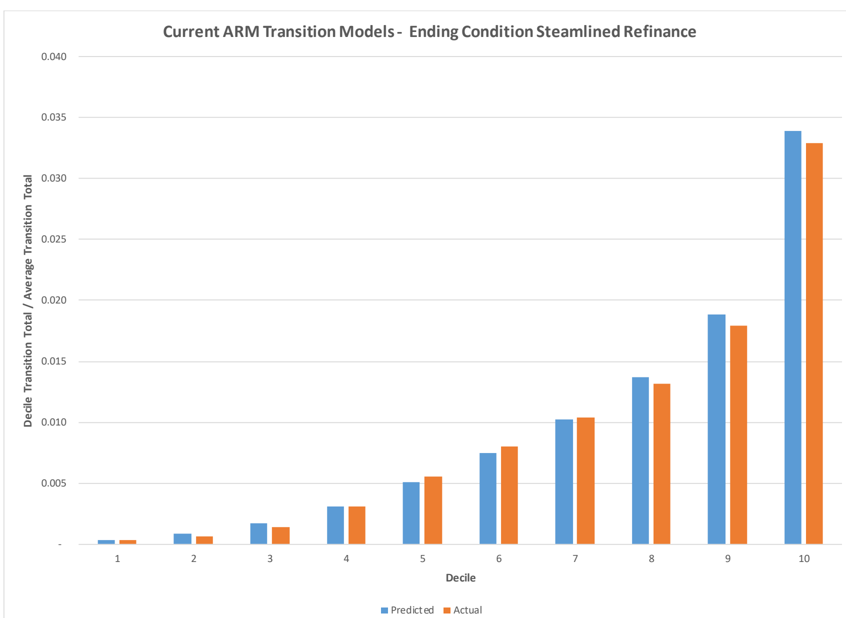


Figure 25: Current ARM Transition Model Validation - Ending Condition Default

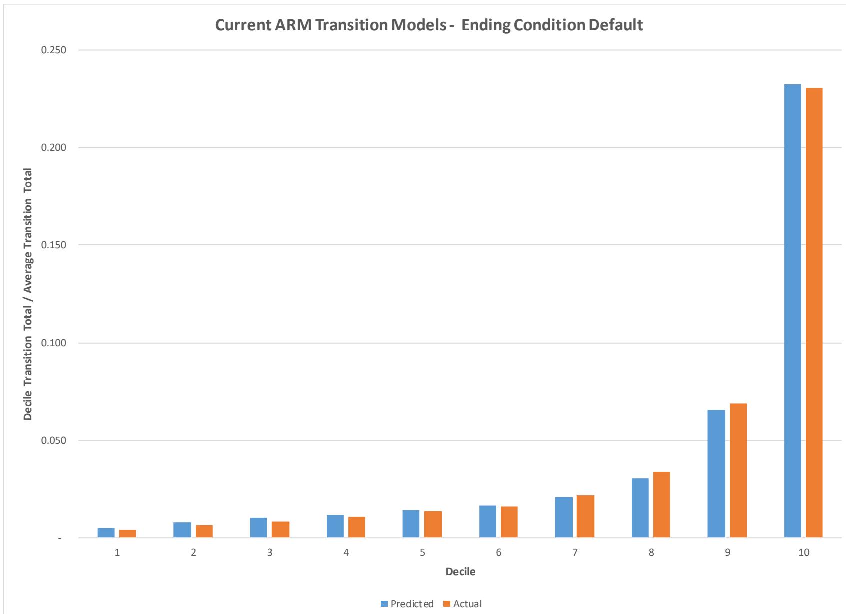


Figure 26: Current ARM Transition Model Validation - Ending Condition Self-Cure

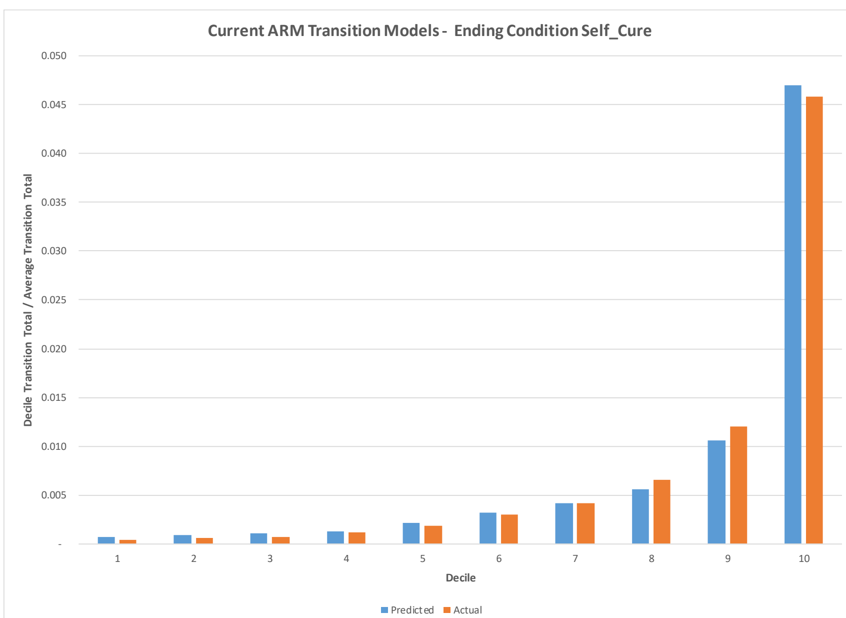
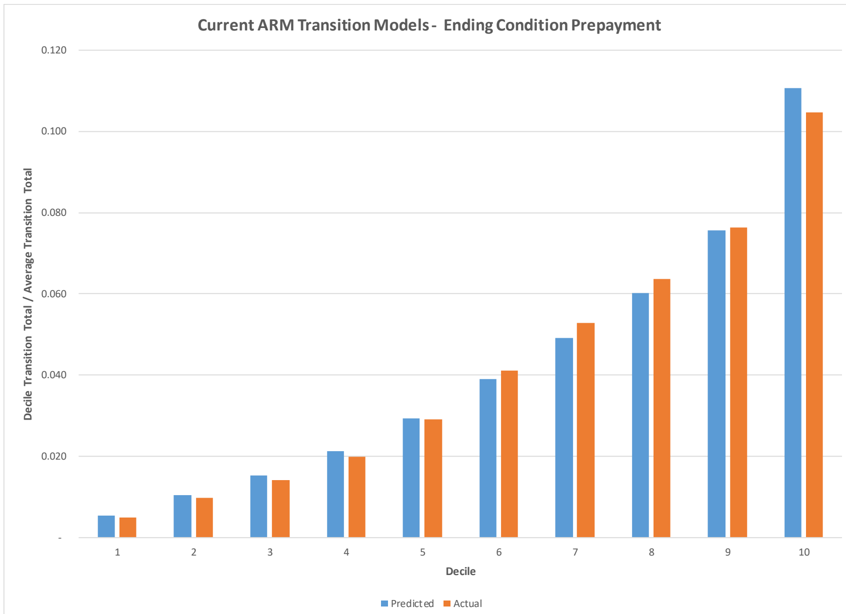


Figure 27: Current ARM Transition Model Validation - Ending Condition Prepayment



Default FRM30NSR Transition Models

The validation charts by ending condition for the FRM30NSR models are shown below.

Figure 28: Default FRM30 Transition Model Validation - Ending Condition Claim

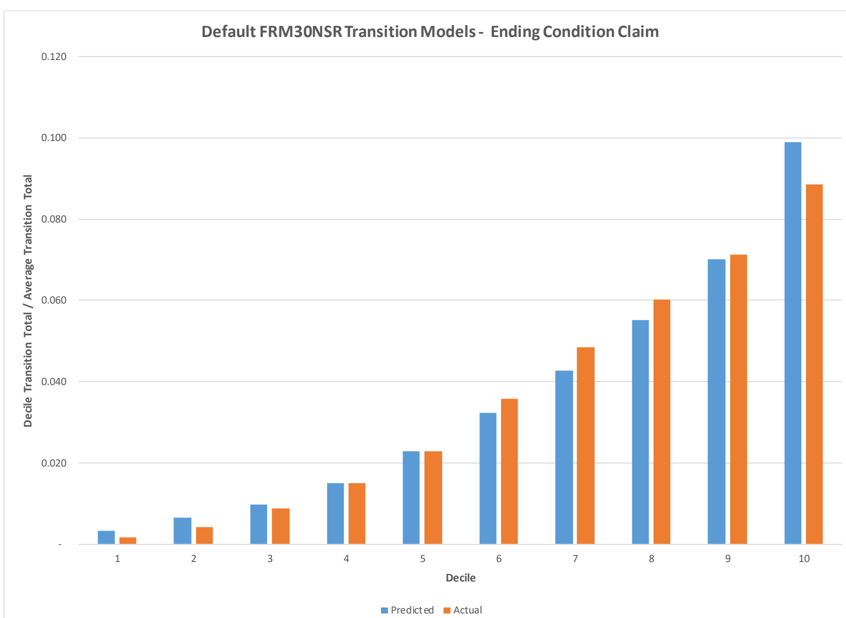


Figure 29: Default FRM30 Transition Model Validation - Ending Condition Cure with Modification

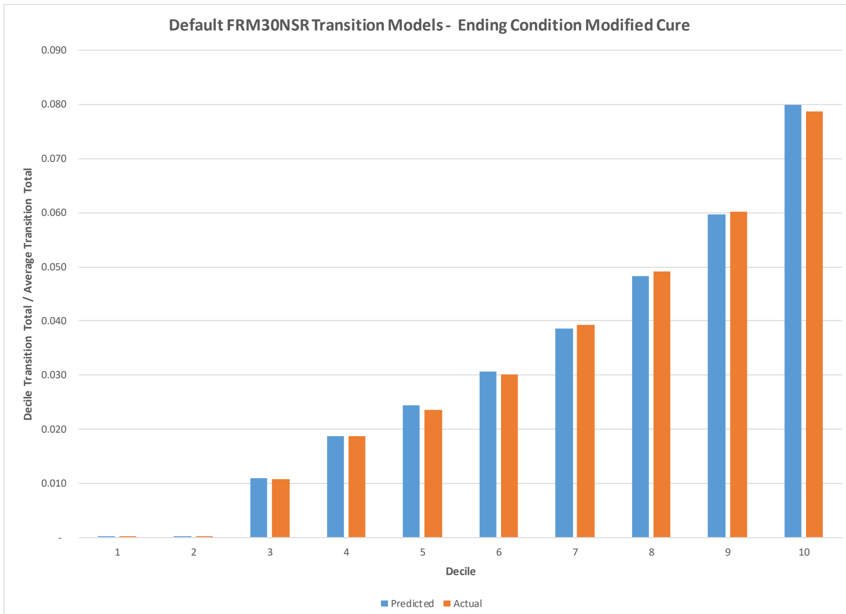


Figure 30: Default FRM30 Transition Model Validation - Ending Condition Cure with Self-Cure

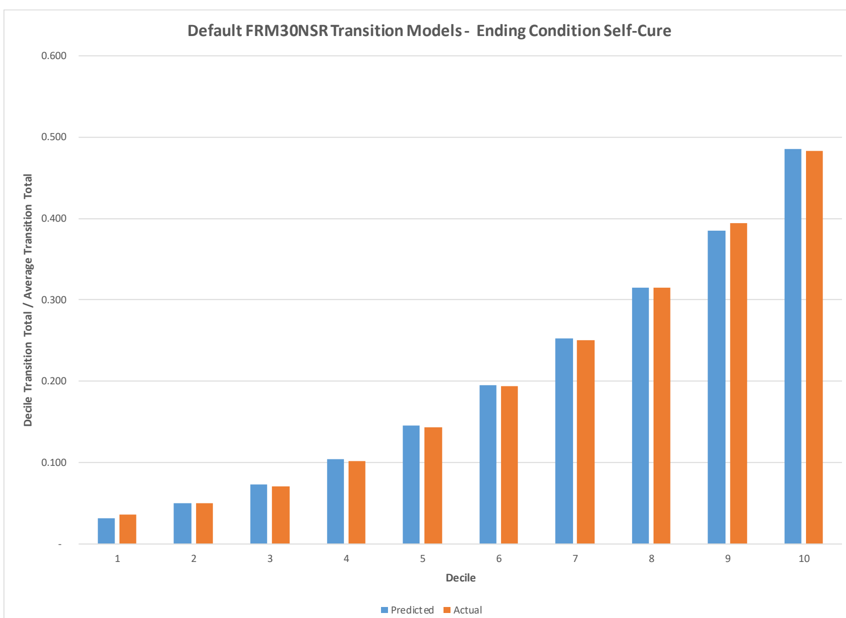
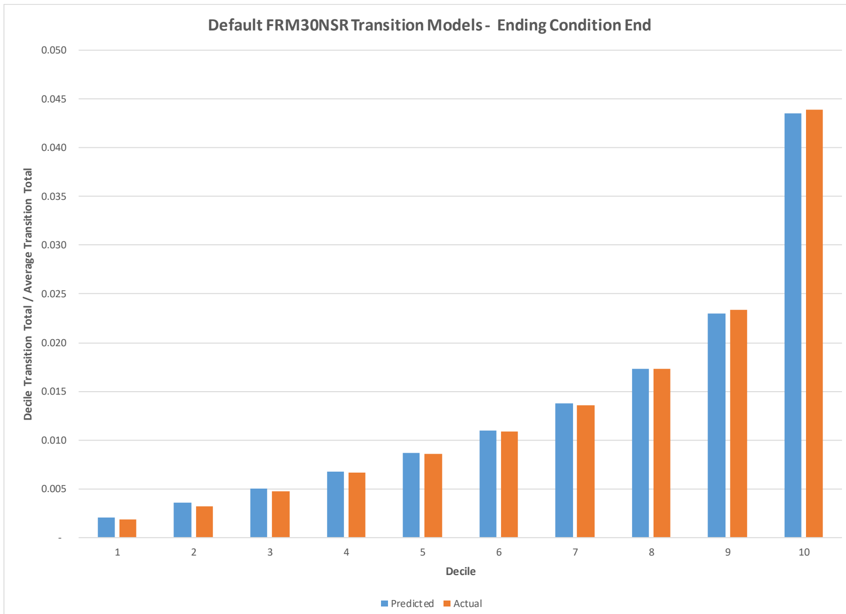


Figure 31: Default FRM30 Transition Model Validation - Ending Condition End



Default FRM30SR Transition Models

The validation charts by ending condition for the FRM30SR models are shown below.

Figure 32: Default FRM30 Transition Model Validation - Ending Condition Claim

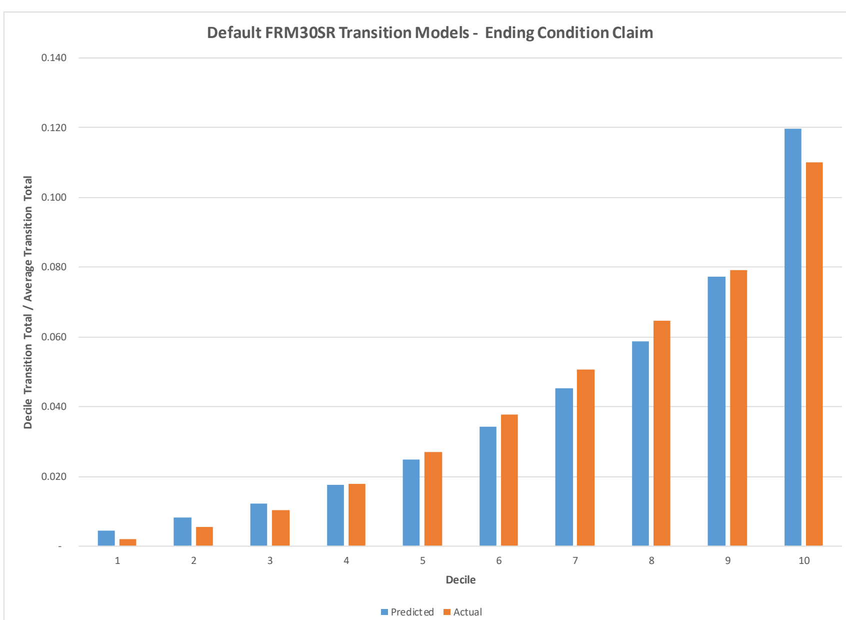


Figure 33: Default FRM30 Transition Model Validation - Ending Condition Modified Cure

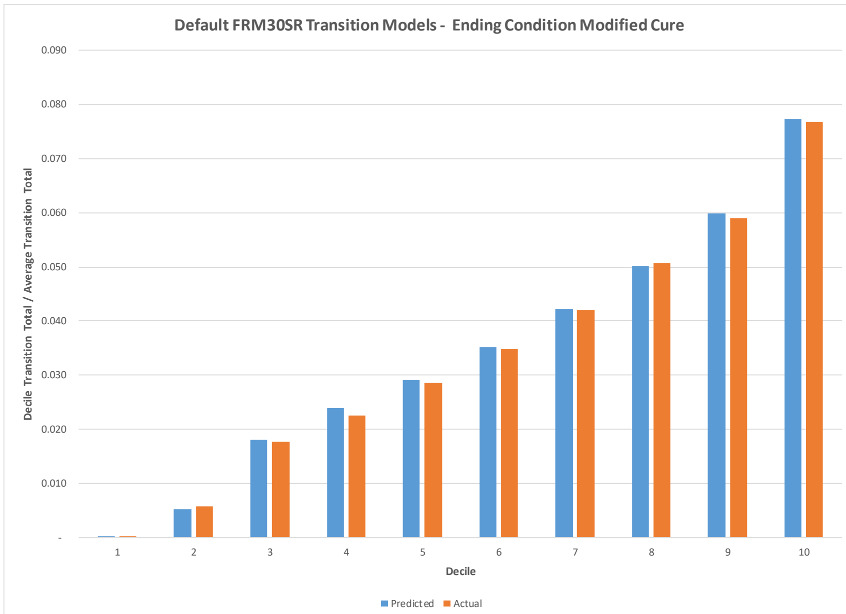


Figure 34: Default FRM30 Transition Model Validation - Ending Condition Self-Cure

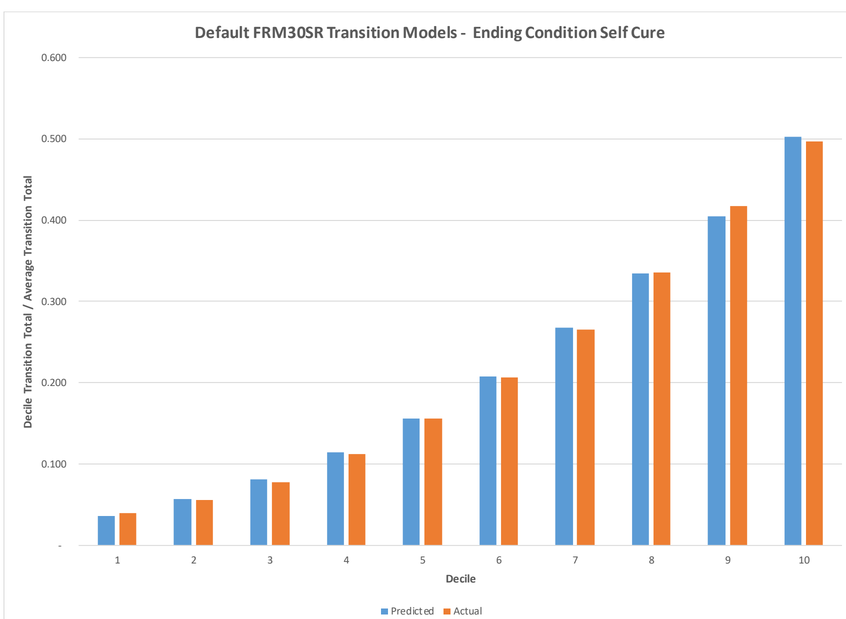
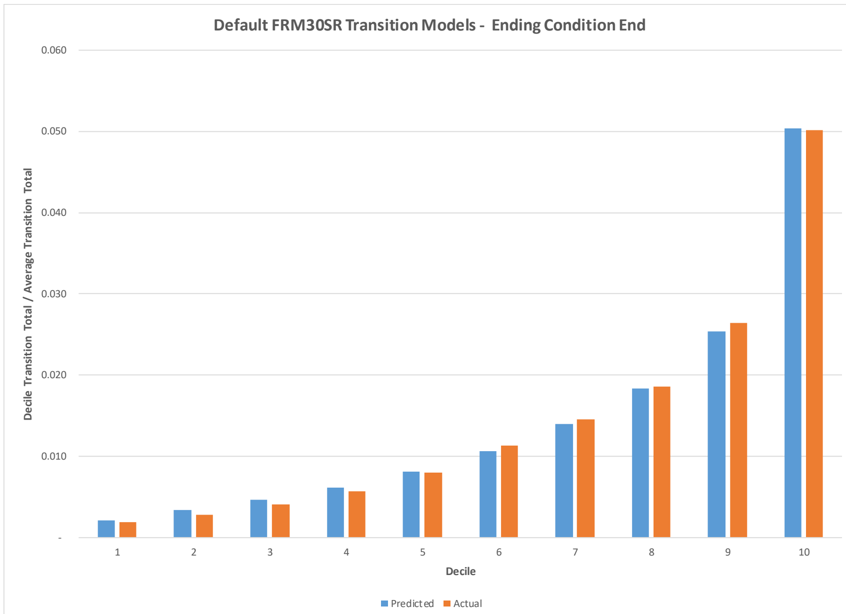


Figure 35: Default FRM30 Transition Model Validation - Ending Condition End



Default FRM15 Transition Models

The validation charts by ending condition for the FRM15 model are shown below.

Figure 36: Default FRM15 Transition Model Validation - Ending Condition Claim

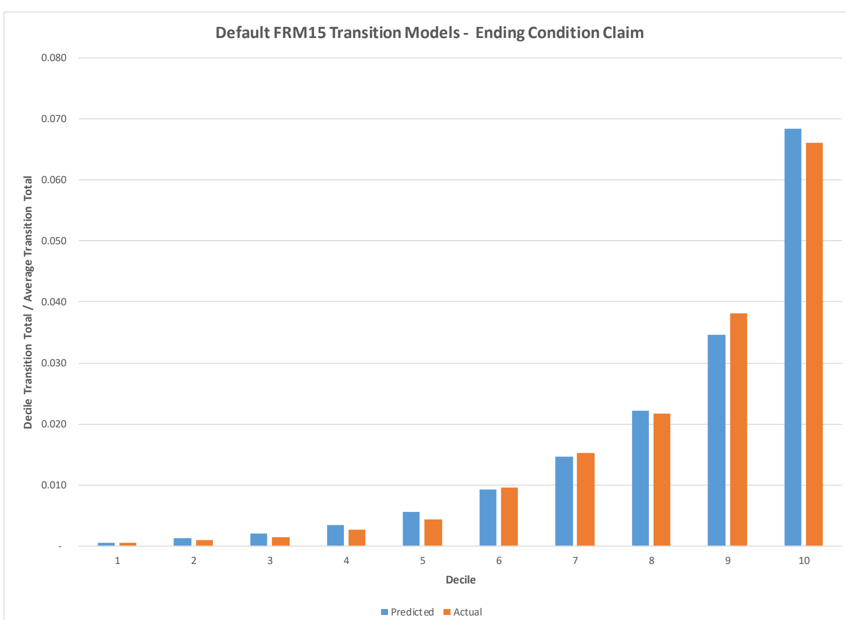


Figure 37: Default FRM15 Transition Model Validation - Ending Condition Modified Cure

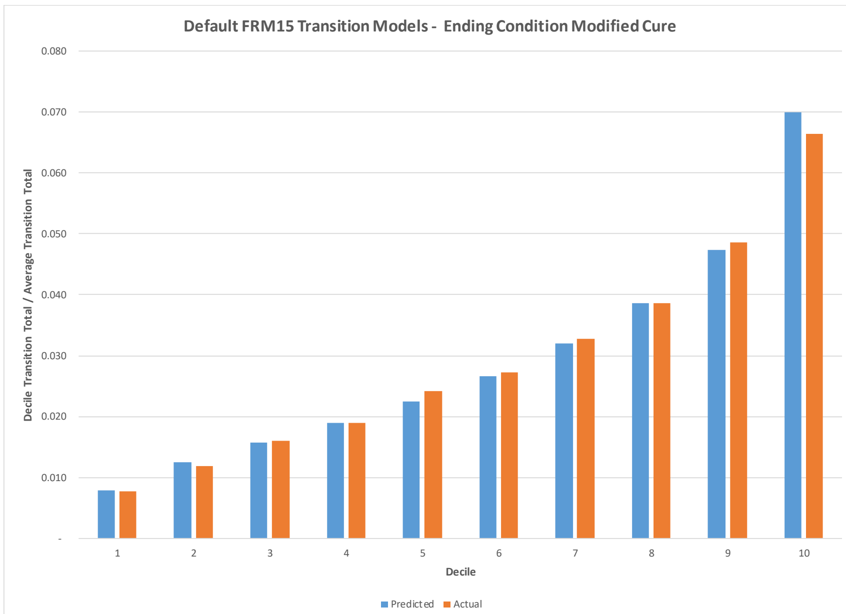


Figure 38: Default FRM15 Transition Model Validation - Ending Condition Self-Cure

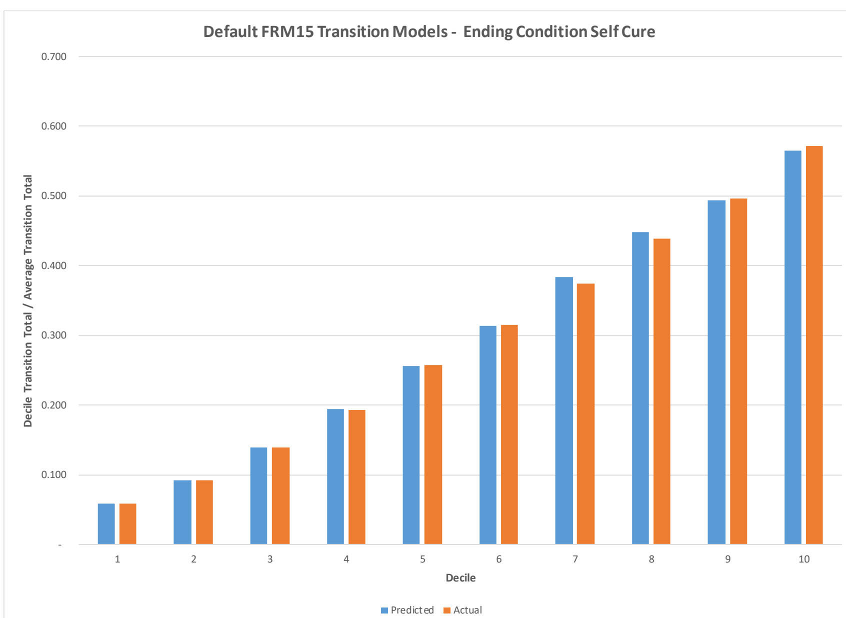
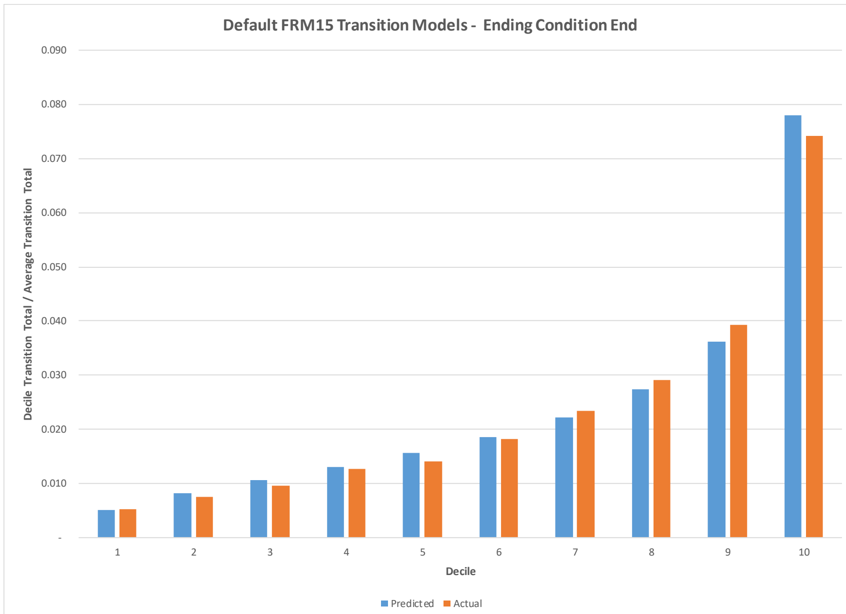


Figure 39: Default FRM15 Transition Model Validation - Ending Condition End



Default ARM Transition Models

The validation charts by ending condition for the ARM models are shown below.

Figure 40: Default ARM Transition Model Validation - Ending Condition Claim

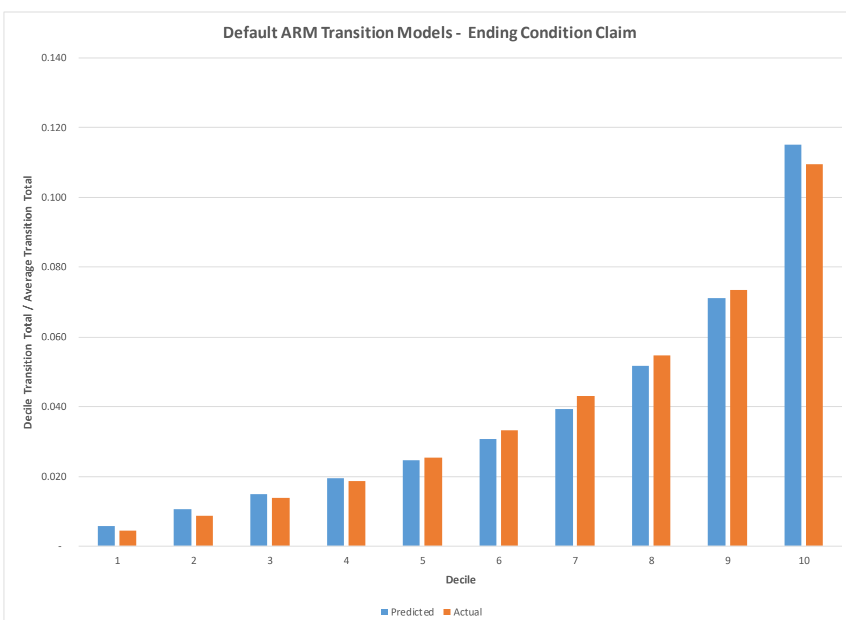


Figure 41: Default ARM Transition Model Validation - Ending Condition Modified Cure

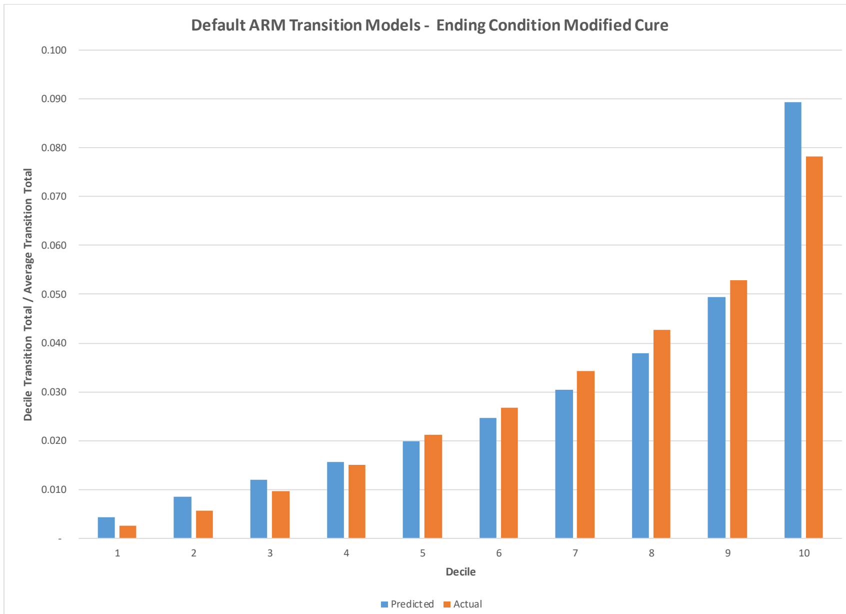


Figure 42: Default ARM Transition Model Validation - Ending Condition Self-Cure

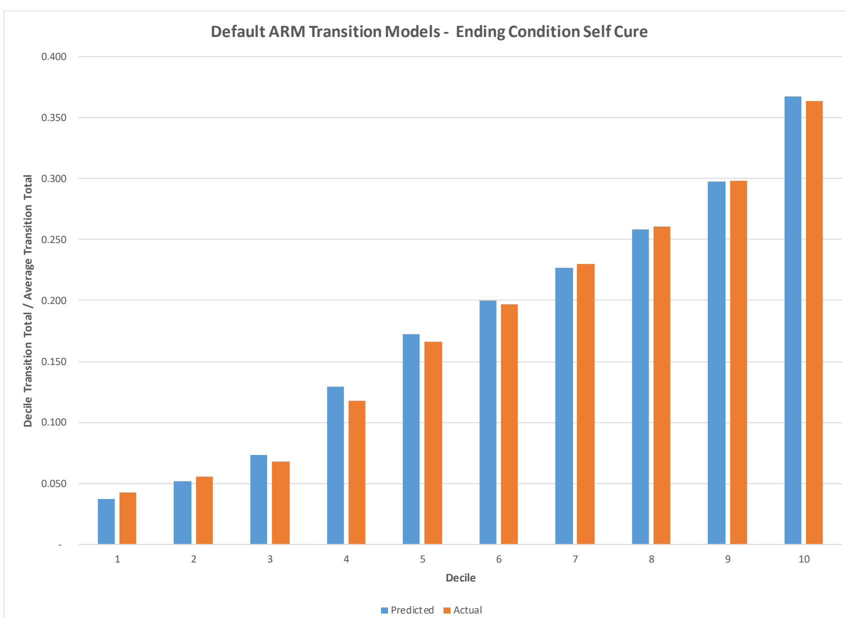
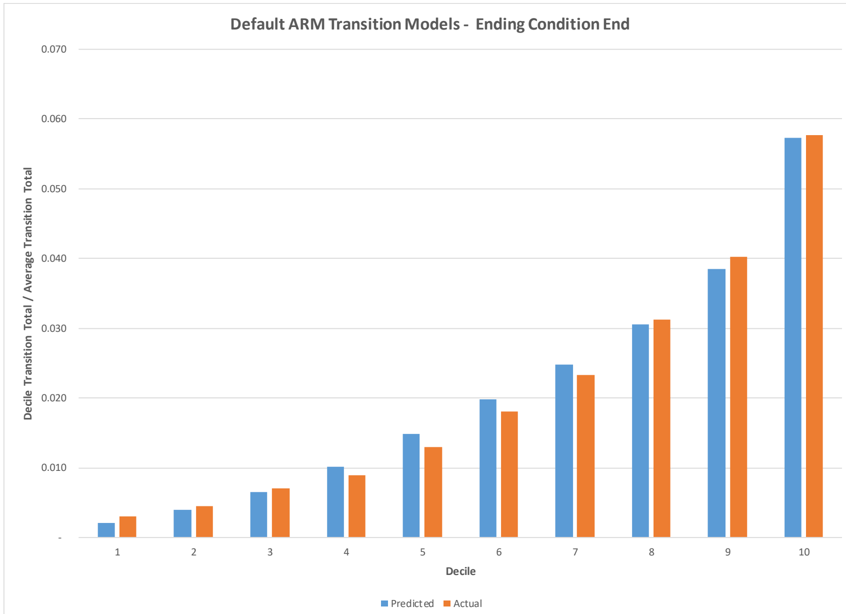


Figure 43: Default ARM Transition Model Validation - Ending Condition End



Appendix C: Loss Severity Models

This appendix describes the loss severity models used in this analysis. One of the primary sources of variation in the MMIF performance has been the loss severity experienced on mortgages that terminate as claims. In the case of a single mortgage, net loss is defined as the difference between the acquisition cost to HUD (acq_cost_to_HUD) from the IDB table and the recoveries realized by FHA on properties owned. We predict the net loss by modeling the probability of the type of claim that develops, then modeling separately the loss for each type of claim and the recovery for REO claims.

In this appendix, we also summarize the model specifications, describe the explanatory variables used, provide the model parameters and provide validation exhibits for the final models.

Model Specifications

Typically, when an FHA-endorsed mortgage terminates as a claim, the property is conveyed to FHA, and FHA makes a payment to the lender to settle the claim and acquire the underlying property. That is, the underlying house becomes real estate owned, or REO. The claim payment FHA makes to the servicer, known as the acquisition cost, consists of three components:

1. the outstanding unpaid principal balance on the mortgage;
2. the foregone interest advanced by the servicer as a result of the mortgage default; and
3. legal and administrative costs paid by the servicer associated with foreclosure, including any expenses associated with the cost of repairing or maintaining the property prior to conveyance.

The formula for acquisition cost is:

Acquisition Cost = Unpaid Principal Balance + Foregone Interest + Foreclosure Expense

Following acquisition, FHA attempts to sell the property, sometimes at a reduced price in order to assist low-income prospective homebuyers in achieving homeownership. During the period when the property is held by FHA, but not yet sold, FHA incurs various holding costs associated with maintenance, repairs, tax payments and expenses incurred in preparing the property for sale. Upon sale of the collateral property, FHA receives the sale price less any sales expenses. In sum, the net loss amount is the net amount that FHA cannot recoup from this process:

Net Loss = Acquisition Cost + Holding Cost - Sale Price + Sale Expense

Table 61 shows the distribution of different types of FHA claim terminations. Conveyance refers to the foreclosure procedure discussed above, wherein the property is conveyed to FHA after foreclosure is completed. This is the most common type of claim.

FHA permits pre-foreclosure sales (PFS) as an alternative to the foreclosure process. In the case of a PFS, the property is sold by the borrower without the foreclosure process being completed, or even started in some cases. Instead of acquiring the foreclosed house, FHA directly pays the loss amount claimed by the lender. The loss amount of a PFS case is reported as an acquisition cost to FHA. By 2012, the percentage of PFS was just under 24%. Since then, the percentage of PFS has decreased to 7.5%.

There were a significant volume of note (non-performing mortgage) sales from claim fiscal year 2003 through claim fiscal year 2006. From claim fiscal year 2007 to claim fiscal year 2012, there were few note sales. By 2014, however, the percentage of note sales rose above 27%. In these cases, the expenses of foreclosure procedures and subsequent house sales are avoided by FHA. Note sales are discretionary and highly unpredictable. For forecasting purposes, we use a note sale override to incorporate recent note sale transactions. We do not model note sales as a continuing program.

FHA changed its servicing guide in 2013 to allow foreclosure without conveyance. This consists of a Third Party Sale (TPS) during the foreclosure auction. A third party, instead of FHA, acquires the property directly from the foreclosure auction. This process allows FHA to avoid the process and expenses of property disposition after conveyance including any associated holding costs. TPS' have increased significantly since 2012, accounting for 57% of claims in 2019.

Table 61: Percentage of Claim Termination Types by Fiscal Claim Year

Claim Year	Conveyance (REO)	Note Sales	Third Party Sales (TPS)	Pre Foreclosure Sale (PFS)
1999	94.87%	0.11%	0.00%	5.02%
2000	95.06%	0.09%	0.00%	4.85%
2001	95.03%	0.01%	0.00%	4.97%
2002	94.33%	0.00%	0.00%	5.66%
2003	86.74%	8.34%	0.00%	4.92%
2004	85.57%	8.41%	0.00%	6.02%
2005	83.30%	9.79%	0.00%	6.91%
2006	89.37%	2.83%	0.00%	7.80%
2007	92.80%	0.00%	0.00%	7.20%
2008	93.06%	0.00%	0.10%	6.83%
2009	90.06%	0.00%	0.01%	9.93%
2010	84.46%	0.31%	0.00%	15.22%
2011	76.29%	1.17%	0.02%	22.51%
2012	71.24%	1.32%	3.59%	23.85%
2013	56.73%	17.66%	6.87%	18.74%
2014	42.69%	27.28%	15.39%	14.63%
2015	54.28%	16.26%	18.24%	11.22%
2016	49.57%	11.51%	29.26%	9.66%
2017	38.27%	6.25%	46.82%	8.66%
2018	34.57%	0.10%	56.19%	9.14%
2019	35.00%	0.09%	57.41%	7.50%

Table 62 shows the average net loss for the combined foreclosure (REO and TPS) and PFS claims by claim fiscal year for 1991 to 2018. The average net loss increased from 1991 to 2012, reaching a high of almost $129,000 in fiscal year 2013. Since 2013, the average net loss has decreased.

Table 62: Historical Average Net Loss

Claim Year	Average Net Loss
1991	61,095
1992	62,389
1993	65,613
1994	68,849
1995	71,119
1996	73,856
1997	77,428
1998	81,172
1999	84,209
2000	85,853
2001	87,040
2002	88,196
2003	91,199
2004	92,989
2005	94,303
2006	97,599
2007	101,695
2008	109,992
2009	118,361
2010	127,964
2011	128,821
2012	128,871
2013	124,540
2014	112,645
2015	115,407
2016	107,321
2017	94,843
2018	86,398
2019	81,394

Net Loss Severity Model Specification

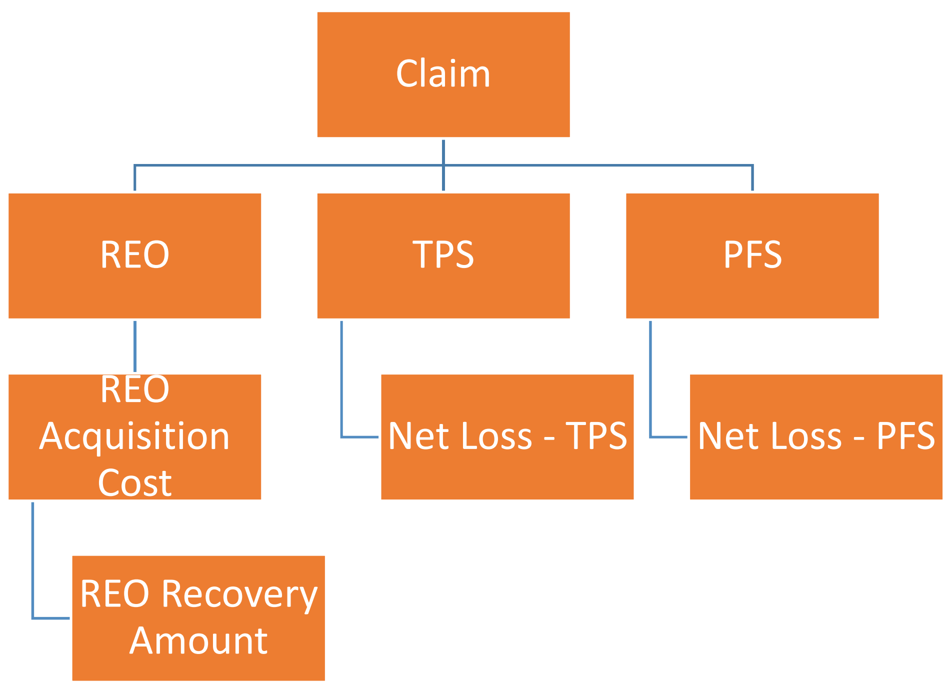
As described above, there are several components of the total loss amount, and each component is influenced by a number of factors. Foregone interest depends on the interest rate on the mortgage and on the length of the default-to-claim lag. Foreclosure expenses can vary depending on whether a judicial foreclosure process is used that can lengthen the time period of the foreclosure process. Repair expenses may be a function of the financial condition of the borrowers, which we proxy by credit scores. Sale prices are influenced by the house price appreciation since origination and by the prevailing local housing market conditions during the default and property disposition periods. Several components of the net loss amount involve expenses that are fixed across foreclosed properties. Hence, mortgages with lower values are more likely to realize higher net losses as a percentage of the sales amount, as the amount of the recovery will be smaller relative to higher value homes.

As shown in Table 61, the distribution between REO/TPS (foreclosure) and PFS was relatively stable through fiscal year 2009. Beginning in fiscal year 2010, there were widespread house price declines and a higher volume of defaults. As a result, the foreclosure claim process had been lengthened and foreclosure claims were delayed, while the PFS process has remained relatively stable. From fiscal year 2009 to 2012, the PFS share increased significantly. Since fiscal year 2012, the PFS share has declined. Moreover, the proceeds recovered from REO and PFS sales differ significantly. To achieve more accurate estimates of net loss severities, we adopted a three-stage model:

1. Model to predict the development of an REO, TPS or PFS claims
2. Model of REO acquisition cost and TPS and PFS net loss
3. Model of recovery amount conditional on claim being a foreclosure REO claim

The net loss severity model follows the flowchart in Figure 44.

Figure 44: Net Loss Severity Model Structure



First, we estimate the probability that a claim is settled by the REO, TPS, or PFS process. To model the first-stage choice event, we used a multinomial logistic model to estimate the probability of the claim settlement type.

Second, we estimate the REO Acquisition Amount, TPS net loss and PFS net loss as a function of all the same explanatory factors used in the multinomial model. The gross loss severity distribution is smooth and continuous with a long right tail. Thus, we use a GLM approach with a Gamma error structure and a log link function to develop the gross loss severity models. The Gamma structure is used for each loss severity model (REO, TPS, PFS). For REO claims, a recovery model estimating sales proceeds net of the Capital Income Expenses is built using a similar framework.

In addition to the loss severity models described above, we also developed a set of models to project loss mitigation costs. Implemented in 1996, the loss mitigation program was designed as a way to help financially stressed borrowers stay in their homes. Loss mitigation costs can be incurred from modifying the terms of the mortgage, allowing a borrower to refinance into a new mortgage and writing off a portion of the unpaid principal (partial claim), or a forbearance, which is a written agreement with the borrower which includes a plan to reinstate the mortgage. The loss mitigation cost is modeled using a GLM with a Gamma error structure.

Thus, the estimated net loss to the MMIF is the expected value of net loss of the different claim types:

$$\text{Net Loss} = Probability\ of\ REO * (\text{GrossLoss}_{REO} - \text{Recovery}) + Probablity\ of\ TPS * \text{NetLoss}_{TPS} + Probablity\ of\ PFS * \text{NetLoss}_{PFS} + Probability\ of\ Loss\ Mitigation * \text{Net Loss Mitigation Cost}$$

Estimation Sample

The sample used to estimate the loss severity model consists of mortgage level data from the FHA single-family data warehouse. The available data covers the period from the first quarter of fiscal year 1975 to the third quarter of fiscal year 2019. In total, there are over 2.9 million claims in the FHA database.

The models were built using a traditional train/validate approach. A random sample of the data is used to train the models, and the remaining data is used to validate and refine the model parameters and to determine inclusion and exclusion of explanatory variables.

Explanatory Variables

Multiple categories of explanatory variables were used.

- Fixed initial mortgage characteristics: ARM adjustment period, mortgage product, interest rate, initial mortgage size, spread at origination
- Fixed initial borrower characteristics: down payment assistance, first time home buyer, credit score
- Property characteristics: the number of living units, initial home values
- Dynamic variables based on mortgage information: prior default indicator, prior mortgage modification, LTV ratio, interest rate spread, TEI, age of mortgage
- Dynamic variables derived by combining mortgage information and external economic data: spread, spread at origination
- Dynamic macroeconomic variables: 10-year average unemployment rate, change in the unemployment rate, prior year unemployment rate, HPI, state unemployment rate relative to countrywide unemployment rate, CMT rates, state unemployment rate
- Geographic variables: judicial state, collateral state

Most of the explanatory variables used in the loss severity model are the same as those used in the mortgage status transition models. The additional variables used in the loss severity models are defined below.

- **Product**: loan product type. This variable is incorporated as a categorical variable.

- **Balance**: outstanding mortgage balance. This variable is incorporated as a variate.
- **Deltatm3**: change in 3-month CMT rate from policy inception to current. This variable is incorporated as a grouped categorical variable.
- **Arm_ind**: ARM product type indicator. This variable is incorporated as a grouped categorical variable.

Model Parameters

Loss Mitigation Binomial Model

The model parameters for the binomial model to estimate whether a claim is a loss mitigation (HAMP) claim are below.

Table 63: Loss Mitigation Binomial Model Parameters

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				-1.1792	0.7621	0.1218
Mproduct	ARM	Categorical of product type	adjustable rate mortgage	0.4291	0.0381	0.0000
Mproduct	ARMSR	Categorical of product type	adjustable rate mortgage - streamline refinance	0.4277	0.0650	0.0000
Mproduct	FRM15	Categorical of product type	15 year fixed rate mortgage	-1.1067	0.0504	0.0000
Mproduct	FRM15SR	Categorical of product type	15 year fixed rate mortgage - streamline refinance	-0.7906	0.0959	0.0000
Mproduct	FRM30SR	Categorical of product type	30 year fixed rate mortgage - streamline refinance	0.0575	0.0292	0.0489
Mproduct	z_FRM30	Categorical of product type	30 year fixed rate mortgage			
mseason	L01	Categorical of season	season = "winter"	-0.1712	0.0133	0.0000
mseason	L02	Categorical of season	season = "spring"	-0.1628	0.0132	0.0000
mseason	L03	Categorical of season	season = "summer"	-0.1812	0.0139	0.0000
mseason	Z04	Categorical of season	season = "fall"			
mjudicial	L01	Categorical of judicial (judicial state)	judicial = 1	-0.0384	0.0099	0.0001
mjudicial	Z00	Categorical of judicial (judicial state)	base level: else			
mdpa_rel	LRela	Categorical of down payment assistance, relative level indicator	dpa = "relative"	-0.0742	0.0132	0.0000
mdpa_rel	ZOthr	Categorical of down payment assistance, relative level indicator	base level: else			
mycslope	L01	Categorical of yield curve slope	1<=ycslope<=2	-0.3774	0.0108	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mycslope	Z00	Categorical of yield curve slope	base level: else			
mrfncind	LY	Categorical of rfnc_ind (refinanced loan indicator)	rfnc_ind <> "N"	-0.0241	0.0145	0.0957
mrfncind	ZN	Categorical of rfnc_ind (refinanced loan indicator)	base level: else			
Vloansize_raw_grp		Variate version of loansize_raw	min(loansize/1000,600)	0.0027	0.0001	0.0000
Mperiodnbr_LML	L01_04	Categorical of period number	1 <= period_number <= 4	-3.9656	0.3088	0.0000
Mperiodnbr_LML	L05	Categorical of period number	period_number = 5	-2.4442	0.1522	0.0000
Mperiodnbr_LML	L06	Categorical of period number	period_number = 6	-1.1346	0.0746	0.0000
Mperiodnbr_LML	L07	Categorical of period number	period_number = 7	-0.3114	0.0414	0.0000
Mperiodnbr_LML	Z00	Categorical of period number	base level: else			
vperiodnbr_cd_pw1		Variate piecewise version of period number	median(0,period_number-8,40-8)	-0.0349	0.0007	0.0000
vperiodnbr_cd_pw2		Variate piecewise version of period number	median(0,period_number-40,53-40)	0.0008	0.0020	0.7026
vperiodnbr_cd_pw3		Variate piecewise version of period number	median(0,period_number-53,68-53)	-0.0047	0.0026	0.0717
vperiodnbr_cd_pw4		Variate piecewise version of period number	median(0,period_number-68,108-68)	-0.0087	0.0020	0.0000
vdeltaue_cd_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	min(deltaUEinit_r,90)	0.0039	0.0004	0.0000
vdeltaue_cd_pw2		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-90,97-90)	-0.0078	0.0049	0.1120
vdeltaue_cd_pw3		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-97,100-97)	0.0392	0.0117	0.0008
vdeltaue_cd_pw5		Variate piecewise of DeltaUEInit_r[1] (change in	median(0,deltaUEinit_r-110,140-110)	0.0039	0.0011	0.0003

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
		unemployment rate from policy inception to current)				
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	1.1928	0.0508	0.0000
mRatioTmpTei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else			
vratiotmptei_cd_pw1		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-0,24-0)	0.0352	0.0021	0.0000
vratiotmptei_cd_pw2		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-24,36-24)	0.0774	0.0014	0.0000
vratiotmptei_cd_pw3		Variate piecewise version of front end ratio	max(0,ratio_tmp_tei-36)	0.0090	0.0021	0.0000
mpriordef	L01	Categorical of prior defaults	prior_default_count = 1	-0.1052	0.0153	0.0000
mpriordef	L02	Categorical of prior defaults	prior_default_count = 2	-0.1995	0.0167	0.0000
mpriordef	L03	Categorical of prior defaults	prior_default_count >= 3	-0.2794	0.0165	0.0000
mpriordef	Z00	Categorical of prior defaults	prior_default_count = 0			
vpriordef_cd_pw1		Variate piecewise version of prior defaults	min(prior_default_cnt,15)-3	-0.0337	0.0036	0.0000
vhpa2yb_cd_pw1		Variate piecewise of hpa2y_blended_r[2]	min(hpa2y_blended_r,85)	0.0079	0.0091	0.3832
vhpa2yb_cd_pw2		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-85,95-85)	-0.0529	0.0144	0.0002
vhpa2yb_cd_pw3		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-95,113-95)	-0.0126	0.0018	0.0000
vhpa2yb_cd_pw4		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-113,120-113)	0.0174	0.0030	0.0000
vhpa2yb_cd_pw5		Variate piecewise of hpa2y_blended_r[2]	max(0,hpa2y_blended_r-120)	-0.0108	0.0069	0.1200
mdurdefepi	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	0.3756	0.0161	0.0000
mdurdefepi	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	0.5132	0.0171	0.0000
mdurdefepi	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	0.5589	0.0186	0.0000

Variable	ClassVal0	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdurdefepi	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	0.6089	0.0203	0.0000
mdurdefepi	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	0.6913	0.0223	0.0000
mdurdefepi	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	0.6787	0.0250	0.0000
mdurdefepi	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	0.6898	0.0276	0.0000
mdurdefepi	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 9	0.7851	0.0308	0.0000
mdurdefepi	L10	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 10	0.7572	0.0347	0.0000
mdurdefepi	L11	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 11	0.8176	0.0203	0.0000
mdurdefepi	Z01	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 1			

Loss Mitigation HAMP Severity Model

The model parameters for the HAMP claim severity model are shown below.

Table 64: Loss Mitigation HAMP Severity Model Parameters

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				4.9450	0.2975	0
Mproduct	ARM	Categorical of product type	adjustable rate mortgage	0.0553	0.0147	0.0002
Mproduct	ARMSR	Categorical of product type	adjustable rate mortgage - streamline refinance	0.0220	0.0257	0.3928
Mproduct	FRM15	Categorical of product type	15 year fixed rate mortgage	0.2060	0.0276	0
Mproduct	FRM15SR	Categorical of product type	15 year fixed rate mortgage - streamline refinance	0.5280	0.0520	0
Mproduct	FRM30SR	Categorical of product type	30 year fixed rate mortgage - streamline refinance	-0.0288	0.0121	0.0176
Mproduct	z_FRM30	Categorical of product type	30 year fixed rate mortgage	0.0000	0.0000	

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Vbalance_i_log		Variate version of log transformed outstanding balance at start of quarter	log(balance_i/1000)	0.9545	0.0039	0
mseason	L01	Categorical of season	season = "winter"	0.0174	0.0057	0.0023
mseason	L02	Categorical of season	season = "spring"	0.0100	0.0057	0.0793
mseason	L03	Categorical of season	season = "summer"	0.0222	0.0060	0.0002
mseason	Z04	Categorical of season	season = "fall"	0.0000	0.0000	
mjudicial	L01	Categorical of judicial (judicial state)	judicial = 1	0.0341	0.0044	0
mjudicial	Z00	Categorical of judicial (judicial state)	base level: else	0.0000	0.0000	
mdpa_nprof	LNPro	Categorical of down payment assistance, non-profit level indicator	dpa = "nonprof"	-0.1131	0.0093	0
mdpa_nprof	ZOthr	Categorical of down payment assistance, non-profit level indicator	base level: else	0.0000	0.0000	
mdpa_rel	LRela	Categorical of down payment assistance, relative level indicator	dpa = "relative"	-0.0164	0.0056	0.0036
mdpa_rel	ZOthr	Categorical of down payment assistance, relative level indicator	base level: else	0.0000	0.0000	
mycslope	L01	Categorical of yield curve slope	1<=ycslope<=2	0.0616	0.0062	0
mycslope	Z00	Categorical of yield curve slope	base level: else	0.0000	0.0000	
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	-0.0229	0.0072	0.0016
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else	0.0000	0.0000	
mrfncind	LY	Categorical of rfnc_ind (refinanced loan indicator)	rfnc_ind <> "N"	-0.1016	0.0088	0
mrfncind	ZN	Categorical of rfnc_ind (refinanced loan indicator)	base level: else	0.0000	0.0000	

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vdeltaue_cd_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	min(deltaUEinit_r,90)	0.0031	0.0002	0
vdeltaue_cd_pw2		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-90,97-90)	-0.0090	0.0016	0
vdeltaue_cd_pw4		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-100,110-100)	-0.0029	0.0012	0.0176
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	0.2776	0.0243	0
mRatioTmpTei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else	0.0000	0.0000	
vratiotmptei_cd_pw1		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-0,24-0)	0.0029	0.0010	0.0042
vratiotmptei_cd_pw2		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-24,36-24)	0.0144	0.0006	0
vratiotmptei_cd_pw3		Variate piecewise version of front end ratio	max(0,ratio_tmp_tei-36)	0.0083	0.0008	0
vUEblend_CD_pw2		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	median(0,ue_blended_r-420,820-420)	0.0001	0.0000	0.0019
vUeblend_CD_pw3		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	max(0,ue_blended_r-820)	-0.0001	0.0000	0.0002
vhpa2yb_cd_pw1		Variate piecewise of hpa2y_blended_r[3]	min(hpa2y_blended_r,85)	0.0000	0.0035	0.9906
vhpa2yb_cd_pw2		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_r-85,95-85)	0.0226	0.0055	0
vhpa2yb_cd_pw3		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_r-95,113-95)	-0.0031	0.0008	0
vhpa2yb_cd_pw4		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_r-113,120-113)	0.0047	0.0013	0.0002

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vhpa2yb_cd_pw5		Variate piecewise of hpa2y_blended_r[3]	max(0,hpa2y_blended_r-120)	-0.0027	0.0029	0.3466
mdurdefepi	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	-0.0284	0.0074	0.0001
mdurdefepi	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	-0.0330	0.0077	0
mdurdefepi	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	0.0050	0.0083	0.55
mdurdefepi	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	0.0108	0.0089	0.2268
mdurdefepi	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	0.0500	0.0096	0
mdurdefepi	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	0.0772	0.0108	0
mdurdefepi	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	0.0911	0.0118	0
mdurdefepi	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 9	0.1180	0.0130	0
mdurdefepi	L10	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 10	0.1594	0.0147	0
mdurdefepi	L11	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 11	0.2273	0.0116	0
mdurdefepi	Z01	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 1	0.0000	0.0000	
vdurdefepi_DCLM_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-10,30-10)	0.0104	0.0012	0
mDeltaTY10	L01	Categorical of DeltaTy10Init_r[4] (change in 10-year Treasury rate from policy	DeltaTy10Init_r < 53	-0.0023	0.0069	0.7458

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
		inception to current)				
mDeltaTY10	L02	Categorical of DeltaTy10Init_r[4] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r > 130	0.0714	0.0070	0
mDeltaTY10	Z00	Categorical of DeltaTy10Init_r[4] (change in 10-year Treasury rate from policy inception to current)	base level: else	0.0000	0.0000	
mDeltaTm3	L01	Categorical of DeltaTm3Init_r[5] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r > 600	0.0489	0.0056	0
mDeltaTm3	Z00	Categorical of DeltaTm3Init_r[5] (change in 3-month Treasury rate from policy inception to current)	base level: else	0.0000	0.0000	
Scale				2.2908	0.0094	

Claims Logistic Model

The model parameters for the multinomial model to predict the claim type are shown below.

Table 65: Claims Logistic Model Parameters

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
Intercept				OTHER	-6.4961	0.2578	0.0000
Intercept				PRE	-2.2283	0.1526	0.0000
Intercept				TPS	-2.1585	0.1255	0.0000
Mproduct	ARM	Categorical of product type	adjustable rate mortgage	OTHER	0.0753	0.0474	0.1123
Mproduct	ARM	Categorical of product type	adjustable rate mortgage	PRE	-0.1643	0.0353	0.0000
Mproduct	ARM	Categorical of product type	adjustable rate mortgage	TPS	0.0744	0.0382	0.0511
Mproduct	ARMSR	Categorical of product type	adjustable rate mortgage - streamline refinance	OTHER	0.4290	0.0657	0.0000

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
Mproduct	ARMSR	Categorical of product type	adjustable rate mortgage - streamline refinance	PRE	0.4500	0.0488	0.0000
Mproduct	ARMSR	Categorical of product type	adjustable rate mortgage - streamline refinance	TPS	0.6973	0.0572	0.0000
Mproduct	FRM15	Categorical of product type	15 year fixed rate mortgage	OTHER	0.2030	0.0550	0.0002
Mproduct	FRM15	Categorical of product type	15 year fixed rate mortgage	PRE	-0.4583	0.0595	0.0000
Mproduct	FRM15	Categorical of product type	15 year fixed rate mortgage	TPS	-0.0355	0.0488	0.4664
Mproduct	FRM15SR	Categorical of product type	15 year fixed rate mortgage - streamline refinance	OTHER	0.3187	0.1173	0.0066
Mproduct	FRM15SR	Categorical of product type	15 year fixed rate mortgage - streamline refinance	PRE	-0.0784	0.1223	0.5216
Mproduct	FRM15SR	Categorical of product type	15 year fixed rate mortgage - streamline refinance	TPS	0.7791	0.0992	0.0000
Mproduct	FRM30SR	Categorical of product type	30 year fixed rate mortgage - streamline refinance	OTHER	0.2124	0.0366	0.0000
Mproduct	FRM30SR	Categorical of product type	30 year fixed rate mortgage - streamline refinance	PRE	0.5659	0.0269	0.0000
Mproduct	FRM30SR	Categorical of product type	30 year fixed rate mortgage - streamline refinance	TPS	0.7428	0.0285	0.0000
Mproduct	z_FRM30	Categorical of product type	30 year fixed rate mortgage	OTHER			
Mproduct	z_FRM30	Categorical of product type	30 year fixed rate mortgage	PRE			
Mproduct	z_FRM30	Categorical of product type	30 year fixed rate mortgage	TPS			
Vloansize_raw_grp		Variate of loansize_raw	min(loansize/1000,600)	OTHER	0.0092	0.0001	0.0000
Vloansize_raw_grp		Variate of loansize_raw	min(loansize/1000,600)	PRE	0.0095	0.0001	0.0000
Vloansize_raw_grp		Variate of loansize_raw	min(loansize/1000,600)	TPS	0.0047	0.0001	0.0000
mseason	L01	Categorical of season	season = "winter"	OTHER	-0.7307	0.0168	0.0000
mseason	L01	Categorical of season	season = "winter"	PRE	-0.2092	0.0131	0.0000
mseason	L01	Categorical of season	season = "winter"	TPS	-0.0454	0.0134	0.0007
mseason	L02	Categorical of season	season = "spring"	OTHER	-0.4396	0.0158	0.0000
mseason	L02	Categorical of season	season = "spring"	PRE	0.0065	0.0126	0.6027
mseason	L02	Categorical of season	season = "spring"	TPS	0.0739	0.0133	0.0000
mseason	L03	Categorical of season	season = "summer"	OTHER	0.1795	0.0142	0.0000
mseason	L03	Categorical of season	season = "summer"	PRE	0.0318	0.0127	0.0122
mseason	L03	Categorical of season	season = "summer"	TPS	0.1338	0.0134	0.0000

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
mseason	Z04	Categorical of season	seaon="fall"	OTHER			
mseason	Z04	Categorical of season	seaon="fall"	PRE			
mseason	Z04	Categorical of season	seaon="fall"	TPS			
mjudicial	L01	Categorical of judicial (judicial state)	judicial = 1	OTHER	1.3724	0.0118	0.0000
mjudicial	L01	Categorical of judicial (judicial state)	judicial = 1	PRE	0.3276	0.0096	0.0000
mjudicial	L01	Categorical of judicial (judicial state)	judicial = 1	TPS	0.0423	0.0098	0.0000
mjudicial	Z00	Categorical of judicial (judicial state)	base level: else	OTHER			
mjudicial	Z00	Categorical of judicial (judicial state)	base level: else	PRE			
mjudicial	Z00	Categorical of judicial (judicial state)	base level: else	TPS			
mdpa_govt	LGovt	Categorical of down payment assistance, government level indicator	dpa = "govt"	OTHER	-0.3101	0.0453	0.0000
mdpa_govt	LGovt	Categorical of down payment assistance, government level indicator	dpa = "govt"	PRE	-0.0548	0.0346	0.1138
mdpa_govt	LGovt	Categorical of down payment assistance, government level indicator	dpa = "govt"	TPS	-0.1401	0.0327	0.0000
mdpa_govt	ZOthr	Categorical of down payment assistance, government level indicator	base level: else	OTHER			
mdpa_govt	ZOthr	Categorical of down payment assistance, government level indicator	base level: else	PRE			
mdpa_govt	ZOthr	Categorical of down payment assistance, government level indicator	base level: else	TPS			
mdpa_nprof	LNPro	Categorical of down payment assistance, non-	dpa = "nonprof"	OTHER	-0.2491	0.0199	0.0000

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
		profit level indicator					
mdpa_nprof	LNPro	Categorical of down payment assistance, non-profit level indicator	dpa = "nonprof"	PRE	-0.0443	0.0152	0.0036
mdpa_nprof	LNPro	Categorical of down payment assistance, non-profit level indicator	dpa = "nonprof"	TPS	0.0815	0.0162	0.0000
mdpa_nprof	ZOthr	Categorical of down payment assistance, non-profit level indicator	base level: else	OTHER			
mdpa_nprof	ZOthr	Categorical of down payment assistance, non-profit level indicator	base level: else	PRE			
mdpa_nprof	ZOthr	Categorical of down payment assistance, non-profit level indicator	base level: else	TPS			
mdpa_rel	LRela	Categorical of down payment assistance, relative level indicator	dpa = "relative"	OTHER	0.0769	0.0196	0.0001
mdpa_rel	LRela	Categorical of down payment assistance, relative level indicator	dpa = "relative"	PRE	-0.0267	0.0168	0.1119
mdpa_rel	LRela	Categorical of down payment assistance, relative level indicator	dpa = "relative"	TPS	0.0706	0.0157	0.0000
mdpa_rel	ZOthr	Categorical of down payment assistance, relative level indicator	base level: else	OTHER			
mdpa_rel	ZOthr	Categorical of down payment assistance, relative level indicator	base level: else	PRE			
mdpa_rel	ZOthr	Categorical of down payment assistance, relative level indicator	base level: else	TPS			

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
mycslope	L01	Categorical of yield curve slope	1<=ycslope<=2	OTHER	-4.9302	0.1681	0.0000
mycslope	L01	Categorical of yield curve slope	1<=ycslope<=2	PRE	0.0809	0.0282	0.0041
mycslope	L01	Categorical of yield curve slope	1<=ycslope<=2	TPS	0.2933	0.0176	0.0000
mycslope	Z00	Categorical of yield curve slope	base level: else	OTHER			
mycslope	Z00	Categorical of yield curve slope	base level: else	PRE			
mycslope	Z00	Categorical of yield curve slope	base level: else	TPS			
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	OTHER	0.1721	0.0202	0.0000
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	PRE	0.0237	0.0155	0.1252
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	TPS	0.0654	0.0161	0.0000
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else	OTHER			
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else	PRE			
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else	TPS			
mrfncind	LY	Categorical of rfnc_ind (refinanced loan indicator)	rfnc_ind <> "N"	OTHER	0.2358	0.0221	0.0000
mrfncind	LY	Categorical of rfnc_ind (refinanced loan indicator)	rfnc_ind <> "N"	PRE	-0.0164	0.0175	0.3471
mrfncind	LY	Categorical of rfnc_ind (refinanced loan indicator)	rfnc_ind <> "N"	TPS	-0.0950	0.0190	0.0000
mrfncind	ZN	Categorical of rfnc_ind (refinanced loan indicator)	base level: else	OTHER			

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
mrfncind	ZN	Categorical of rfnc_ind (refinanced loan indicator)	base level: else	PRE			
mrfncind	ZN	Categorical of rfnc_ind (refinanced loan indicator)	base level: else	TPS			
Mperiodnbr_clm	L01_04	Categorical of period number	1 <= period_number <= 4	OTHER	-0.6651	0.2401	0.0056
Mperiodnbr_clm	L01_04	Categorical of period number	1 <= period_number <= 4	PRE	1.1814	0.0737	0.0000
Mperiodnbr_clm	L01_04	Categorical of period number	1 <= period_number <= 4	TPS	0.6356	0.1463	0.0000
Mperiodnbr_clm	L05	Categorical of period number	period_number = 5	OTHER	-0.9109	0.1575	0.0000
Mperiodnbr_clm	L05	Categorical of period number	period_number = 5	PRE	0.5247	0.0494	0.0000
Mperiodnbr_clm	L05	Categorical of period number	period_number = 5	TPS	0.5939	0.0856	0.0000
Mperiodnbr_clm	L06	Categorical of period number	period_number = 6	OTHER	-0.7647	0.1027	0.0000
Mperiodnbr_clm	L06	Categorical of period number	period_number = 6	PRE	0.1519	0.0385	0.0001
Mperiodnbr_clm	L06	Categorical of period number	period_number = 6	TPS	0.4363	0.0649	0.0000
Mperiodnbr_clm	L07	Categorical of period number	period_number = 7	OTHER	-0.7343	0.0812	0.0000
Mperiodnbr_clm	L07	Categorical of period number	period_number = 7	PRE	0.0880	0.0320	0.0059
Mperiodnbr_clm	L07	Categorical of period number	period_number = 7	TPS	0.2542	0.0550	0.0000
Mperiodnbr_clm	Z00	Categorical of period number	base level: else	OTHER			
Mperiodnbr_clm	Z00	Categorical of period number	base level: else	PRE			
Mperiodnbr_clm	Z00	Categorical of period number	base level: else	TPS			
vperiodnbr_cd_pw1		Variate piecewise version of period number	median(0,period_number-8,40-8)	OTHER	0.0362	0.0009	0.0000
vperiodnbr_cd_pw1		Variate piecewise version of period number	median(0,period_number-8,40-8)	PRE	-0.0298	0.0008	0.0000
vperiodnbr_cd_pw1		Variate piecewise version of period number	median(0,period_number-8,40-8)	TPS	0.0443	0.0008	0.0000
vperiodnbr_cd_pw2		Variate piecewise version of period number	median(0,period_number-40,53-40)	OTHER	-0.0114	0.0033	0.0006
vperiodnbr_cd_pw2		Variate piecewise version of period number	median(0,period_number-40,53-40)	PRE	-0.0085	0.0032	0.0077

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
vperiodnbr_cd_pw2		Variate piecewise version of period number	median(0,period_number-40,53-40)	TPS	0.0368	0.0021	0.0000
vperiodnbr_cd_pw3		Variate piecewise version of period number	median(0,period_number-53,68-53)	OTHER	0.0455	0.0050	0.0000
vperiodnbr_cd_pw3		Variate piecewise version of period number	median(0,period_number-53,68-53)	PRE	-0.0132	0.0055	0.0154
vperiodnbr_cd_pw3		Variate piecewise version of period number	median(0,period_number-53,68-53)	TPS	0.0389	0.0026	0.0000
vperiodnbr_cd_pw4		Variate piecewise version of period number	median(0,period_number-68,108-68)	OTHER	-0.0218	0.0043	0.0000
vperiodnbr_cd_pw4		Variate piecewise version of period number	median(0,period_number-68,108-68)	PRE	-0.0309	0.0061	0.0000
vperiodnbr_cd_pw4		Variate piecewise version of period number	median(0,period_number-68,108-68)	TPS	-0.0131	0.0020	0.0000
icredit_grp0	L000	Categorical of credit	credit_score = 0	OTHER	-0.6886	0.1198	0.0000
icredit_grp0	L000	Categorical of credit	credit_score = 0	PRE	-0.7265	0.0811	0.0000
icredit_grp0	L000	Categorical of credit	credit_score = 0	TPS	-0.7614	0.0929	0.0000
icredit_grp0	L000	Categorical of credit	base level: else	OTHER			
icredit_grp0	L000	Categorical of credit	base level: else	PRE			
icredit_grp0	L000	Categorical of credit	base level: else	TPS			
icredit_grp1	L450	Categorical of credit	0<credit_score<=450	OTHER	0.3156	0.1882	0.0935
icredit_grp1	L450	Categorical of credit	0<credit_score<=450	PRE	-0.7393	0.1623	0.0000
icredit_grp1	L450	Categorical of credit	0<credit_score<=450	TPS	-0.4330	0.1893	0.0221
icredit_grp1	L450	Categorical of credit	base level: else	OTHER			
icredit_grp1	L450	Categorical of credit	base level: else	PRE			
icredit_grp1	L450	Categorical of credit	base level: else	TPS			
icredit_grp2	L500	Categorical of credit	450<credit_score<=500	OTHER	0.3286	0.1347	0.0147
icredit_grp2	L500	Categorical of credit	450<credit_score<=500	PRE	-0.9401	0.1041	0.0000
icredit_grp2	L500	Categorical of credit	450<credit_score<=500	TPS	-0.3058	0.1161	0.0084

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
icredit_grp2	L500	Categorical of credit	base level: else	OTHER			
icredit_grp2	L500	Categorical of credit	base level: else	PRE			
icredit_grp2	L500	Categorical of credit	base level: else	TPS			
icredit_grp3	L600	Categorical of credit	500<credit_score<=600	OTHER	0.1676	0.1192	0.1598
icredit_grp3	L600	Categorical of credit	500<credit_score<=600	PRE	-0.8802	0.0810	0
icredit_grp3	L600	Categorical of credit	500<credit_score<=600	TPS	-0.3176	0.0928	0.0006
icredit_grp3	L600	Categorical of credit	base level: else	OTHER			
icredit_grp3	L600	Categorical of credit	base level: else	PRE			
icredit_grp3	L600	Categorical of credit	base level: else	TPS			
icredit_grp4	L630	Categorical of credit	600<credit_score<=630	OTHER	0.0198	0.1191	0.8681
icredit_grp4	L630	Categorical of credit	600<credit_score<=630	PRE	-0.7828	0.0808	0
icredit_grp4	L630	Categorical of credit	600<credit_score<=630	TPS	-0.3332	0.0926	0.0003
icredit_grp4	L630	Categorical of credit	base level: else	OTHER			
icredit_grp4	L630	Categorical of credit	base level: else	PRE			
icredit_grp4	L630	Categorical of credit	base level: else	TPS			
icredit_grp5	L680	Categorical of credit	630<credit_score<=680	OTHER	0.0107	0.1187	0.9279
icredit_grp5	L680	Categorical of credit	630<credit_score<=680	PRE	-0.6033	0.0802	0
icredit_grp5	L680	Categorical of credit	630<credit_score<=680	TPS	-0.2086	0.0920	0.0234
icredit_grp5	L680	Categorical of credit	base level: else	OTHER			
icredit_grp5	L680	Categorical of credit	base level: else	PRE			
icredit_grp5	L680	Categorical of credit	base level: else	TPS			
icredit_grp6	L720	Categorical of credit	680<credit_score<=720	OTHER	-0.0438	0.1197	0.7145
icredit_grp6	L720	Categorical of credit	680<credit_score<=720	PRE	-0.3624	0.0809	0
icredit_grp6	L720	Categorical of credit	680<credit_score<=720	TPS	-0.1627	0.0929	0.0799
icredit_grp6	L720	Categorical of credit	base level: else	OTHER			
icredit_grp6	L720	Categorical of credit	base level: else	PRE			
icredit_grp6	L720	Categorical of credit	base level: else	TPS			
icredit_grp7	L745	Categorical of credit	720<credit_score<=745	OTHER	-0.0914	0.1231	0.4579

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
icredit_grp7	L745	Categorical of credit	720<credit_score<=745	PRE	-0.1773	0.0831	0.0328
icredit_grp7	L745	Categorical of credit	720<credit_score<=745	TPS	-0.1791	0.0959	0.0618
icredit_grp7	L745	Categorical of credit	base level: else	OTHER			
icredit_grp7	L745	Categorical of credit	base level: else	PRE			
icredit_grp7	L745	Categorical of credit	base level: else	TPS			
icredit_grp8	L800	Categorical of credit	745<credit_score<=800	OTHER	-0.1049	0.1227	0.3924
icredit_grp8	L800	Categorical of credit	745<credit_score<=800	PRE	-0.0279	0.0826	0.735
icredit_grp8	L800	Categorical of credit	745<credit_score<=800	TPS	-0.1409	0.0954	0.1398
icredit_grp8	L800	Categorical of credit	base level: else	OTHER			
icredit_grp8	L800	Categorical of credit	base level: else	PRE			
icredit_grp8	L800	Categorical of credit	base level: else	TPS			
icredit_grp9	L850	Categorical of credit	800<credit_score	OTHER	0.0000		
icredit_grp9	L850	Categorical of credit	800<credit_score	PRE	0.0000		
icredit_grp9	L850	Categorical of credit	800<credit_score	TPS	0.0000		
icredit_grp9	Z999	Categorical of credit	base level: else	OTHER			
icredit_grp9	Z999	Categorical of credit	base level: else	PRE			
icredit_grp9	Z999	Categorical of credit	base level: else	TPS			
vdeltaue_cd_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	min(deltaUEinit_r,90)	OTHER	0.0024	0.0007	0.0006
vdeltaue_cd_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	min(deltaUEinit_r,90)	PRE	-0.0020	0.0006	0.0011
vdeltaue_cd_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	min(deltaUEinit_r,90)	TPS	-0.0053	0.0005	0

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
vdeltaue_cd_pw2		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-90,97-90)	OTHER	-0.0715	0.0060	0
vdeltaue_cd_pw2		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-90,97-90)	PRE	0.0042	0.0050	0.3967
vdeltaue_cd_pw2		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-90,97-90)	TPS	-0.0315	0.0047	0
vdeltaue_cd_pw3		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-97,100-97)	OTHER	0.0469	0.0172	0.0063
vdeltaue_cd_pw3		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-97,100-97)	PRE	-0.0427	0.0148	0.0038
vdeltaue_cd_pw3		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-97,100-97)	TPS	-0.0166	0.0139	0.2336
vdeltaue_cd_pw4		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-100,110-100)	OTHER	-0.0026	0.0042	0.5289
vdeltaue_cd_pw4		Variate piecewise of DeltaUEInit_r[1]	median(0,deltaUEinit_r-100,110-100)	PRE	-0.0019	0.0038	0.6195

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
		(change in unemployment rate from policy inception to current)					
vdeltaue_cd_pw4		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-100,110-100)	TPS	-0.0159	0.0037	0
vdeltaue_cd_pw5		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-110,140-110)	OTHER	-0.0106	0.0010	0
vdeltaue_cd_pw5		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-110,140-110)	PRE	-0.0065	0.0009	0
vdeltaue_cd_pw5		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-110,140-110)	TPS	-0.0135	0.0010	0
vdeltaue_cd_pw6		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-140,175-140)	OTHER	-0.0148	0.0009	0
vdeltaue_cd_pw6		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-140,175-140)	PRE	-0.0033	0.0006	0
vdeltaue_cd_pw6		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy	median(0,deltaUEinit_r-140,175-140)	TPS	-0.0116	0.0010	0

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
		inception to current)					
vdeltaue_cd_pw7		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	max(0,deltaUEinit_r-175)	OTHER	-0.0134	0.0007	0
vdeltaue_cd_pw7		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	max(0,deltaUEinit_r-175)	PRE	-0.0004	0.0002	0.1186
vdeltaue_cd_pw7		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	max(0,deltaUEinit_r-175)	TPS	-0.0075	0.0007	0
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	OTHER	0.3482	0.0579	0
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	PRE	0.0400	0.0466	0.3909
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	TPS	-0.2221	0.0426	0
mRatioTmpTei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else	OTHER			
mRatioTmpTei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else	PRE			
mRatioTmpTei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else	TPS			
vratiotmptei_cd_pw1		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-0,24-0)	OTHER	0.0012	0.0023	0.587
vratiotmptei_cd_pw1		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-0,24-0)	PRE	0.0152	0.0019	0

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
vratiotmptei_cd_pw1		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-0,24-0)	TPS	0.0018	0.0017	0.2981
vratiotmptei_cd_pw2		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-24,36-24)	OTHER	0.0219	0.0017	0
vratiotmptei_cd_pw2		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-24,36-24)	PRE	-0.0019	0.0014	0.1789
vratiotmptei_cd_pw2		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-24,36-24)	TPS	0.0071	0.0015	0
vratiotmptei_cd_pw3		Variate piecewise version of front end ratio	max(0,ratio_tmp_tei-36)	OTHER	0.0084	0.0020	0
vratiotmptei_cd_pw3		Variate piecewise version of front end ratio	max(0,ratio_tmp_tei-36)	PRE	-0.0035	0.0019	0.0591
vratiotmptei_cd_pw3		Variate piecewise version of front end ratio	max(0,ratio_tmp_tei-36)	TPS	0.0007	0.0020	0.7395
mpriordef	L01	Categorical of prior defaults	prior_default_count = 1	OTHER	0.2002	0.0142	0
mpriordef	L01	Categorical of prior defaults	prior_default_count = 1	PRE	-0.0933	0.0116	0
mpriordef	L01	Categorical of prior defaults	prior_default_count = 1	TPS	0.0910	0.0129	0
mpriordef	L02	Categorical of prior defaults	prior_default_count = 2	OTHER	0.2469	0.0172	0
mpriordef	L02	Categorical of prior defaults	prior_default_count = 2	PRE	-0.0295	0.0152	0.0522
mpriordef	L02	Categorical of prior defaults	prior_default_count = 2	TPS	0.1208	0.0151	0
mpriordef	L03	Categorical of prior defaults	prior_default_count >= 3	OTHER	0.2978	0.0192	0
mpriordef	L03	Categorical of prior defaults	prior_default_count >= 3	PRE	0.1355	0.0172	0
mpriordef	L03	Categorical of prior defaults	prior_default_count >= 3	TPS	0.1745	0.0153	0
mpriordef	Z00	Categorical of prior defaults	prior_default_count = 0				
mpriordef	Z00	Categorical of prior defaults	prior_default_count = 0				
mpriordef	Z00	Categorical of prior defaults	prior_default_count = 0				
vpriordef_cd_pw1		Variate piecewise version of prior defaults	min(prior_default_cnt,15)-3	OTHER	-0.0180	0.0091	0.0465
vpriordef_cd_pw1		Variate piecewise	min(prior_default_cnt,15)-3	PRE	0.1257	0.0075	0

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
		version of prior defaults					
vpriordef_cd_pw1		Variate piecewise version of prior defaults	min(prior_default_cnt,15)-3	TPS	0.0485	0.0048	0
vsato_cd_pw1		Variate piecewise of sato (spread at origination)	min(sato+0.1,0)	OTHER	0.5518	0.0324	0
vsato_cd_pw1		Variate piecewise of sato (spread at origination)	min(sato+0.1,0)	PRE	0.0815	0.0221	0.0002
vsato_cd_pw1		Variate piecewise of sato (spread at origination)	min(sato+0.1,0)	TPS	0.2436	0.0228	0
vsato_cd_pw2		Variate piecewise of sato (spread at origination)	median(0,sato+0.1,0.7+0.1)	OTHER	-0.0518	0.0231	0.0251
vsato_cd_pw2		Variate piecewise of sato (spread at origination)	median(0,sato+0.1,0.7+0.1)	PRE	-0.3362	0.0192	0
vsato_cd_pw2		Variate piecewise of sato (spread at origination)	median(0,sato+0.1,0.7+0.1)	TPS	-0.0872	0.0197	0
vsato_cd_pw3		Variate piecewise of sato (spread at origination)	max(0,sato-0.7)	OTHER	-0.1339	0.0403	0.0009
vsato_cd_pw3		Variate piecewise of sato (spread at origination)	max(0,sato-0.7)	PRE	-0.3460	0.0416	0
vsato_cd_pw3		Variate piecewise of sato (spread at origination)	max(0,sato-0.7)	TPS	-0.2317	0.0355	0
vUEblend_CD_pw1		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	min(ue_blended_r,420)	OTHER	0.0055	0.0005	0
vUEblend_CD_pw1		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	min(ue_blended_r,420)	PRE	0.0006	0.0003	0.0546
vUEblend_CD_pw1		Variate piecewise of ue_blended_r[2] (change in	min(ue_blended_r,420)	TPS	0.0017	0.0002	0

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
		unemployment rate)					
vUEblend_CD_pw2		Variate piecewise of ue_blended_r^2 (change in unemployment rate)	median(0,ue_blended_r-420,820-420)	OTHER	0.0015	0.0001	0
vUEblend_CD_pw2		Variate piecewise of ue_blended_r^2 (change in unemployment rate)	median(0,ue_blended_r-420,820-420)	PRE	0.0008	0.0001	0
vUEblend_CD_pw2		Variate piecewise of ue_blended_r^2 (change in unemployment rate)	median(0,ue_blended_r-420,820-420)	TPS	-0.0027	0.0001	0
vUeblend_CD_pw3		Variate piecewise of ue_blended_r^2 (change in unemployment rate)	max(0,ue_blended_r-820)	OTHER	-0.0041	0.0001	0
vUeblend_CD_pw3		Variate piecewise of ue_blended_r^2 (change in unemployment rate)	max(0,ue_blended_r-820)	PRE	-0.0003	0.0000	0
vUeblend_CD_pw3		Variate piecewise of ue_blended_r^2 (change in unemployment rate)	max(0,ue_blended_r-820)	TPS	-0.0032	0.0001	0
mDeltaTY10	L01	Categorical of DeltaTy10Init_r^3 (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	OTHER	-0.4022	0.0141	0
mDeltaTY10	L01	Categorical of DeltaTy10Init_r^3 (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	PRE	0.0984	0.0118	0
mDeltaTY10	L01	Categorical of DeltaTy10Init_r^3 (change in 10-year Treasury rate from policy	DeltaTy10Init_r < 53	TPS	-0.1513	0.0128	0

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
		inception to current)					
mDeltaTY10	L02	Categorical of DeltaTy10Init_r[3] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r > 130	OTHER	0.5031	0.0613	0
mDeltaTY10	L02	Categorical of DeltaTy10Init_r[3] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r > 130	PRE	0.0872	0.0330	0.0082
mDeltaTY10	L02	Categorical of DeltaTy10Init_r[3] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r > 130	TPS	0.6058	0.0257	0
mDeltaTY10	Z00	Categorical of DeltaTy10Init_r[3] (change in 10-year Treasury rate from policy inception to current)	base level: else	OTHER			
mDeltaTY10	Z00	Categorical of DeltaTy10Init_r[3] (change in 10-year Treasury rate from policy inception to current)	base level: else	PRE			
mDeltaTY10	Z00	Categorical of DeltaTy10Init_r[3] (change in 10-year Treasury rate from policy inception to current)	base level: else	TPS			
mDeltaTm3	L01	Categorical of DeltaTm3Init_r[4] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r > 600	OTHER	-0.6392	0.0462	0
mDeltaTm3	L01	Categorical of DeltaTm3Init_r[4] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r > 600	PRE	-0.1384	0.0268	0

Variable	ClassVal0	Description	Description Detail	Response	Estimate	StdErr	ProbChiSq
mDeltaTm3	L01	Categorical of DeltaTm3Init_r[4] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r > 600	TPS	0.6038	0.0189	0
mDeltaTm3	Z00	Categorical of DeltaTm3Init_r[4] (change in 3-month Treasury rate from policy inception to current)	base level: else	OTHER			
mDeltaTm3	Z00	Categorical of DeltaTm3Init_r[4] (change in 3-month Treasury rate from policy inception to current)	base level: else	PRE			
mDeltaTm3	Z00	Categorical of DeltaTm3Init_r[4] (change in 3-month Treasury rate from policy inception to current)	base level: else	TPS			

Conveyance Severity Model

The model parameters for the Conveyance severity model are shown below.

Table 66: Conveyance Severity Model Parameters

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				7.2409	0.0023	0.0000
Mproduct	ARM	Categorical of product type	adjustable rate mortgage	0.0072	0.0006	0.0000
Mproduct	ARMSR	Categorical of product type	adjustable rate mortgage - streamline refinance	0.0153	0.0013	0.0000
Mproduct	FRM15	Categorical of product type	15 year fixed rate mortgage	0.0672	0.0011	0.0000
Mproduct	FRM15SR	Categorical of product type	15 year fixed rate mortgage - streamline refinance	0.1130	0.0022	0.0000
Mproduct	FRM30SR	Categorical of product type	30 year fixed rate mortgage - streamline refinance	0.0065	0.0006	0.0000
Mproduct	z_FRM30	Categorical of product type	30 year fixed rate mortgage	0.0000	0.0000	
Vbalance_i_log		Variate version of log transformed outstanding	log(balance_i/1000)	0.9276	0.0003	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
		balance at start of quarter				
mjudicial	L01	Categorical of judicial (judicial state)	judicial = 1	0.0419	0.0003	0.0000
mjudicial	Z00	Categorical of judicial (judicial state)	base level: else	0.0000	0.0000	
mdpa_govt	LGovt	Categorical of down payment assistance, government level indicator	dpa = "govt"	-0.0254	0.0010	0.0000
mdpa_govt	ZOthr	Categorical of down payment assistance, government level indicator	base level: else	0.0000	0.0000	
mdpa_nprof	LNPro	Categorical of down payment assistance, non-profit level indicator	dpa = "nonprof"	-0.0190	0.0004	0.0000
mdpa_nprof	ZOthr	Categorical of down payment assistance, non-profit level indicator	base level: else	0.0000	0.0000	
mrfncind	LY	Categorical of rfnc_ind (refinanced loan indicator)	rfnc_ind <> "N"	-0.0164	0.0005	0.0000
mrfncind	ZN	Categorical of rfnc_ind (refinanced loan indicator)	base level: else	0.0000	0.0000	
mcalperiod	L200104	Categorical of calender periods	period < 200604 (2006 Q4)	-0.0144	0.0004	0.0000
mcalperiod	L200604	Categorical of calender periods	period = 200604	0.0040	0.0015	0.0087
mcalperiod	L200701	Categorical of calender periods	period = 200701	0.0067	0.0015	0.0000
mcalperiod	L200702	Categorical of calender periods	period = 200702	0.0065	0.0015	0.0000
mcalperiod	L200703	Categorical of calender periods	period = 200703	0.0095	0.0015	0.0000
mcalperiod	Z201800	Categorical of calender periods	base level: else	0.0000	0.0000	
vdeltaue_cd_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	min(deltaUEinit_r,90)	-0.0001	0.0000	0.0000
vdeltaue_cd_pw3		Variate piecewise of	median(0,deltaUEinit_r-97,100-97)	0.0010	0.0001	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
		DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)				
vdeltaue_cd_pw5		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-110,140-110)	-0.0003	0.0000	0.0000
vdeltaue_cd_pw6		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-140,175-140)	0.0001	0.0000	0.0000
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	0.0281	0.0009	0.0000
mRatioTmpTei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else	0.0000	0.0000	
vratiotmptei_cd_pw1		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-0,24-0)	0.0009	0.0000	0.0000
vratiotmptei_cd_pw2		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-24,36-24)	0.0003	0.0000	0.0000
mpriordef	L01	Categorical of prior defaults	prior_default_count = 1	0.1291	0.0101	0.0000
mpriordef	L02	Categorical of prior defaults	prior_default_count = 2	0.1464	0.0101	0.0000
mpriordef	L03	Categorical of prior defaults	prior_default_count >= 3	0.1694	0.0101	0.0000
mpriordef	Z00	Categorical of prior defaults	prior_default_count = 0	0.0000	0.0000	
vpriordef_cd_pw1		Variate piecewise version of prior defaults	min(prior_default_cnt,15)-3	0.0190	0.0003	0.0000
vsato_cd_pw1		Variate piecewise of sato (spread at origination)	min(sato+0.1,0)	-0.0121	0.0002	0.0000
vsato_cd_pw2		Variate piecewise of sato (spread at origination)	median(0,sato+0.1,0.7+0.1)	0.0084	0.0004	0.0000
vsato_cd_pw3		Variate piecewise of	max(0,sato-0.7)	-0.0115	0.0001	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
		sato (spread at origination)				
vUEblend_CD_pw1		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	min(ue_blended_r,420)	0.0002	0.0000	0.0000
vUEblend_CD_pw2		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	median(0,ue_blended_r-420,820-420)	0.0000	0.0000	0.0000
vUeblend_CD_pw3		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	max(0,ue_blended_r-820)	0.0000	0.0000	0.4849
mtimesinceD	L01	Categorical of time since end of last episode	cx_time <= 1	-0.1151	0.0101	0.0000
mtimesinceD	L02	Categorical of time since end of last episode	cx_time = 2	-0.0792	0.0103	0.0000
mtimesinceD	L03	Categorical of time since end of last episode	cx_time = 3	-0.0661	0.0104	0.0000
mtimesinceD	L04	Categorical of time since end of last episode	cx_time = 4	-0.0509	0.0106	0.0000
mtimesinceD	L05	Categorical of time since end of last episode	cx_time = 5	-0.0421	0.0110	0.0001
mtimesinceD	L06	Categorical of time since end of last episode	cx_time = 6	-0.0414	0.0113	0.0003
mtimesinceD	L07	Categorical of time since end of last episode	cx_time = 7	0.0238	0.0123	0.0526
mtimesinceD	L08	Categorical of time since end of last episode	cx_time = 8	-0.0015	0.0127	0.9053
mtimesinceD	L09	Categorical of time since end of last episode	cx_time = 9	-0.0217	0.0135	0.1077
mtimesinceD	L10	Categorical of time since end of last episode	cx_time = 10	-0.0421	0.0142	0.0031
mtimesinceD	L11	Categorical of time since end of last episode	cx_time = 11	-0.0193	0.0151	0.2036
mtimesinceD	L12	Categorical of time since end of last episode	cx_time = 12	-0.0049	0.0164	0.7664

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mtimesinceD	Z00	Categorical of time since end of last episode	cx_time > 12	0.0000	0.0000	
vtimesinced_cd_pw1		Variate piecewise of time since end of last episode	median(0,dur_def_episode-12,24-12)	0.0010	0.0015	0.5315
mdurdefepi	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	-0.0242	0.0005	0.0000
mdurdefepi	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	-0.0056	0.0005	0.0000
mdurdefepi	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	0.0120	0.0005	0.0000
mdurdefepi	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	0.0293	0.0005	0.0000
mdurdefepi	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	0.0440	0.0005	0.0000
mdurdefepi	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	0.0579	0.0006	0.0000
mdurdefepi	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	0.0704	0.0006	0.0000
mdurdefepi	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 9	0.0819	0.0007	0.0000
mdurdefepi	L10	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 10	0.0924	0.0007	0.0000
mdurdefepi	L11	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 11	0.0961	0.0006	0.0000
mdurdefepi	Z01	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 1	0.0000	0.0000	
vdurdefepi_DCLM_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-10,30-10)	0.0091	0.0001	0.0000
vdurdefepi_DCLM_pw2		Variate piecewise of	median(0,dur_def_episode-30,40-30)	0.0064	0.0003	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
		dur_def_episode (duration of default episode)				
mDeltaTY10	L01	Categorical of DeltaTy10Init_r[3] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	0.0310	0.0004	0.0000
mDeltaTY10	L02	Categorical of DeltaTy10Init_r[3] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r > 130	-0.0063	0.0009	0.0000
mDeltaTY10	Z00	Categorical of DeltaTy10Init_r[3] (change in 10-year Treasury rate from policy inception to current)	base level: else	0.0000	0.0000	
mDeltaTm3	L01	Categorical of DeltaTm3Init_r[4] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r > 600	0.0045	0.0010	0.0000
mDeltaTm3	Z00	Categorical of DeltaTm3Init_r[4] (change in 3-month Treasury rate from policy inception to current)	base level: else	0.0000	0.0000	
Scale				97.5252	0.1511	

Conveyance Recovery Severity Model

The model parameters for the Conveyance Recovery severity model are shown below.

Table 67: Conveyance Recovery Severity Model Parameters

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				5.7575	0.0123	0.0000
Mproduct	ARM	Categorical of product type	adjustable rate mortgage	-0.0898	0.0028	0.0000
Mproduct	ARMSR	Categorical of product type	adjustable rate mortgage - streamline refinance	0.0235	0.0065	0.0003
Mproduct	FRM15	Categorical of product type	15 year fixed rate mortgage	0.1922	0.0060	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Mproduct	FRM15SR	Categorical of product type	15 year fixed rate mortgage - streamline refinance	0.4517	0.0109	0.0000
Mproduct	FRM30SR	Categorical of product type	30 year fixed rate mortgage - streamline refinance	0.1048	0.0031	0.0000
Mproduct	z_FRM30	Categorical of product type	30 year fixed rate mortgage	0.0000	0.0000	
Vbalance_i_log		Variate version of log transformed outstanding balance at start of quarter	log(balance_i/1000)	1.1686	0.0014	0.0000
mseason	L01	Categorical of season	season = "winter"	0.0161	0.0017	0.0000
mseason	L02	Categorical of season	season = "spring"	0.0036	0.0017	0.0337
mseason	L03	Categorical of season	season = "summer"	-0.0144	0.0017	0.0000
mseason	Z04	Categorical of season	season="fall"	0.0000	0.0000	
mjudicial	L01	Categorical of judicial (judicial state)	judicial = 1	-0.0700	0.0013	0.0000
mjudicial	Z00	Categorical of judicial (judicial state)	base level: else	0.0000	0.0000	
mdpa_govt	LGovt	Categorical of down payment assistance, government level indicator	dpa = "govt"	-0.0904	0.0045	0.0000
mdpa_govt	ZOthr	Categorical of down payment assistance, government level indicator	base level: else	0.0000	0.0000	
mdpa_nprof	LNPro	Categorical of down payment assistance, non-profit level indicator	dpa = "nonprof"	-0.1619	0.0021	0.0000
mdpa_nprof	ZOthr	Categorical of down payment assistance, non-profit level indicator	base level: else	0.0000	0.0000	
mycslope	L01	Categorical of yield curve slope	1<=ycslope<=2	-0.0180	0.0017	0.0000
mycslope	Z00	Categorical of yield curve slope	base level: else	0.0000	0.0000	
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	-0.0528	0.0017	0.0000
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else	0.0000	0.0000	
mrfncind	LY	Categorical of rfnc_ind	rfnc_ind <> "N"	-0.2387	0.0026	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(refinanced loan indicator)				
mrfncind	ZN	Categorical of rfnc_ind (refinanced loan indicator)	base level: else	0.0000	0.0000	
mcalperiod	L200104	Categorical of calender periods	period < 200604 (2006 Q4)	0.3086	0.0021	0.0000
mcalperiod	L200604	Categorical of calender periods	period = 200604	0.2524	0.0073	0.0000
mcalperiod	L200701	Categorical of calender periods	period = 200701	0.1994	0.0074	0.0000
mcalperiod	L200702	Categorical of calender periods	period = 200702	0.1614	0.0076	0.0000
mcalperiod	L200703	Categorical of calender periods	period = 200703	0.1294	0.0076	0.0000
mcalperiod	Z201800	Categorical of calender periods	base level: else	0.0000	0.0000	
vdeltaue_cd_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	min(deltaUEinit_r,90)	-0.0004	0.0001	0.0000
vdeltaue_cd_pw2		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-90,97-90)	0.0015	0.0003	0.0000
vdeltaue_cd_pw6		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-140,175-140)	-0.0015	0.0001	0.0000
vdeltaue_cd_pw7		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	max(0,deltaUEinit_r-175)	-0.0006	0.0000	0.0000
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	0.0571	0.0048	0.0000
mRatioTmpTei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else	0.0000	0.0000	
vratiotmptei_cd_pw1		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-0,24-0)	0.0024	0.0002	0.0000
vratiotmptei_cd_pw2		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-24,36-24)	-0.0019	0.0002	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vratiotmptei_cd_pw3		Variate piecewise version of front end ratio	max(0,ratio_tmp_tei-36)	0.0009	0.0003	0.0005
mpriordef	L01	Categorical of prior defaults	prior_default_count = 1	0.0391	0.0016	0.0000
mpriordef	L02	Categorical of prior defaults	prior_default_count = 2	0.0667	0.0023	0.0000
mpriordef	L03	Categorical of prior defaults	prior_default_count >= 3	0.0873	0.0027	0.0000
mpriordef	Z00	Categorical of prior defaults	prior_default_count = 0	0.0000	0.0000	
vpriordef_cd_pw1		Variate piecewise version of prior defaults	min(prior_default_cnt,15)-3	0.0386	0.0013	0.0000
vsato_cd_pw1		Variate piecewise of sato (spread at origination)	min(sato+0.1,0)	-0.0366	0.0014	0.0000
vsato_cd_pw2		Variate piecewise of sato (spread at origination)	median(0,sato+0.1,0.7+0.1)	-0.1226	0.0022	0.0000
vUEblend_CD_pw1		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	min(ue_blended_r,420)	-0.0002	0.0000	0.0000
vUEblend_CD_pw2		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	median(0,ue_blended_r-420,820-420)	-0.0005	0.0000	0.0000
vUeblend_CD_pw3		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	max(0,ue_blended_r-820)	0.0000	0.0000	0.0000
vhpa2yb_cd_pw1		Variate piecewise of hpa2y_blended_r[3]	min(hpa2y_blended_r,85)	-0.0011	0.0001	0.0000
vhpa2yb_cd_pw2		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_r-85,95-85)	0.0139	0.0004	0.0000
vhpa2yb_cd_pw3		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_r-95,113-95)	0.0010	0.0002	0.0000
vhpa2yb_cd_pw4		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_r-113,120-113)	0.0153	0.0004	0.0000
vhpa2yb_cd_pw5		Variate piecewise of hpa2y_blended_r[3]	max(0,hpa2y_blended_r-120)	0.0080	0.0002	0.0000
mDeltaTY10	L01	Categorical of DeltaTy10Init_r[4] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	-0.0111	0.0021	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mDeltaTY10	L02	Categorical of DeltaTy10Init_r[4] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r > 130	0.0419	0.0070	0.0000
mDeltaTY10	Z00	Categorical of DeltaTy10Init_r[4] (change in 10-year Treasury rate from policy inception to current)	base level: else	0.0000	0.0000	
mDeltaTm3	L01	Categorical of DeltaTm3Init_r[5] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r > 600	0.1433	0.0051	0.0000
mDeltaTm3	Z00	Categorical of DeltaTm3Init_r[5] (change in 3-month Treasury rate from policy inception to current)	base level: else	0.0000	0.0000	
Scale				4.4471	0.0075	

Third Party Sales Severity Model

The model parameters for the Third Party Sales severity model are shown below.

Table 68: Third Party Sales Severity Model Parameters

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				6.7984	0.0387	0.0000
Mproduct	ARM	Categorical of product type	adjustable rate mortgage	0.0469	0.0160	0.0034
Mproduct	ARMSR	Categorical of product type	adjustable rate mortgage - streamline refinance	0.0738	0.0234	0.0016
Mproduct	FRM15	Categorical of product type	15 year fixed rate mortgage	0.0040	0.0230	0.8605
Mproduct	FRM15SR	Categorical of product type	15 year fixed rate mortgage - streamline refinance	0.0513	0.0465	0.2700
Mproduct	FRM30SR	Categorical of product type	30 year fixed rate mortgage - streamline refinance	0.0316	0.0074	0.0000
Mproduct	z_FRM30	Categorical of product type	30 year fixed rate mortgage	0.0000	0.0000	
Vbalance_i_log		Variate version of log transformed outstanding	log(balance_i/1000)	0.6765	0.0042	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
		balance at start of quarter				
mseason	L01	Categorical of season	season = "winter"	-0.0062	0.0062	0.3164
mseason	L02	Categorical of season	season = "spring"	-0.0174	0.0062	0.0049
mseason	L03	Categorical of season	season = "summer"	-0.0108	0.0062	0.0800
mseason	Z04	Categorical of season	season="fall"	0.0000	0.0000	
mjudicial	L01	Categorical of judicial (judicial state)	judicial = 1	0.2230	0.0049	0.0000
mjudicial	Z00	Categorical of judicial (judicial state)	base level: else	0.0000	0.0000	
mdpa_govt	LGovt	Categorical of down payment assistance, government level indicator	dpa = "govt"	0.0474	0.0154	0.0021
mdpa_govt	ZOthr	Categorical of down payment assistance, government level indicator	base level: else	0.0000	0.0000	
mdpa_nprof	LNPro	Categorical of down payment assistance, non-profit level indicator	dpa = "nonprof"	0.1407	0.0073	0.0000
mdpa_nprof	ZOthr	Categorical of down payment assistance, non-profit level indicator	base level: else	0.0000	0.0000	
mycslope	L01	Categorical of yield curve slope	1<=ycslope<=2	-0.0187	0.0064	0.0037
mycslope	Z00	Categorical of yield curve slope	base level: else	0.0000	0.0000	
mrfncind	LY	Categorical of rfnc_ind (refinanced loan indicator)	rfnc_ind <> "N"	0.1980	0.0062	0.0000
mrfncind	ZN	Categorical of rfnc_ind (refinanced loan indicator)	base level: else	0.0000	0.0000	
mpriordef	L01	Categorical of prior defaults	prior_default_count = 1	0.0105	0.0060	0.0828
mpriordef	L02	Categorical of prior defaults	prior_default_count = 2	0.0191	0.0069	0.0055
mpriordef	L03	Categorical of prior defaults	prior_default_count >= 3	0.0436	0.0067	0.0000
mpriordef	Z00	Categorical of prior defaults	prior_default_count = 0	0.0000	0.0000	

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
vpriordef_cd_pw1		Variate piecewise version of prior defaults	min(prior_default_cnt,15)-3	0.0043	0.0020	0.0300
vsato_cd_pw2		Variate piecewise of sato (spread at origination)	median(0,sato+0.1,0.7+0.1)	0.1137	0.0084	0.0000
vsato_cd_pw3		Variate piecewise of sato (spread at origination)	max(0,sato-0.7)	0.1141	0.0170	0.0000
vUEblend_CD_pw1		Variate piecewise of ue_blended_r[1] (change in unemployment rate)	min(ue_blended_r,420)	0.0017	0.0001	0.0000
vUEblend_CD_pw2		Variate piecewise of ue_blended_r[1] (change in unemployment rate)	median(0,ue_blended_r-420,820-420)	0.0008	0.0000	0.0000
vhpa2yb_cd_pw3		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-95,113-95)	-0.0116	0.0008	0.0000
vhpa2yb_cd_pw4		Variate piecewise of hpa2y_blended_r[2]	median(0,hpa2y_blended_r-113,120-113)	-0.0275	0.0011	0.0000
mdurdefepi	L02	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 2	-0.1047	0.0130	0.0000
mdurdefepi	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	-0.0553	0.0127	0.0000
mdurdefepi	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	-0.0077	0.0125	0.5358
mdurdefepi	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	0.0557	0.0127	0.0000
mdurdefepi	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	0.0967	0.0130	0.0000
mdurdefepi	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	0.1193	0.0135	0.0000
mdurdefepi	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	0.1629	0.0140	0.0000
mdurdefepi	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 9	0.1935	0.0145	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mdurdefepi	L10	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 10	0.2213	0.0150	0.0000
mdurdefepi	L11	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 11	0.2238	0.0125	0.0000
mdurdefepi	Z01	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 1	0.0000	0.0000	
vdurdefepi_DCLM_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-10,30-10)	0.0223	0.0008	0.0000
vdurdefepi_DCLM_pw2		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-30,40-30)	0.0076	0.0030	0.0123
mDeltaTY10	L01	Categorical of DeltaTy10Init_r[3] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r < 53	0.1157	0.0058	0.0000
mDeltaTY10	L02	Categorical of DeltaTy10Init_r[3] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r > 130	-0.0943	0.0092	0.0000
mDeltaTY10	Z00	Categorical of DeltaTy10Init_r[3] (change in 10-year Treasury rate from policy inception to current)	base level: else	0.0000	0.0000	
mDeltaTm3	L01	Categorical of DeltaTm3Init_r[4] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r > 600	-0.0917	0.0066	0.0000
mDeltaTm3	Z00	Categorical of DeltaTm3Init_r[4] (change in 3-month Treasury rate from policy inception to current)	base level: else	0.0000	0.0000	
Scale				2.8602	0.0140	

Pre-Foreclosure Sale Severity Model

The model parameters for the Pre-Foreclosure Sale severity model are shown below.

Table 69: Pre-Foreclosure Sale Severity Model

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
Intercept				5.8083	0.0404	0.0000
Marm_ind	Y	Categorical of ARM product type indicator	adjustable rate mortgage	0.0476	0.0086	0.0000
Marm_ind	z_N	Categorical of ARM product type indicator	fixed rate mortgage	0.0000	0.0000	
Vbalance_i_log		Variate version of outstanding balance at start of quarter	log(balance_i/1000)	0.7900	0.0040	0.0000
mjudicial	L01	Categorical of judicial (judicial state)	judicial = 1	0.0467	0.0037	0.0000
mjudicial	Z00	Categorical of judicial (judicial state)	base level: else	0.0000	0.0000	
mdpa_govt	LGovt	Categorical of down payment assistance, government level indicator	dpa = "govt"	0.0666	0.0138	0.0000
mdpa_govt	ZOthr	Categorical of down payment assistance, government level indicator	base level: else	0.0000	0.0000	
mdpa_nprof	LNPro	Categorical of down payment assistance, non-profit level indicator	dpa = "nonprof"	0.1256	0.0056	0.0000
mdpa_nprof	ZOthr	Categorical of down payment assistance, non-profit level indicator	base level: else	0.0000	0.0000	
mdpa_rel	LRela	Categorical of down payment assistance, relative level indicator	dpa = "relative"	-0.0223	0.0062	0.0003
mdpa_rel	ZOthr	Categorical of down payment assistance, relative level indicator	base level: else	0.0000	0.0000	
mycslope	L01	Categorical of yield curve slope	1<=ycslope<=2	0.0872	0.0062	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
mycslope	Z00	Categorical of yield curve slope	base level: else	0.0000	0.0000	
mfrst_tm_by	1	Categorical of frst_tm_by (first-time buyer)	frst_tm_by = "Y"	0.0402	0.0051	0.0000
mfrst_tm_by	2	Categorical of frst_tm_by (first-time buyer)	base level: else	0.0000	0.0000	
mrfncind	LY	Categorical of rfnc_ind (refinanced loan indicator)	rfnc_ind <> "N"	0.2092	0.0058	0.0000
mrfncind	ZN	Categorical of rfnc_ind (refinanced loan indicator)	base level: else	0.0000	0.0000	
mcalperiod	L200104	Categorical of calender periods	period < 200604 (2006 Q4)	-0.4798	0.0067	0.0000
mcalperiod	L200604	Categorical of calender periods	period = 200604	-0.2585	0.0287	0.0000
mcalperiod	L200701	Categorical of calender periods	period = 200701	-0.2204	0.0268	0.0000
mcalperiod	L200702	Categorical of calender periods	period = 200702	-0.2540	0.0247	0.0000
mcalperiod	L200703	Categorical of calender periods	period = 200703	-0.3107	0.0270	0.0000
mcalperiod	Z201800	Categorical of calender periods	base level: else	0.0000	0.0000	
vdeltaue_cd_pw1		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	min(deltaUEinit_r,90)	-0.0006	0.0002	0.0011
vdeltaue_cd_pw4		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-100,110-100)	0.0028	0.0008	0.0003
vdeltaue_cd_pw5		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-110,140-110)	0.0014	0.0003	0.0000
vdeltaue_cd_pw6		Variate piecewise of DeltaUEInit_r[1] (change in unemployment rate from policy inception to current)	median(0,deltaUEinit_r-140,175-140)	0.0003	0.0002	0.1695
vdeltaue_cd_pw7		Variate piecewise of DeltaUEInit_r[1]	max(0,deltaUEinit_r-175)	0.0018	0.0001	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(change in unemployment rate from policy inception to current)				
mRatioTmpTei	L00	Categorical of ratio_tmp_tei (front-end ratio)	ratio_tmp_tei=0	0.1142	0.0052	0.0000
mRatioTmpTei	Z01	Categorical of ratio_tmp_tei (front-end ratio)	base level: else	0.0000	0.0000	
vratiotmptei_cd_pw2		Variate piecewise version of front end ratio	median(0,ratio_tmp_tei-24,36-24)	0.0066	0.0004	0.0000
mpriordef	L01	Categorical of prior defaults	prior_default_count = 1	0.0264	0.0044	0.0000
mpriordef	L02	Categorical of prior defaults	prior_default_count = 2	0.0508	0.0061	0.0000
mpriordef	L03	Categorical of prior defaults	prior_default_count >= 3	0.0995	0.0071	0.0000
mpriordef	Z00	Categorical of prior defaults	prior_default_count = 0	0.0000	0.0000	
vpriordef_cd_pw1		Variate piecewise version of prior defaults	min(prior_default_cnt,15)-3	0.0320	0.0034	0.0000
vsato_cd_pw1		Variate piecewise of sato (spread at origination)	min(sato+0.1,0)	-0.0165	0.0060	0.0057
vsato_cd_pw2		Variate piecewise of sato (spread at origination)	median(0,sato+0.1,0.7+0.1)	0.0732	0.0069	0.0000
vsato_cd_pw3		Variate piecewise of sato (spread at origination)	max(0,sato-0.7)	0.0548	0.0140	0.0001
vUEblend_CD_pw1		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	min(ue_blended_r,420)	0.0014	0.0001	0.0000
vUEblend_CD_pw2		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	median(0,ue_blended_r-420,820-420)	0.0008	0.0000	0.0000
vUeblend_CD_pw3		Variate piecewise of ue_blended_r[2] (change in unemployment rate)	max(0,ue_blended_r-820)	0.0002	0.0000	0.0000
vhpa2yb_cd_pw3		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_r-95,113-95)	0.0031	0.0004	0.0000
vhpa2yb_cd_pw4		Variate piecewise of hpa2y_blended_r[3]	median(0,hpa2y_blended_r-113,120-113)	-0.0047	0.0008	0.0000
mdurdefepi	L02	Categorical of dur_def_episode	dur_def_episode = 2	0.0970	0.0051	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
		(duration of default episode)				
mdurdefepi	L03	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 3	0.1567	0.0055	0.0000
mdurdefepi	L04	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 4	0.2068	0.0062	0.0000
mdurdefepi	L05	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 5	0.2636	0.0070	0.0000
mdurdefepi	L06	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 6	0.3154	0.0079	0.0000
mdurdefepi	L07	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 7	0.3704	0.0088	0.0000
mdurdefepi	L08	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 8	0.4028	0.0099	0.0000
mdurdefepi	L09	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 9	0.4523	0.0113	0.0000
mdurdefepi	L10	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 10	0.4654	0.0125	0.0000
mdurdefepi	L11	Categorical of dur_def_episode (duration of default episode)	dur_def_episode >= 11	0.4986	0.0099	0.0000
mdurdefepi	Z01	Categorical of dur_def_episode (duration of default episode)	dur_def_episode = 1	0.0000	0.0000	
vdurdefepi_DCLM_pw1		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-10,30-10)	0.0283	0.0014	0.0000
vdurdefepi_DCLM_pw2		Variate piecewise of dur_def_episode (duration of default episode)	median(0,dur_def_episode-30,40-30)	-0.0403	0.0091	0.0000
mDeltaTY10	L01	Categorical of DeltaTy10Init_r[4] (change in 10-year Treasury rate from policy	DeltaTy10Init_r < 53	0.1134	0.0050	0.0000

Parameter	Level1	Description	Description Detail	Estimate	StdErr	ProbChiSq
		inception to current)				
mDeltaTY10	L02	Categorical of DeltaTy10Init_r[4] (change in 10-year Treasury rate from policy inception to current)	DeltaTy10Init_r > 130	-0.0998	0.0116	0.0000
mDeltaTY10	Z00	Categorical of DeltaTy10Init_r[4] (change in 10-year Treasury rate from policy inception to current)	base level: else	0.0000	0.0000	
mDeltaTm3	L01	Categorical of DeltaTm3Init_r[5] (change in 3-month Treasury rate from policy inception to current)	DeltaTm3Init_r > 600	-0.1072	0.0099	0.0000
mDeltaTm3	Z00	Categorical of DeltaTm3Init_r[5] (change in 3-month Treasury rate from policy inception to current)	base level: else	0.0000	0.0000	
Scale				4.0617	0.0182	

Model Validation

Model validation was accomplished by applying the models developed using the training set to the validation dataset. The application of the models to the validation data produces the probability of each type of claim settlement type and a predicted net loss. The actual target variable is then compared to the predicted target variable to ensure the model fits the claim settlement process and net loss process without over-fitting the actual data.

Specifically for the loss settlement models, for the final loss settlement type we calculate the predicted probability of the settlement type. The actual settlement type is 1.0 for the final type of claim and 0.0 for all other claim types. The probability of each claim type for each record in the validation dataset is derived from the model parameters. The sum of all predicted claim type probabilities is 1.0 for each record.

For the net loss severity models, we calculate a predicted net loss. We also summarize the actual net loss for each claim. The predicted loss severity for each record in the validation dataset is derived from the model parameters.

Decile charts are then created for each final claim type selection and each net loss. All records are sorted, or ranked, in ascending order by the predicted value. Ten equal-sized decile groups are created with 10% of the records in each group. The sum of the actual probability and the sum of the predicted probability for each claim type within each decile is calculated for the claim type models. The sum of the actual net loss and the sum of the predicted net loss within each decile is calculated for the loss severity models. The actual and predicted numbers are then compared for consistency. The objective of a model is to have a significant spread in predicted values while maintaining a close relationship between the resulting actual and predicted values.

Loss Mitigation Model

The validation charts for the Loss Mitigation Binomial Model are shown below.

Figure 45: Loss Mitigation Binomial Model Validation

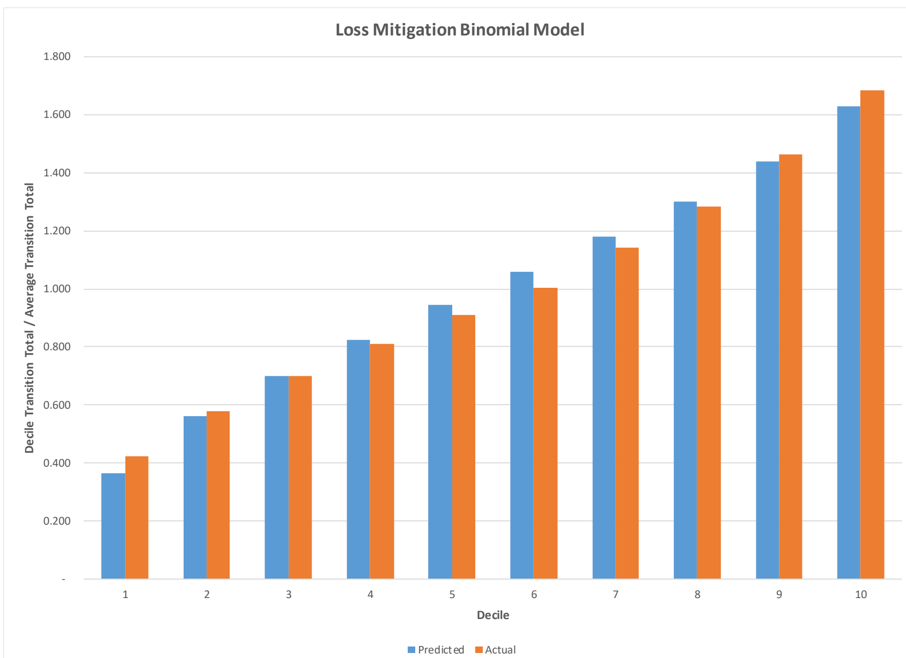
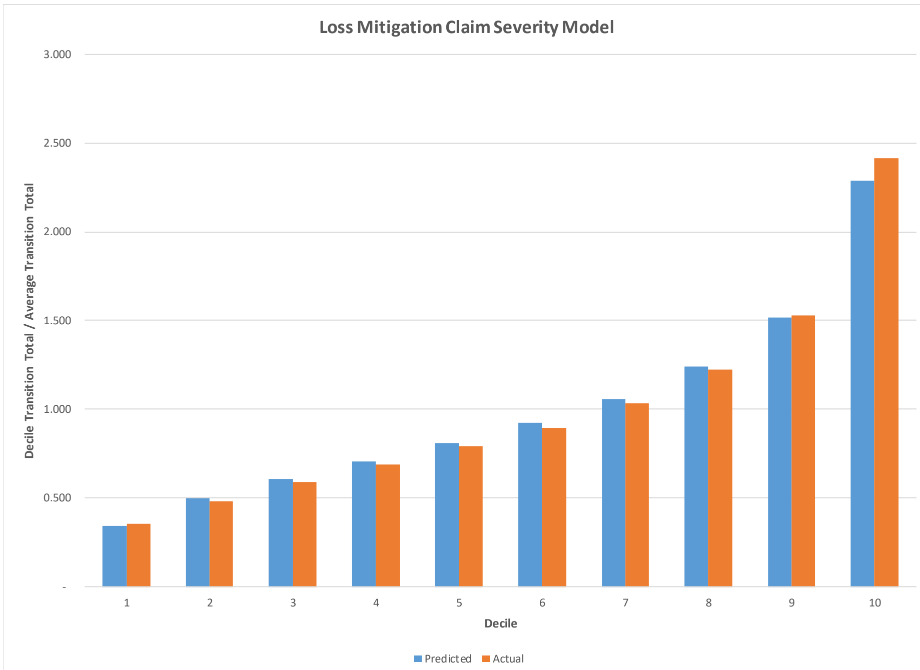


Figure 46: Loss Mitigation Claim Severity Model Validation



Claim Type Model

The validation charts for the Claim Type model are shown below.

Figure 47: Conveyance Claim Type Model Validation Chart

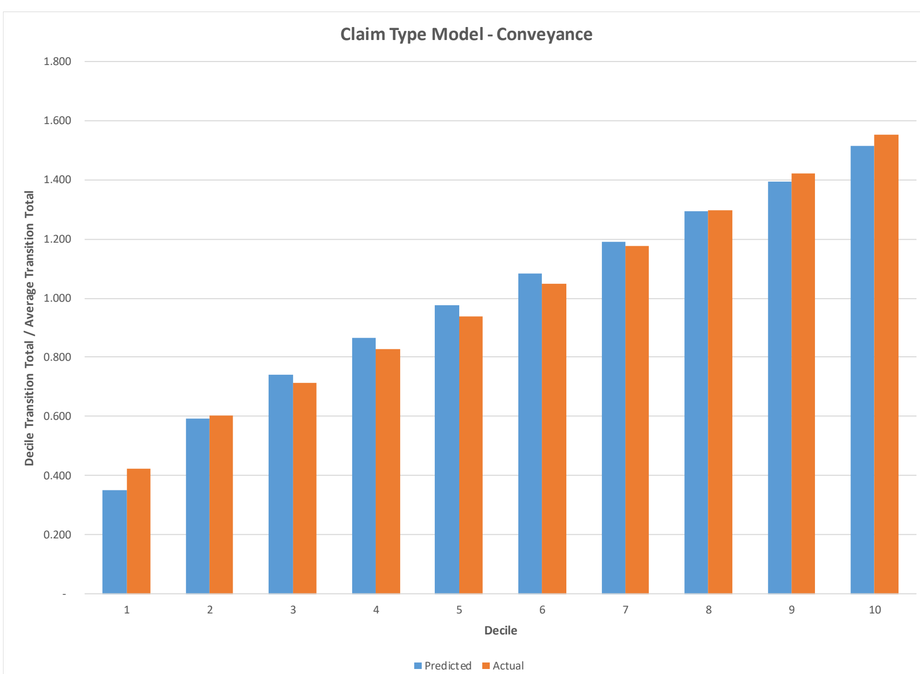


Figure 48: TPS Claim Type Model Validation Chart

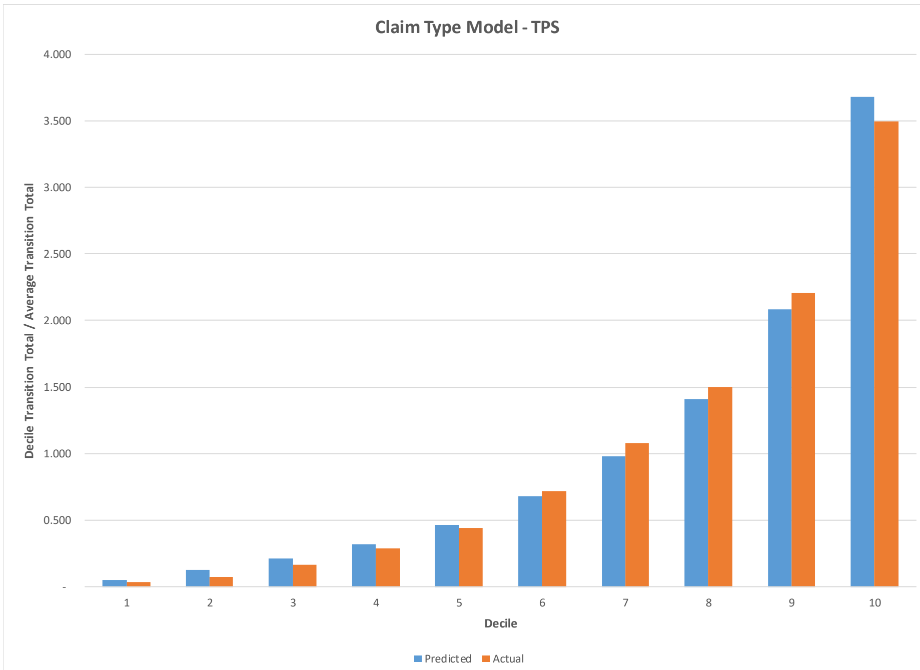
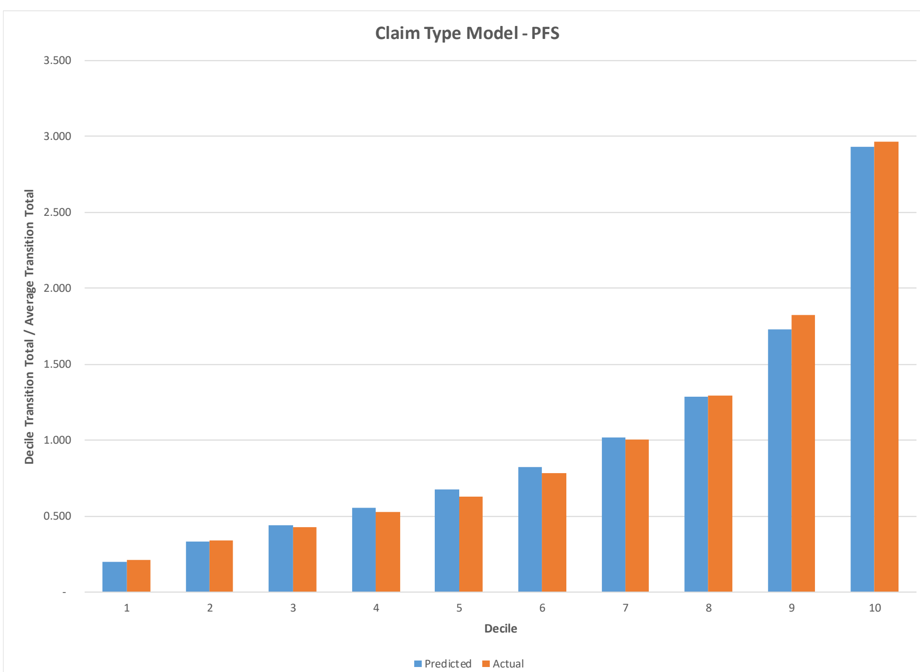


Figure 49: PFS Claim Type Model Validation Chart



Claim Type Severity Models

The validation charts for the Claim Type Severity Models are shown below.

Figure 50: Conveyance Loss Severity Model Validation

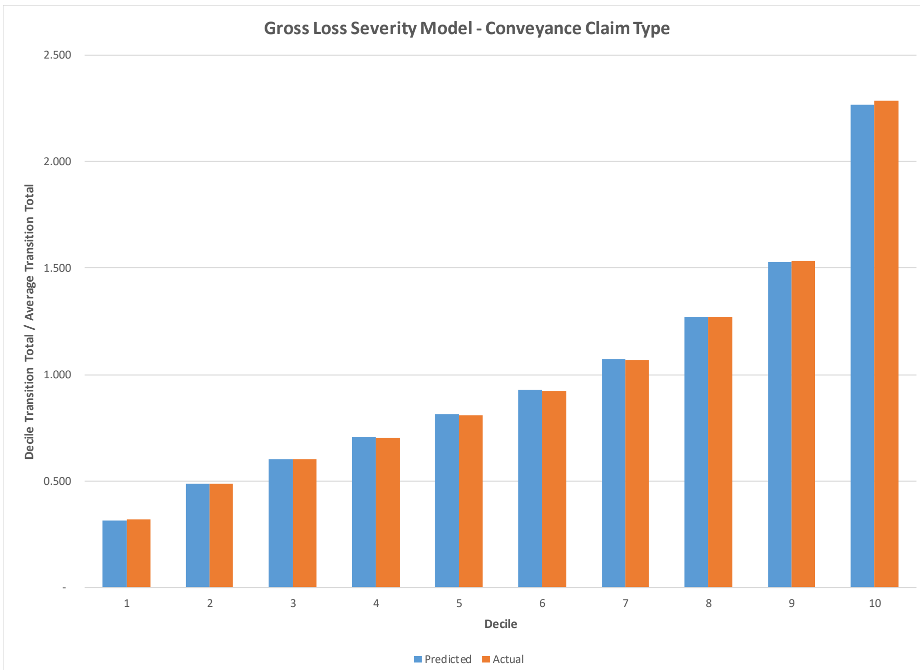


Figure 51: Conveyance Recovery Loss Severity Model Validation

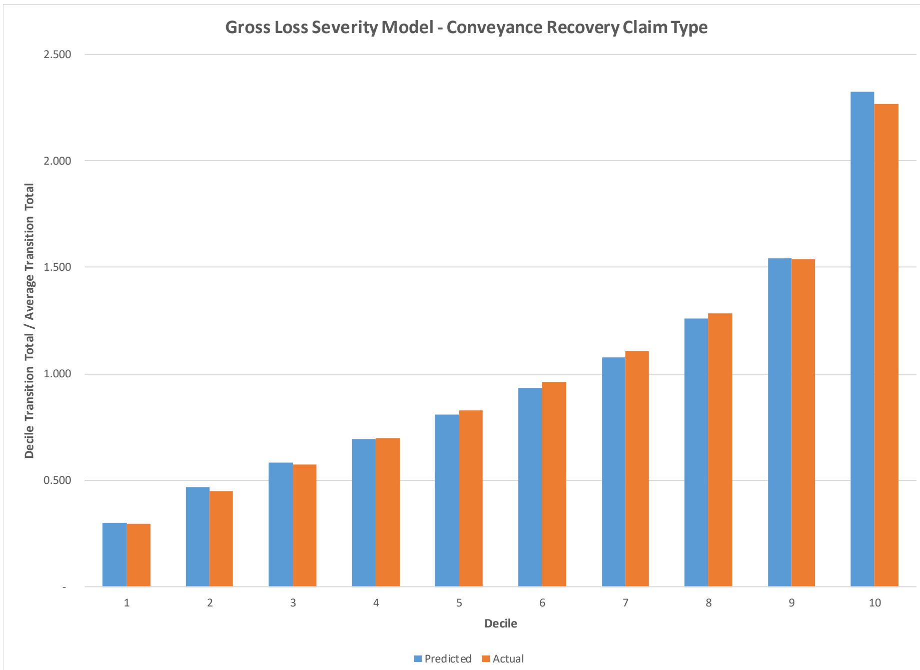


Figure 52: PFS Loss Severity Model Validation

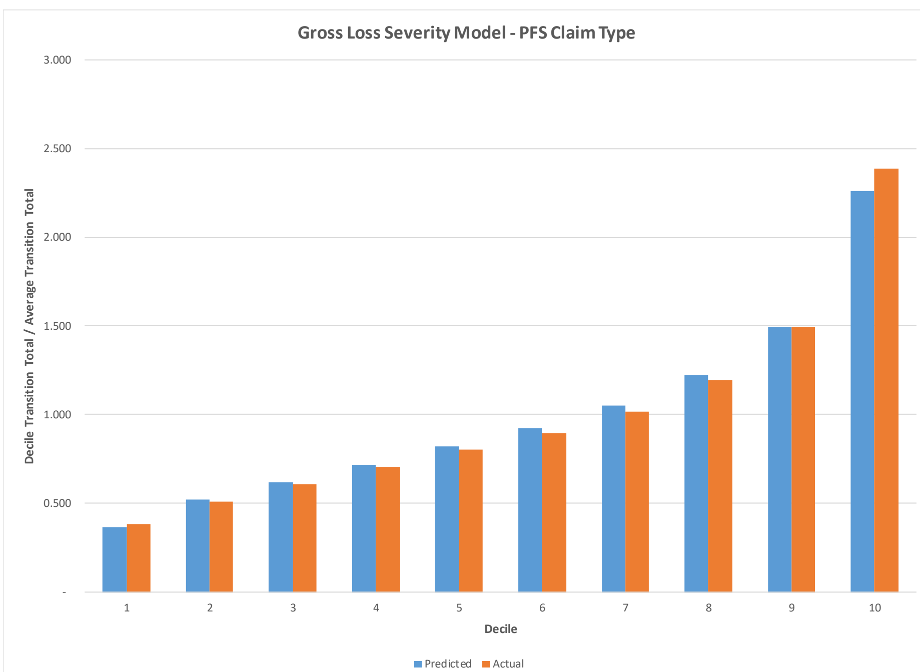
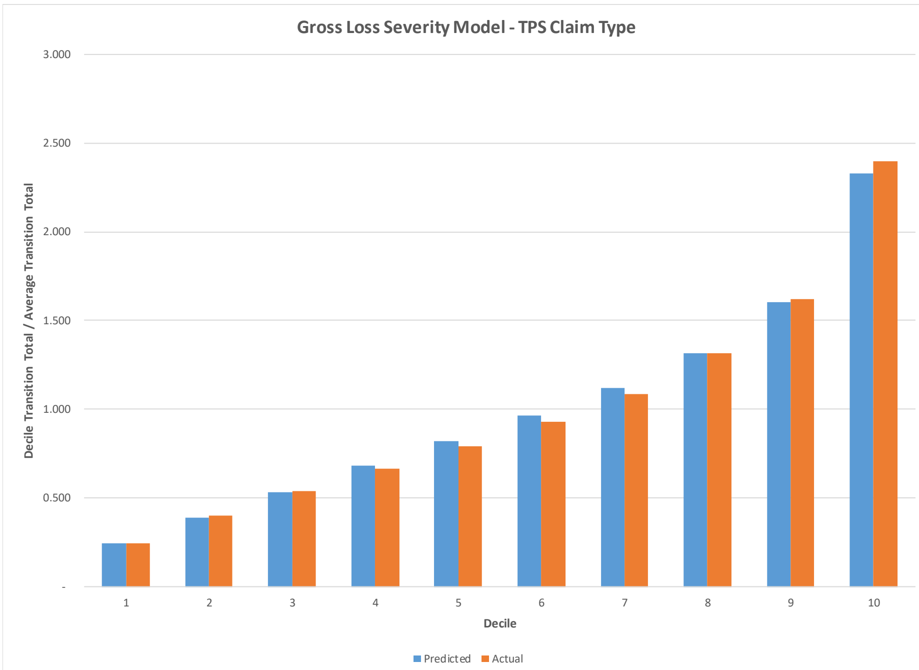


Figure 53: TPS Loss Severity Model Validation



Appendix D: Economic Scenarios

To measure the possible variation in MMIF's Cash Flow NPV on the existing portfolio, we developed a baseline projection using OMB Economic Assumptions and also projections for ten additional deterministic economic scenarios from Moody's. For this analysis, we used the Moody's July 2019 forecast of the U.S. economy. For purposes of our analysis, the components of Moody's forecast include:

- HPI at the MSA, state, regional and national levels
- 1-year CMT rate
- 3-year CMT rate
- 5-year CMT rate
- 10-year CMT rate
- 30-year CMT rate
- Commitment rate on 30-year fixed-rate mortgages
- Unemployment rates at the MSA, state, regional and national levels
- GDP

Alternative Scenarios

To assess the effect of alternative economic scenarios on the Cash Flow NPV, ten alternative scenarios from Moody's were used. The ten Moody's scenarios are:

- Baseline
- Exceptionally Strong Growth
- Stronger Near-Term Rebound
- Slower Near-Term Growth
- Moderate Recession
- Protracted Slump
- Below-Trend Long-Term Growth
- Stagflation
- Next-Cycle Recession
- Low Oil Price

The Moody's projections provide a range of better than expected economic assumptions and worse than expected economic assumptions. This range of assumptions produces a range of Cash Flow NPV projections.

Graphical Depiction of the Scenarios

Figure 54 shows the future movements of the HPI under the baseline and the alternative economic scenarios. In the Moody's Baseline scenario, the HPI increases over the entire projection period, and the rate of change varies between 2.5% and 5.0%.

Figure 54: Paths of the Future National House Price Index in Different Scenarios

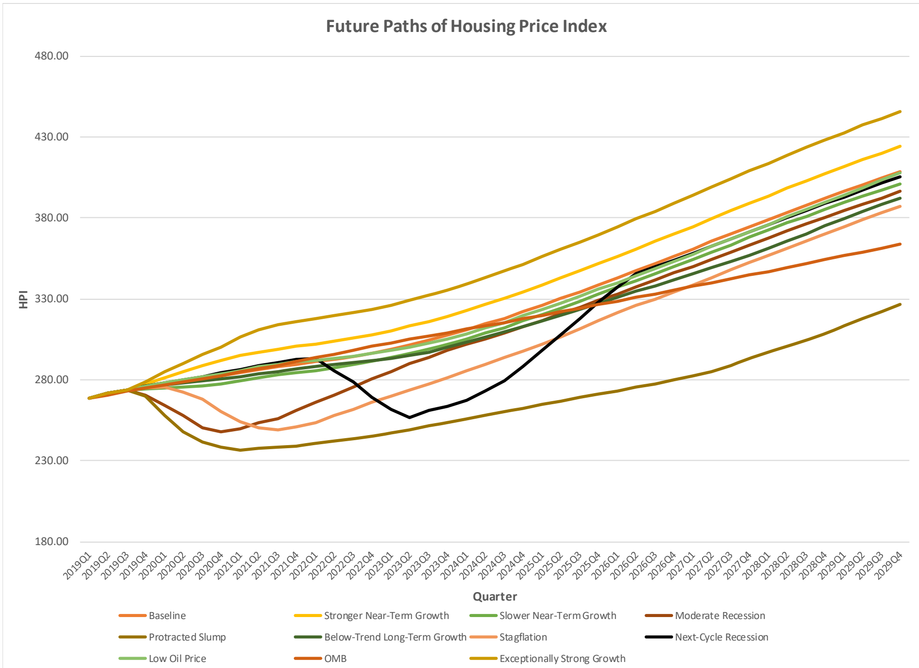


Figure 55 shows the forecasted mortgage rate of 30-year fixed-rate mortgages for the ten Moody's scenarios. Moody's Baseline forecast for the 30-year fixed interest rate shows that the mortgage interest rate increases to just under 5.4% by 2023, holds steady though 2024, then increases to a long-term average rate of around 5.5%. For the Moody's projections, we use the 30-year fixed rate as this represents the majority of the mortgage products sold.

Figure 55: Paths of the Future Mortgage Rate

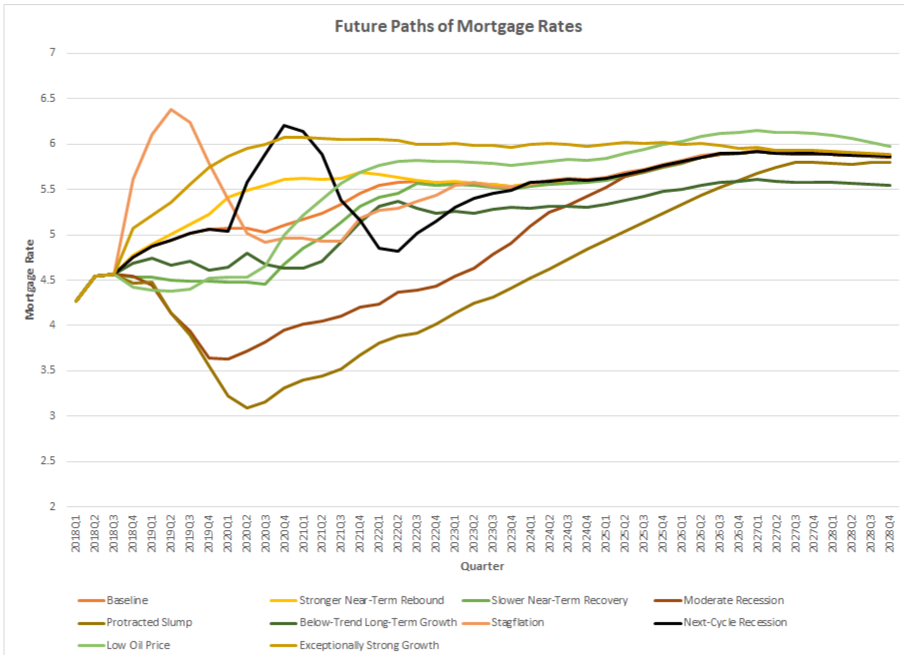
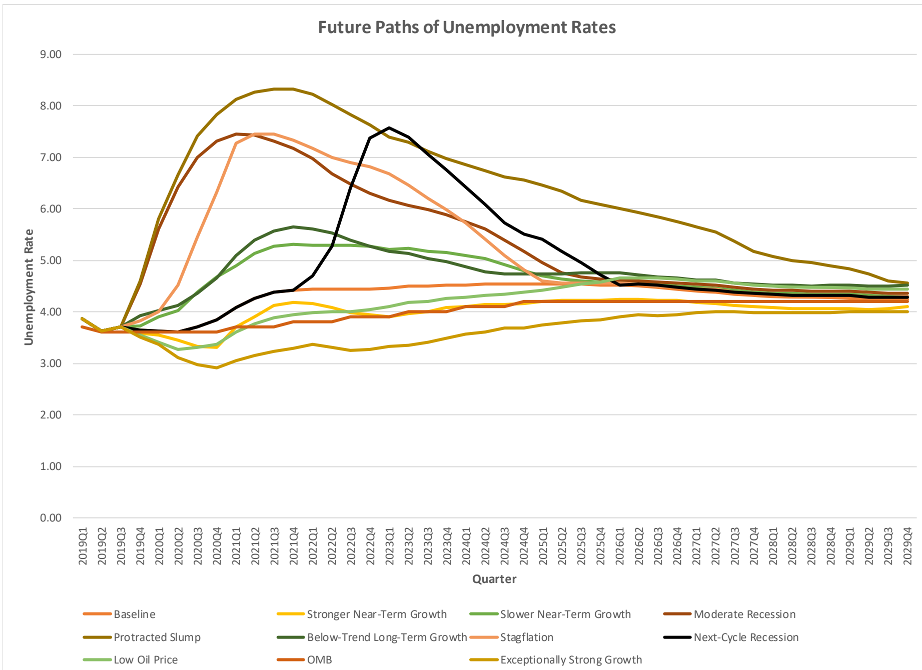


Figure 56 shows the forecasted unemployment rate under alternative economic scenarios. The Moody's Baseline forecast projects that the unemployment rate will decrease to 3.6% in 2020, and then increases to a long-term average of about 4.5%.

Figure 56: Paths of Future National Unemployment Rate



Stochastic Simulation

This section describes the stochastic models fitted to generate the economic variables simulations used in the projection of Cash Flow NPV.

The economic variables modeled herein as stochastic for computing expected present values include:

- 1-Year CMT Rates
- 3-Month CMT Rates
- 6-Month CMT Rates
- 2-Year CMT Rates
- 3-Year CMT Rates
- 5-Year CMT Rates
- 7-Year CMT Rates
- 10-Year CMT Rates
- 20-Year CMT Rates
- 30-Year CMT Rates
- 30-Year FRM Rates
- FHFA National Purchase Only House Price Index (HPI-PO)
- Unemployment Rates

- Gross Domestic Product (GDP)

Historical Data

A. Interest Rates

Figure 57 shows historical interest rates since 1971.

This graph illustrates the variability of interest rates over time and the consistent spread between rates. Shown are the 1-year CMT rate (tr1y), 10-year CMT rate (tr10y) and the 30-year fixed rate mortgage rate (mr).

High inflation rates caused by the global oil crisis in the late 1970's was the major factor for the historically high level in early 1980's. The Federal Reserve shifted its monetary policy from managing interest rates to managing the money supply as a way to influence interest rates after this period of time. The 1-year CMT rate (tr1y) was around 5% in CY 1971 and increased steadily to its peak of 16.31% in CY 1981 Q3. After that, it followed a decreasing trend and reached an all-time low of 0.10% in CY 2014 Q2. Since then rates have started a slow upward trend.

Figure 57: Historical Interest Rates (%)

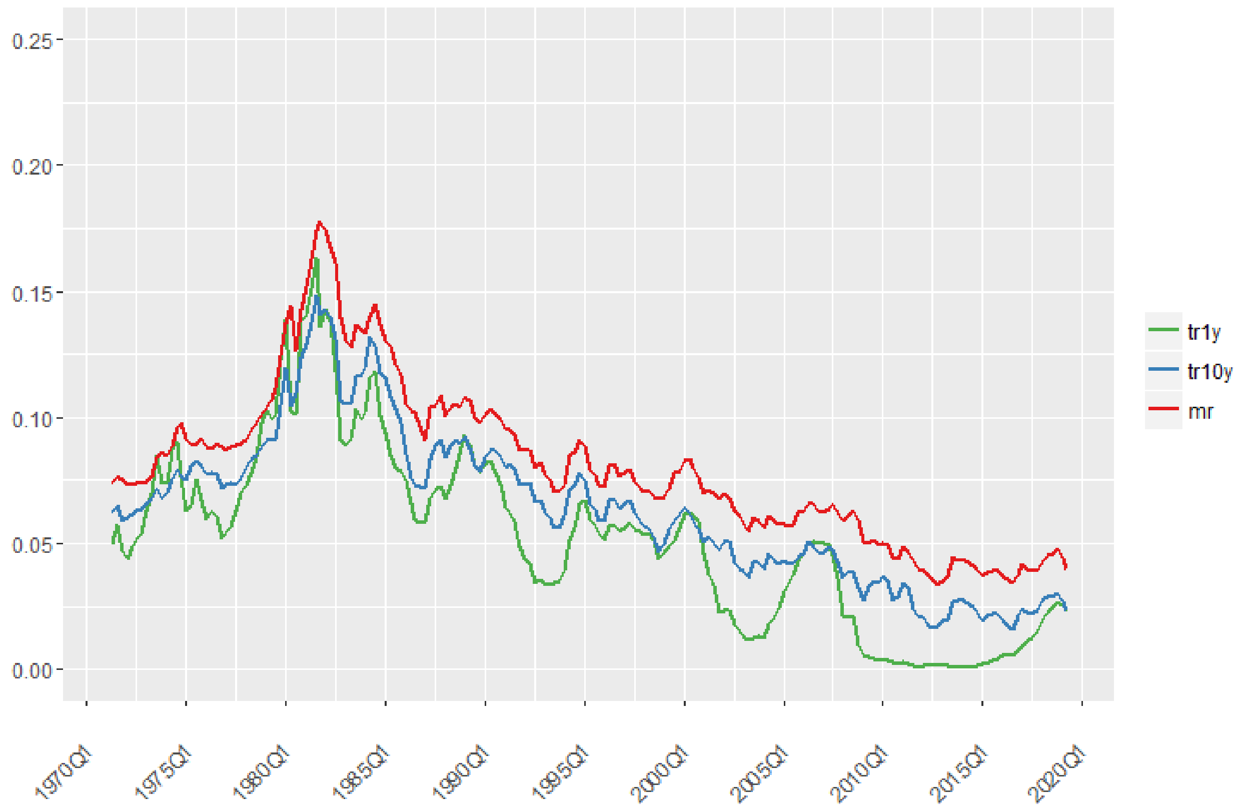
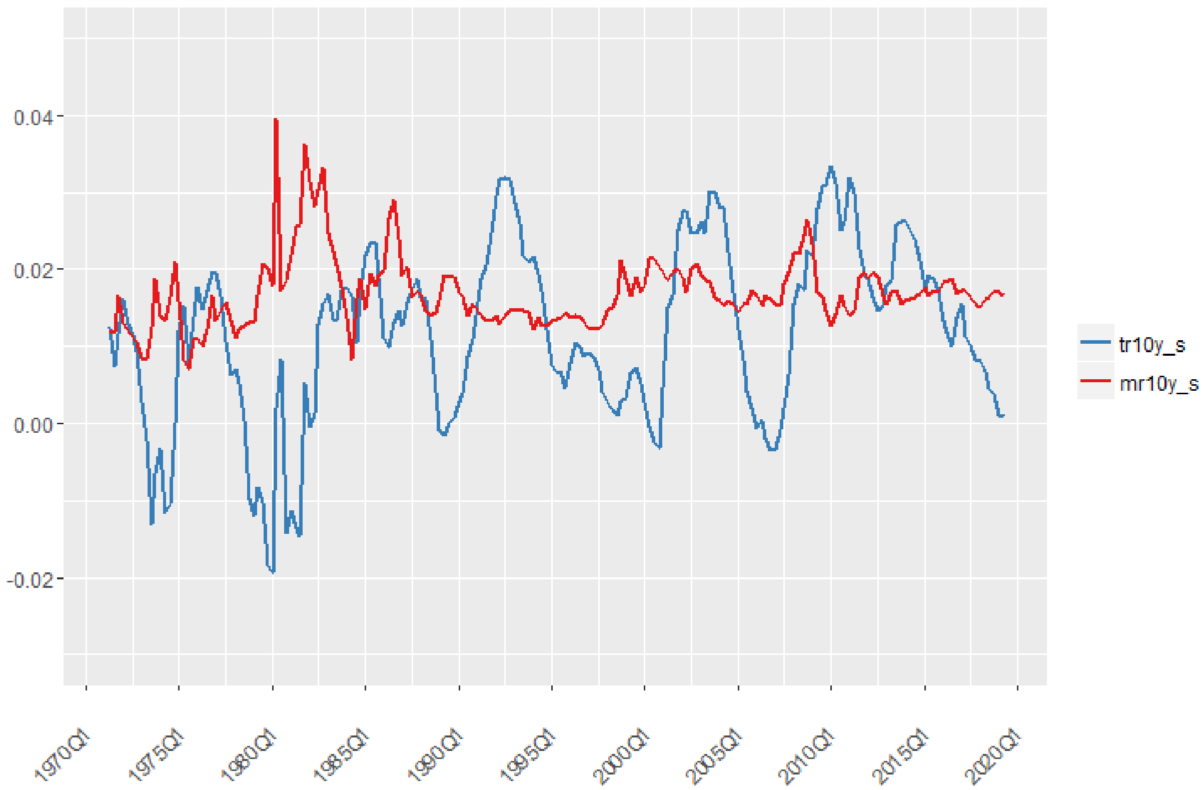


Figure 58 shows historical interest rate spreads, including the spread between 10-year and 1-year CMT rates (tr10y_s) and the spread between the 30-year mortgage rate and the 10-year Treasury rate (mr10y_s). Both spreads have a mostly positive value with long cycles. Lower, and negative spreads typically correspond with economic downturns, as occurred in the late 70's through early 80's. Also note, the spread of the mortgage rate over the 10-year CMT rate is always positive, reflecting the premium for credit risk.

Figure 58: Historical Interest Rate Spreads (%)



B. House Price Appreciation Rates

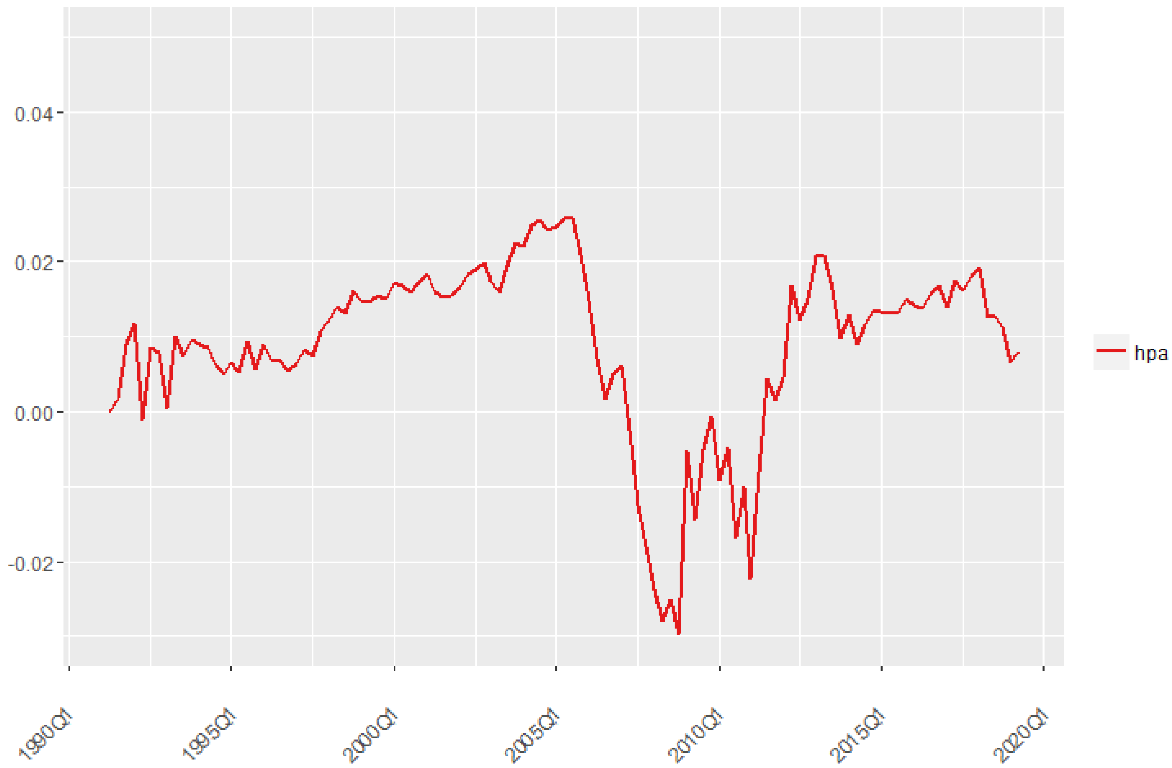
The national house price appreciation rate (HPA) is derived from the FHFA repeat sales house price indexes (HPIs) of purchase-only (PO) transactions. The PO HPI provides a reliable measure of housing market conditions, since it is based on repeat sales at market prices and does not use any appraised values.

The HPA series being modeled is defined as:

$$HPA_t = \ln\left(\frac{HPI_t}{HPI_{t-1}}\right) \qquad (1)$$

Figure 59 shows the national quarterly HPA from CY 1991 Q1 to CY 2019 Q2. The long-term average quarterly HPA is around 0.87% (3.30% annual rate).

Figure 59: Historical National HPI and Quarterly HPA



The HPA increased steadily before 2004, and the quarterly appreciation rate was around 1.14%. Then house prices rose sharply starting in 2004. The average quarterly house price appreciation rate was 1.88% during the subprime mortgage expansion period from 2004 to 2006, and reached its peak of 2.59% in CY 2005 Q2. After 2006, the average growth rate of house price became negative until 2011 when appreciation returns to a positive value. It is interesting to note the last three quarters have shown a shrinking in this growth to almost zero (0.065) in 2019 Q1 and Q2.

Table 70 shows the quarterly HPA by selected historical time periods.

Table 70: Average Quarterly HPA by Time Span

Period	Average Quarterly HPA
1991 – 2003	1.13%
2004 – 2006	1.87%
2007 – 2010	-1.23%
2011 – 2019	1.00%

Modeling Techniques

The primary modeling techniques used in these simulations include:

- Auto Regressive Moving Average (ARMA)
- General Auto Regressive Conditional Heteroscedasticity (GARCH)

ARMA models are typically specified as ARMA(*p,q*) where *p* is the auto regressive component of the series, and *q* is the moving average.

GARCH models are typically specified as GARCH(*p,q)* where *p* is the auto regressive component of ${\sigma_t}^2$, and *q* is the AR component of the error term.

Description and examples of using an ARMA-GARCH model for time series analysis includes Engle and Mezrich (1995).

1-Year CMT Rate

In this section, we present some historical statistics on the 1-year CMT rate, and then describe the estimation model for the stochastic process, and finally report the parameter estimates and their standard errors.

Table 71 shows the summary statistics of the historical 1-year CMT rates for three periods as well as the simulated series. We can see that in the last 50 or more years, interest rates have had a much broader range as compared to the last 25 years.

Table 71: Statistics for the 1-Year Treasury Rates

Statistics	Since 1953	Since 1969	Since 1992	Simulations
Mean	4.82%	5.23%	2.46%	4.92%
Standard Deviation	3.27%	3.60%	2.27%	4.52%
Max	16.31%	16.31%	6.71%	18.25%
95- Percentile	10.30%	11.82%	5.93%	15.15%
90- Percentile	8.97%	9.94%	5.65%	12.71%
50- Percentile	4.64%	5.41%	2.40%	3.22%
25-Percentile	2.39%	2.22%	0.56%	1.64%
10- Percentile	0.54%	0.34%	0.17%	0.52%
5- Percentile	0.19%	0.16%	0.13%	0.02%
Min	0.10%	0.10%	0.10%	0.01%

An ARMA(2,4) parameterization was used to model the 1-Year CMT rate (*r1*) difference from the previous period and estimated it using data from CY 1969 Q3 to CY 2019 Q2 or the last 50 years. The process takes the following form:

$$r_{1,t} = x_1 r_{1,ar1} + x_2 r_{1,ar2} + x_3 r_{1,ar2} + x_4 w_{1,ma1} + x_5 w_{1,ma2} + x_6 w_{1,ma3} + x_7 w_{1,ma4} + x_8 w_{1,ma4} + \sigma_t dZ_1 \quad (2)$$

Where Z_1 is an independent Wiener random process with distribution N(0,.5), and where the variance (σ) of the residual term follows a GARCH(1,1) process:

$$\sigma_t{}^2 = \beta_0 + \beta_1 \varepsilon^2{}_{t-1} + \beta_2 \sigma^2{}_{t-1} \qquad (3)$$

Where ε is the error term, which equals $\sigma_t dZ_1$ from equation (2).

Full information maximum likelihood (FIML) method was used to estimate the parameters in equations (2) and (3). The results are presented in Table 72.

Table 72: Estimation Results for 1-Year CMT Rate Model

Parameter	Estimate	Std Dev	t-value	prob>t
x_1	1.0955	0.1271	8.6217	0.0000
x_2	-0.2184	0.2912	-0.7499	0.4533
x_3	0.0874	0.2168	0.4034	0.6867
x_4	-0.6172	0.3739	-1.6507	0.0988
X_5	-0.3024	0.3534	-0.8556	0.3922
X_6	0.1907	0.2488	0.7667	0.4432
X_7	-0.0366	0.2774	-0.1318	0.8952
X_8	-0.1886	0.0964	-1.9564	0.0504
β0	0.0000	0.0001	0.0010	0.9992
β1	0.3131	0.3367	0.9301	0.3523
β2	0.6859	0.7569	0.9061	0.3649
Pearson's GOF	0.2714			

The model based on these parameters is used to simulate the 1-year CMT rates for the forecast period starting in FY 2019 Q3. The model was fit using Akaike Information Criterion (AIC) and Pearson's goodness-of-fit test.

A lower bound of 0.01 percent was applied to the simulated future 1-year CMT rates to avoid negative rates in the simulation.

Additional Interest Rate Models

Additional interest rate models were developed. All are transformed as a spread (difference) between the current maturity length and prior. Table 73 describes these spreads and models.

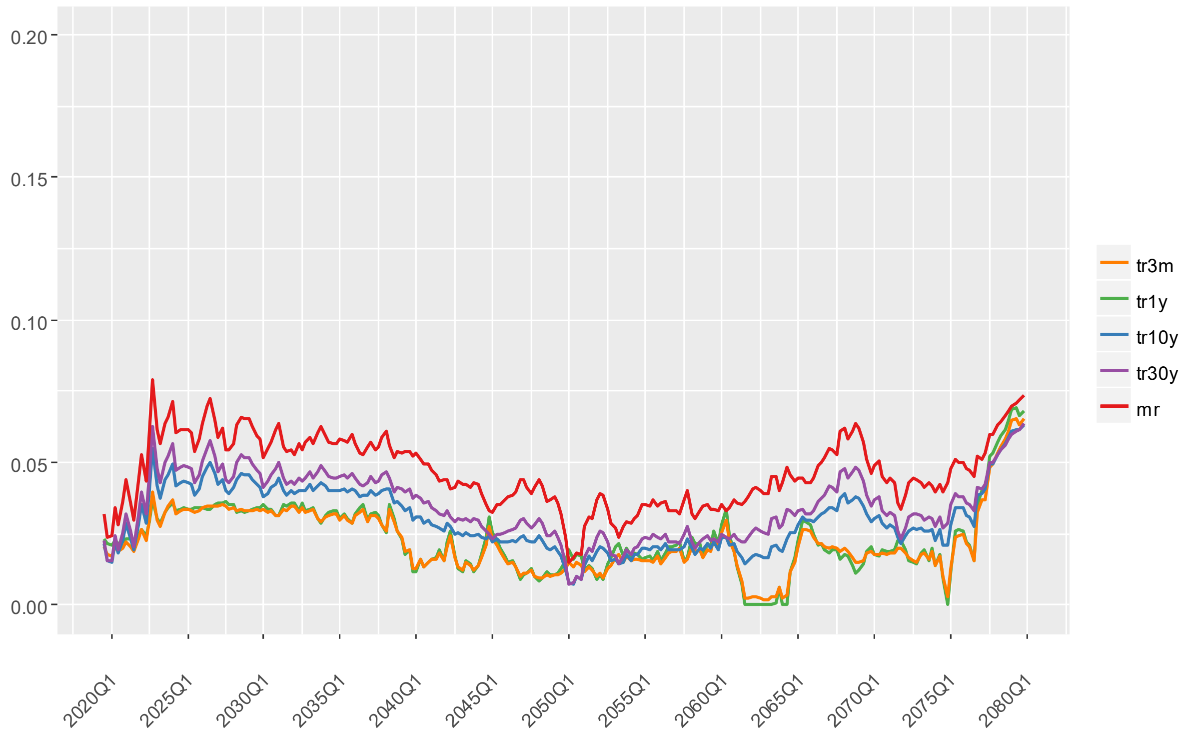
Table 73: Model Specification for Additional Interest Rates

Variable	Variable Transformation	Model Specification	*Notes
3-month	$S_{3m} = r_{3m} - r_{6m}$	AR(1)-GARCH(1,1)	
6-month	$S_{6m} = r_{6m} - r_{1y}$	ARMA(4,2)-GARCH(1,1)	
1-year	r_{1y}	ARMA(3,5)-GARCH(1,1)	*Base Interest Rate
2-year	$S_{2y} = r_{2y} - r_{1y}$	ARMA(1,2)-ARCH(1)	
3-year	$S_{3y} = r_{3y} - r_{2y}$	ARMA(2,1)-ARCH(1)	
5-year	$S_{5y} = r_{5y} - r_{2y}$	ARMA(2,1)-ARCH(1)	
7-year	$S_{7y} = r_{7y} - r_{5y}$	ARMA(2,1)-ARCH(1)	
10-year	$S_{10y} = r_{10y} - r_{7y}$	ARMA(2,1)-ARCH(1)	
20-year	$S_{20y} = r_{20y} - r_{10y}$	AR (2)	*dataset for 1980 forward producing a weaker model
30-year	$S_{30y} = r_{30y} - r_{10y}$	ARMA(1,1)-GARCH(1,1)	*used 10 year rate for spread
30-year FRM	$S_{mr} = r_{mr} - r_{30y}$	AR(1)-ARCH(1)	

All of these models also used Akaike Information Criterion (AIC) and/or Pearson's goodness-of-fit test to determine the best fitting model.

A lower bound of 0.01 percent was applied to the simulated future Treasury rates to avoid negative rates in the simulation.

Figure 60: Interest Rate Sample Simulation



House Price Appreciation Rate (HPA)

A. National HPA

The national HPA series was fit using an ARMA(1,1)-GARCH(1,1). The 1-year CMT, 10-year CMT, and mortgage rates at time *t* and *t-1* were also included as external regressors for a model formula:

$$HPA_t = \mu + x_1 HPA_{ar1} + x_2 w_{1,ma1} + x_3 r_{1,t} + x_4 r_{1,t-1} + x_5 r_{10,t} + x_6 r_{10,t-1} + x_7 mr_t + x_8 mr_{t-1} + \sigma_t dZ_1 \quad (4)$$

Where Z_1 is an independent Wiener random process with distribution N(0,1), and where the variance (σ) of the residual term follows a GARCH(1,1) process:

$$\sigma_t{}^2 = \beta_0 + \beta_1 \varepsilon^2{}_{t-1} + \beta_2 \sigma^2{}_{t-1} \quad (5)$$

The model specification and variable inclusions were determined by achieving appropriate coefficient signs and significance, and overall model fit. FIML was used to estimate parameters in equations (4) and (5). The results are shown in Table 74.

Table 74: Estimation Results for the National HPA Model

Parameter	Estimate	Std Dev	t-value	prob>t
μ	0.0250	0.0071	3.5373	0.0004
x_1	0.9350	0.0354	26.4392	0.0000
x_2	-0.2718	0.1248	-2.1785	0.0294
x_3	-0.0440	0.0606	-0.7258	0.4680
x_4	-0.1616	0.0509	-3.1720	0.0015
x_5	0.1506	0.2367	0.6361	0.5247
x_6	-0.2497	0.1200	-2.0817	0.0374
x_7	-0.1151	0.0928	-1.2401	0.2149
x_8	-0.1368	0.0730	-1.8727	0.0611
β0	0.0000	0.0000	0.0551	0.9560
β1	0.4269	0.2372	1.7998	0.0719
β2	0.5721	0.2346	2.4387	0.0147
Pearson's GOF	0.2318			

We used these parameters to simulate future HPAs from FY 2019 Q3.

B. Geographic Dispersion

The MSA-level HPA forecasts were based on Moody's forecast of local and the national HPA forecasts. Specifically, at each time *t*, there is a dispersion ratio of HPAs between the i^{th} MSA or State level and the national forecast:

$$Disp_{i,t}^{Base} = HPA_{i,t}^{Base} / HPA_{national,t}^{Base} \qquad (6)$$

This dispersion forecast under Moody's base case was preserved for all local house price forecasts under individual future economic paths. That is, for economic path *j*, the HPA of the i^{th} MSA at time t was computed as:

$$HPA_{i,t}^{j} = HPA_{national,t}^{j} * Disp_{i,t}^{Base} \qquad (7)$$

This approach retains the relative current housing market cycle among different geographic locations and it allows us to capture the geographical concentration of FHA's current endorsement portfolio. This approach is also consistent with Moody's logic in creating local market HPA forecasts relative to the national HPA forecast under alternative economic scenario forecasts.[49]

We understand this approach is equivalent to assuming perfect correlation of dispersions among different locations across simulated national HPA paths, which creates systematic house price decreases during economic downturns and vice versa during booms. Due to Jensen's Inequality, this tends to generate a more conservative

[49] The dispersion of each MSA remains constant among all alternative Moody's forecast scenarios.

estimate of claim losses of the Fund.

Unemployment Rate

A. National Unemployment Rate

In our unemployment rate model, the unemployment rate depends on the prior unemployment rate, mortgage rates and Treasury rates.

We used quarterly data from CY 1971 to CY 2019 Q2 to estimate the national unemployment rate. The model we adopted was:

$$ue_t = \mu + x_1 ue_{ar1} + x_2 ue_{ar2} + x_3 ue_{ar3} + x_4 r_t + x_5 s_{mr} + \varepsilon_t \quad (8)$$

where r_t is the 1-year CMT rate,

s_{mr} is the 30-year mortgage rate to 10-year CMT rate spread,

ue_{ari} is the unemployment rate auto regressive component at the i^{th} interval.

The model specification and variable inclusions were determined by achieving appropriate coefficient signs and significance, and overall model fit. FIML was used to estimate parameters in equation (8). The results are shown in Table 75.

Table 75: Estimation Results for the National Unemployment Rate Model

Parameter	Estimate	Std Error
μ	1.6302	0.0731
x_1	-0.6095	0.1337
x_2	-0.0462	0.0734
x_3	0.0675	0.0061
X_4	-0.1391	0.0218
X_5	-0.0057	0.0404

From the simulated interest rates and house prices, we applied the parameters shown in Table 75 to calculate the corresponding national unemployment rate. Based on historical statistics, the national unemployment rate was capped at 20% with a floor at 2%.

B. Geographic Dispersion

Following the same logic that we applied to the MSA-level HPA forecasts, we first obtained the dispersion of unemployment rates between the i^{th} MSA or State level and the national level from Moody's July base-case forecast at each time t:

$$Disp_{i,t}^{Base} = ue_{i,t}^{Base} / ue_{national,t}^{Base} \quad (9)$$

This dispersion forecast was preserved for all local unemployment rate forecasts under each individual future economic path. That is, for economic path *j*, the unemployment rate of the *i*th MSA at time *t* was computed as:

$$ue_{i,t}^{j} = ue_{national,t}^{j} * Disp_{i,t}^{Base} \quad (10)$$

For the simulation, we capped the unemployment rate at the local level at 30% with a floor at 1%.

Gross Domestic Product

In the Gross Domestic Product (GDP) model, the GDP depends on the prior GDP, unemployment, mortgage and Treasury rates.

We used quarterly data from CY 1971 to CY 2019 Q2 to estimate the national unemployment rate. The model tested for integration, so first difference transformations were used prior to estimations. The model adopted was an ARMA(1,2):

$$GDP_t = x_1 GDP_{ar1} + x_2 GDP_{ma1} + x_3 GDP_{ma2} + x_4 r_t + x_5 s_{mr,t} + x_6 ue_t + \varepsilon_t \quad (11)$$

where, r_t is the 1-year CMT rate,

$s_{mr,t}$ is the 30-year mortgage rate to 10-year CMT rate spread,

ue_t is the unemployment rate,

GDP_{ar1} is the unemployment rate auto regressive component,

GDP_{mai} is the unemployment rate moving average component at the *i*th interval.

The model specification and variable inclusions were determined by achieving appropriate coefficient signs and significance, and overall model fit. FIML was used to estimate parameters in equation (11). The results are shown in Table 76.

Table 76: Estimation Results for the National Gross Domestic Product Model

Parameter	Estimate	Std Error
x_1	0.7254	0.1268
x_2	-1.3616	0.1553
x_3	0.3910	0.1412
x_4	1227.5821	749.9991
X_5	-1351.2852	917.7638
X_6	-220.6296	723.6363

Simulation Selection/Moody's Baseline

A total of 10,000 simulations paths were generated using all of the economic variable models described. From these 10,000, a subset of 100 were randomly chosen.

Appendix E: Cash Flow Analysis

Introduction

The calculation of the Cash Flow NPV of the MMIF involves the estimation of the present value of future cash flows generated by the existing portfolio. The analysis requires the projection of future prepayment and claim incidences, and severity and cash flow items associated with each type of outcome. The Cash Flow NPV represents future revenue and expenses associated with the existing book of mortgage guarantees. This appendix describes the components of these cash flow calculations.

To develop the estimated Cash Flow NPV, our model incorporates projections of mortgage performance and information about the existing portfolio composition to project the MMIF's various cash flow sources. The cash flow projection model uses projections from predictive models as discussed in Appendix B (Transition Models), Appendix C (Loss Severity Models), and the economic scenarios described in Appendix D. We developed predictive models for conditional transition probabilities for individual mortgages depending on a number of mortgage and economic characteristics. From these models and using detailed mortgage-level characteristics, we estimated the various transition probabilities and then generated respective cash flows for individual mortgages.

Based on the mortgage termination rates projected by the predictive models, individual components of cash flows are projected into the future. These cash flows are discounted to present value based on the single discount rate provided by the OMB. Based on the specific characteristics of the mortgage, the probability of each transition is calculated. Then, a random number between 0 and 1 is generated, and based on this random draw a mortgage transition is determined. The projection process continues for each mortgage until the mortgage ends by prepayment, claim or reaches maturity.

The cash flow components are shown in the following table:

Table 77: Cash Flow Components

Cash Inflows	Cash Out Flows
Upfront MIP	Net Claim Payments
Annual MIP	Loss Mitigation Expenses
Interest Income	Refunded Upfront Premiums

These cash flows were projected quarterly for individual mortgages and then aggregated by product type and origination year. Below, we discuss the development of each of these cash flows.

Cash Flow Components

The components of cash flow are discussed below.

MIP

The primary source of revenue to the MMIF is insurance premiums. If the MMIF's mortgage insurance is priced to meet the expected liabilities, the MIP collected and interest earned on the MIP will cover all costs associated with mortgage mortgages insured by the MMIF under a normal or expected economic environment. The MIP structure and the premium rates have changed over the period under evaluation. Details of MIP changes are as follows:

- For mortgages originated prior to September 1, 1983, the MIP was collected on a monthly basis at an annualized rate of 0.50% of the outstanding principal balance for the period. To align this change with fiscal quarters, we assumed that this annual MIP policy was in effect through September 30, 1983.

- Between September 1, 1983 and June 30, 1991, the MIP was charged only upon mortgage origination and was based on a percentage of the original mortgage amount at the time of origination. This amount was 3.80% for 30-year mortgages and 2.40% for 15-year mortgages.

- Effective July 1, 1991, NAHA implemented a new MIP structure. An upfront MIP of 3.80% was charged for all product types except for 15-year non-SR mortgages, for which the upfront MIP was set at 2.00%. An annual MIP of 0.50% per year on the outstanding balance was also implemented. The annual MIP would cease at different years of maturity depending on the initial LTV of the mortgage.

- On October 1, 1992, the upfront MIP for 30-year mortgages was reduced from 3.80% to 3.00%. The annual MIP for 30-year mortgages was extended for a longer time period, while for 15-year mortgages it was lowered to 0.25% for a shorter time period or completely waived if the initial LTV ratio was less than 90%.

- As of April 17, 1994, FHA lowered the upfront MIP rate on 30-year mortgages from 3.00% to 2.25%. To align this change with fiscal quarters, we applied this policy change on April 1, 1994.

- Starting from October 1, 1996, FHA lowered the upfront MIP rate on 30-year mortgages for first-time homebuyers who receive homeowner counseling from 2.25% to 2.00%. This rate was further reduced to 1.75% for mortgages originated on or after September 22, 1997. This favorable treatment for borrowers with homeownership counseling was terminated shortly thereafter.

- Effective January 1, 2001, FHA lowered the upfront MIP rate for all mortgages to 1.50%. The annual MIP would be discontinued as soon as the current LTV ratio of the mortgage was below 78% according to the home price as of the mortgage origination date. The annual MIP was required to be paid for a minimum of five years for 30-year mortgages.

- Effective October 1, 2008, FHA charged an upfront premium rate of 1.75% for home purchase and full-credit qualifying refinances; and 1.50% for all types of streamline refinance mortgages. A varying annual MIP, collected on a monthly basis, was charged based on the initial LTV ratio and maturity of the mortgage.

- Effective April 1, 2010, FHA changed the upfront MIP to 2.25% for all mortgages executed after April 1, 2010.

- Effective October 4, 2010, FHA lowered the upfront MIP of all mortgages to 1.0%. The annual MIP for mortgages with 30-year terms was increased to 0.85% for LTV ratios up to 95 percent and to 0.90% for LTV ratios greater than 95%. For mortgages with 15-year terms, an annual MIP of 0.25% was set for LTV ratios greater than 90%. To align this change with fiscal quarters, we started applying this policy change on October 1, 2010.

- Effective April 18, 2011, the annual MIP for mortgages with 30-year terms was increased to 1.10% for LTV ratios up to 95% and to 1.15% for LTV ratios greater than 95%. For mortgages with 15-year terms, the annual MIP was increased to 0.25% for LTV ratios up to 90% and to 0.50% for LTV ratios greater than 90%. To align this change with fiscal quarters, we started applying this policy change on April 1, 2011.

- Effective April 9, 2012, FHA increased the upfront MIP of all mortgages to 1.75%. The annual MIP for mortgages with 30-years terms was increased to 1.20% for LTV ratios up to 95%, and to 1.25% for LTV ratios greater than 95%. For mortgages with 15-year terms, the annual MIP was increased to 0.35% for LTV ratios up to 90%, and to 0.60% for LTV ratios greater than 90%. To align this change with fiscal quarters, we started applying this policy change on April 1, 2012.

- Effective June 11, 2012, the annual MIP for mortgages with 30-year terms and base mortgage amounts above $625,500 was increased to 1.45% for LTV ratios up to 95%, and to 1.50% for LTV ratios greater than 95%. For mortgages with 15-year terms, and base mortgage amount above $625,500, the annual MIP was increased to 0.60% for LTV ratios up to 90%, and to 0.85% for LTV ratios greater than 90%. Also effective June 11, 2012, for all single family forward SR mortgages which are refinancing existing FHA mortgages that were endorsed on or before May 31, 2009, the upfront MIP decreased to 0.01% of the base mortgage amount, and the annual MIP was set at 0.55%, regardless of the base mortgage amount. To align this change with fiscal quarters, we started applying this policy change on July 1, 2012.

- Effective April 1, 2013, the annual MIP for mortgages with 30-year terms and base mortgage amounts below $625,500 was increased to 1.30% for LTV ratios up to 95%, and to 1.35% for LTV ratios greater than 95%. The annual MIP for mortgages with 30-year terms and base mortgage amounts above $625,500 was increased to 1.50% for LTV ratios up to 95%, and to 1.55% for LTV ratios greater than 95%. For mortgages with 15-year terms and base mortgage amounts below $625,500, the annual MIP was increased to 0.45% for LTV ratios up to 90%, and to 0.70% percent for LTV ratios greater than 90%. For mortgages with 15-year terms and base mortgage amounts above $625,500, the annual MIP was increased to 0.70% for LTV ratios up to 90%, and to 0.95% for LTV ratios greater than 90%. This increase was effective for all forward mortgages except single family forward SR transactions that refinance existing FHA mortgages that were endorsed on or before May 31, 2009.

- Effective June 3, 2013, the annual MIP rates for mortgages with an LTV of less than or equal to 78% and with terms of up to 15 years was 0.45%. The new payment period for annual MIP for mortgages with case numbers assigned on or after June 3, 2013 and with an LTV up to 90% was 11 years, and the annual MIP applied for the life of the mortgage for LTVs greater than 90%. To align this change with fiscal quarters, we started applying these policy changes on July 1, 2013.

- Effective January 26, 2015, the annual MIP rates for mortgages with a term greater than 15-years have been reduced by 50 basis points. To align this change with fiscal quarters, we applied these policy changes on January 1, 2015.

Upfront MIP

The upfront MIP is assumed to be fully paid at the mortgage origination date and the amount is calculated as follows:

*Upfront MIP = Origination Mortgage Amount * Upfront MIP Rate*

In practice, FHA allows qualified homeowners to finance the upfront MIP so that the upfront MIP does not add to the borrower's equity burden at the beginning of the contract. Instead, the borrower can add the upfront MIP to the original mortgage balance, in essence paying the upfront MIP on the same schedule as their principal balance. The annual MIP is charged based on the unpaid principal balance excluding the financed upfront MIP. Almost all borrowers finance their upfront MIP in this fashion. However, the LTV including refinanced upfront MIP cannot exceed 96.5%.

Annual Premium

The annual MIP is calculated as follows:

*Monthly MIP = UPB (excluding any upfront MIP) * Annual MIP Rate / 12*

The MIP is actually collected on a monthly basis. For purposes of the simulation, the monthly MIP is aggregated by quarter, and this quarterly premium is used to discount MIP for the simulation.

Refunded MIP

FHA first introduced the upfront MIP refund program in 1983. It specified that FHA would refund a portion of the upfront MIP when a household prepaid its mortgage. The upfront MIP was considered to be "earned" over the life of the mortgage. Upon prepayment, an approximation of the unearned upfront MIP is returned to the borrower. Therefore, the amount of the refund depends on the time from origination to when the mortgage is prepaid. For modeling purposes, the refund payments are calculated as follows:

*Refund Payments = Original UPB * Upfront MIP Rate* Refund Rate*

Refund payments at each quarter are calculated based on the number of mortgages prepaid in that quarter and the origination date of the mortgage. In the past, borrowers always received the upfront MIP refund when they prepaid their mortgages before the maturity of the mortgage contract. In 2000, FHA changed its policy so that borrowers would obtain refunds only if they prepaid within the first five years of their mortgage contracts. The most recent policy change at the end of 2004 eliminated refunds for early prepayments of any mortgages endorsed after that date, except for those borrowers who refinanced into a new FHA mortgage within three years following the original endorsement date.

Losses Associated with Claims

The MMIF's largest expense component comes in the form of payments arising from claims. FHA pays the claim to the lender after a lender files a claim. Traditionally, in most cases, FHA takes possession of the foreclosed property and sells the property to partially recover the loss. This particular type of claim is called a conveyance (REO).

Based on this practice, claim cash flows can be decomposed into two components:

1. Cash outflow of the claim payment at the claim date including expenses incurred, and
2. Cash inflow of any net proceeds received in selling the conveyed property at the property disposition date.

We have estimated the net loss as discussed in Appendix C separately for PFS, TPS and REO. Based on the specific characteristics of the mortgage, the net loss for each claim is calculated. Then, a random number between 0 and 1 is generated, and based on this random draw the predicted net loss is determined.

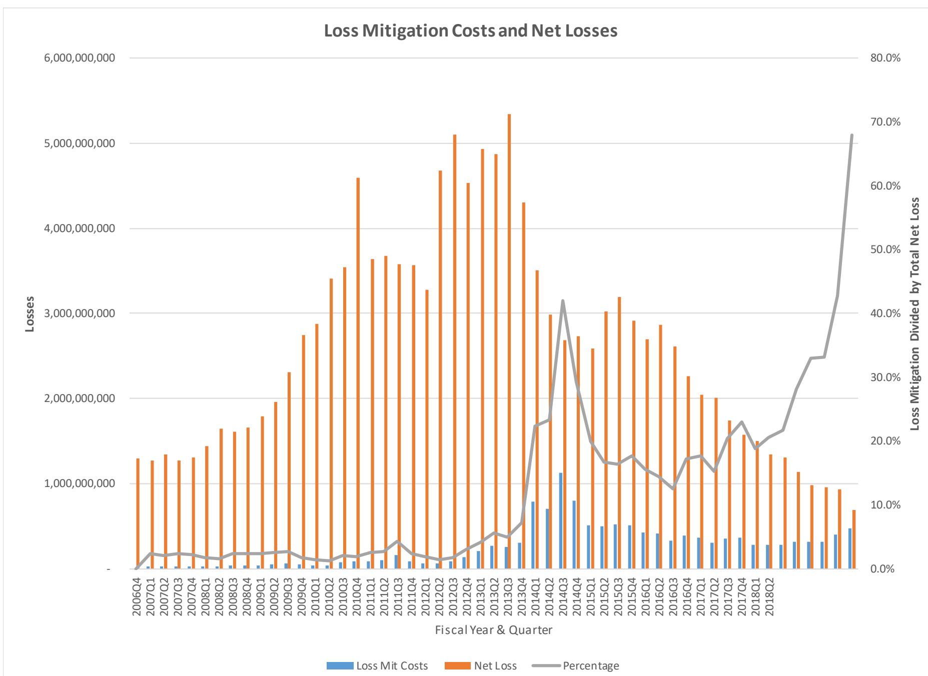
Loss Mitigation Expenses

FHA initiated a loss mitigation program in 1996 in an effort to provide opportunities for borrowers in financial difficulties to retain homeownership. Loss mitigation also reduces foreclosure costs. In the standard process, the mortgagees provide default counseling for borrowers who are behind in their payments, and offer appropriate loss mitigation options to prevent borrowers from losing their homes. In 2009, FHA started the HAMP program as a new loss mitigation option, and the program represented increasing percentages of loss mitigation assistance through the years. In 2016, Mortgage Modification as a standalone option was eliminated and combined into HAMP.

The loss mitigation program includes Forbearance and HAMP, which has Loan Modification and Partial Claim options. A Special Forbearance is a written repayment agreement between the mortgagee, acting on behalf of FHA, and the borrower that contains a plan to reinstate a mortgage. A Loan Modification modifies the contractual terms of the mortgage permanently, such as lowering the interest rate, or increasing the mortgage term. Under the partial claim option, a mortgagee will advance funds on behalf of a mortgagor in an amount necessary to reinstate a delinquent mortgage. The borrowers are required to sign a promissory note and a subordinated mortgage payable to FHA of the amount advanced.

Figure 61 shows the ratio of loss mitigation costs to overall net losses. Loan mitigation cases increased significantly from fiscal year 2007 to fiscal year 2014. There were just under 80,000 loss mitigation claims in fiscal year 2007 which to over 180,000 cases in fiscal year 2014. The amount FHA paid in these cases and curtailments was $116 million in fiscal year 2007, which increased to $3.41 billion in fiscal year 2014. Loss mitigation payments made by FHA include administrative fees and costs of title searches, recording fees and subordinated mortgage note amounts.

Figure 61: Loss Mitigation Expense



As discussed in Appendix C, we have developed models to project loss mitigation expenses.

Net Present Value

Once all the above future cash flow components are estimated, their present value is computed by discounting them at an appropriate rate.

The discount factors applied were provided by FHA and reflect the OMB discount factors and the expected timing of future cash flows. The rates are constant and vary by mortgage cohort year. The discount factors reflect the most recent Treasury yield curve, which captures the federal government's cost of capital in raising funds. These factors reflect the capital market's expectation of the consolidated interest risk of U.S. Treasury securities. Our simulations aggregated each future year's cash flows by quarter, and treat the cash flows as being received at the end of the quarter.

Appendix F: Review of HUD Analysis of Economic Net Worth, Comparison of HUD and Pinnacle Models, and Assessment of Vulnerabilities

Appendix F presents a high-level review of HUD models developed to project Economic Net Worth, compares the models developed by HUD with the models developed by Pinnacle, and assesses the vulnerabilities of the models developed. We have also identified potential areas of future research based on this assessment.

Deliverable 4 of the Actuarial Report states:

> ***Deliverable 4: To promote transparency of the Studies' assessments, the Studies should identify methodological vulnerabilities that may occur in its actuarial models or in HUD's analyses of economic net worth. This discussion should evaluate the scope and scale of such vulnerabilities in creating possible forecast risk and suggest possible lines of research in these areas. The Studies should assess and comment upon HUD's own models that estimate economic net worth for methodological vulnerabilities and compare HUD's methodologies with those in the Studies.***

There are several different aspects of forecast risk that can arise in the projection of Economic Net Worth, including:

- Process risk— actual results vary from projected results due to variability in the insurance process
- Parameter risk— the uncertainty related to the parameters selected for a given model
- Specification risk— the uncertainty related to the type of model that is selected for a forecast

The following discussion comments on these various types of forecast risk.

Forward Budget Model Commentary

Summit-Milliman (S-M) has developed a series of models consisting of their Single Family (Forward) Budget Model Schema that are used to forecast cash flows for the Forward mortgages in the FHA portfolio. The following discusses strengths and potential vulnerability of these models, as well as identifies potential areas for further research.

Model Schema

The Loan Performance Models consist of a Stage 1 model for loans that have never been seriously delinquent and a Stage 2 model for loans that have experienced a 90-day delinquency. Both models are used to predict the likelihood of a given loan becoming seriously delinquent or prepaying. This is reasonable as the two sub-populations exhibit different future transition behaviors.

The Stage 1 model uses a series of binomial logistic cell regressions to estimate the probabilities for non-claim termination and serious delinquency, incorporating the assumption of Independent Irrelevant Alternatives (IIA). The IIA assumption states that adding or removing termination events does not impact the odds of the original termination event. This is a potential vulnerability of the models if this assumption is violated. However, to the extent this assumption holds, then the S-M approach is mathematically equivalent to a multinomial logistic model, which would be a reasonable approach given the number and type of outcomes being predicted.

S-M built two Stage 1 models, one for purchase loans and one for refinance loans, as they exhibit different prepayment rates. This is also appears to be a reasonable assumption based on our independent analysis of purchase and refinance loans.

The Stage 1 models were built using cell regression, which aggregates the loans into unique groups using combinations of values of 20 different variables. The purpose of this method is to maximize the amount of data used to build the model while minimizing the required computing capacity. This is different than Pinnacle's approach where the models were built on an individual loan level.

There are two potential vulnerabilities in the S-M modeling approach, which are acknowledged by S-M as well:

- The models were developed using a long period of data (1990-2018). This may cause slower reflection of shorter term trends. As Pinnacle uses data from the beginning of the Forward Mortgage Guaranty program, this is potential vulnerability in the Pinnacle models as well.

- The historical data may not be reflective of future performance or of program changes. Again, these are potential shortcomings in the Pinnacle models as well.

For both of these vulnerabilities, but in particular the first one, one area of potential future research is to refit the models on more recent data and evaluate the change in the model parameters. Also, results of the model could be validated against more recent data to test how well the models reflect more recent experience. One approach that Pinnacle has incorporated to account for this vulnerability is to include credit subsidy cohort and loan period as variables in the models. An additional research step would be to test the interaction of these time related elements with other independent variables in the models.

The Stage 2 Loan Performance Model was developed on a loan level basis. Due to different claim rates, S-M built two Stage 2 models depending on whether the loan received loss mitigation in the past or not. The models used multinomial logistic regression given the number and type of different potential outcomes.

S-M used a few approaches to validate their Stage 1 and Stage 2 Loss Performance Models, including out-of-sample actual vs. expected results and Receiver Operating Characteristic (ROC) curves. S-M also reviewed the variable significance levels for the models. All of these are reasonable approaches. An additional approach to consider would be to use out of time data to validate the models, however if more recent data was left out of the initial model development, it would potentially increase the likelihood of shorter-term trends being missed.

The Loss Mitigation Models developed by S-M have two parts for Stage 2, one for loans with loss mitigation applied and one for loans without loss mitigation. This is done since the probabilities of claim vs. non-claim termination vary greatly depending on if a loan receives loss mitigation or not, and is consistent with the S-M approach for Stage 2 Loan Performance Models. However, due to changes in government programs and frequency of mitigation usage over the years, S-M notes there may not be enough data to develop a reliable model to predict which delinquent loans will receive loss mitigation. Therefore, actuarial methods were used to project these rates. While it is reasonable to use actuarial methods in this case, this does introduce a additional potential source of uncertainty in the results. Also, it is not clear what testing that S-M did to conclude there was not enough data to develop a loss mitigation prediction model. Future research could involve attempting to build models on the data that does exist and comparing the model results to recent actual results to determine if the accuracy is sufficient.

The Loss Severity Models developed by S-M predict the disposition and severity of a loan loss from Stage 2 in two parts. The disposition estimation model predicts the probability of a loan entering a specific disposition path (PFS, Single Family Loans Sales [SFLS], CWCOT, or REO). The loss severity model predicts the amount of loss given a default. The disposition model uses a waterfall approach.

The model first uses binomial logistic regression to estimate the probability of a PFS vs. other type of disposition. Due to lower data volume, historical data from January 1, 2017 to January 1, 2019 is then used to determine if a non-PFS is estimated to be either a SFLS or CWCOT. Finally, the conditional probability for REO is just 100% of any remaining claim since it is the end of the process waterfall. Potential future research could be to test the two-year period for historical data to determine whether two years of data is sufficient, or to demonstrate how sensitive the results are to different lengths of time. Similarly, CWCOT severity, SFLS severity, and SFLS sales price are determined using this same two-year period. Future analysis should be considered to validate this length of time and its impact on results. Pinnacle uses the entire data history to build models determining the likelihood of an REO or TPS claim.

In prior model versions, S-M modeled net loss directly instead of net loss severity given a claim. They did test this change and found that the Loss Severity Model produces estimates that are consistent with historical experience.

These three models (Loan Performance, Loss Mitigation, and Loss Severity) combine to produce cash flows to then calculate Liability of Loan Guarantee (LLG) and Return on Assets.

S-M then estimates acquisition costs separately from Net Loss using Ordinary Least-Squares (OLS) regression. They also estimate sale ratio using linear regression, whereas previously the ratio was calculated from sales price. While these can be improvements in sophistication of the modeling and results, this can also now add additional uncertainty from the additional model parameters.

With this model version, S-M introduced a 2.0% Quarterly Prepayment Rate Floor. While this could introduce some future variability in the results, S-M tested the selection using historical data to determine a reasonable floor, and also tested results with different (including no) floors. This was also the result of S-M's discussion with FHA on a reasonable prepayment rate floor to use.

S-M's process for selecting variables is reasonable. This process included performing exploratory data analyses and univariate analyses to better understand the data. When considering whether to include a variable in a model, S-M considered the intuitive relationship of the model variables and the predictive nature of the variable. S-M notes that several variables such as credit score, borrower income, debt-to-income ratio, and loan-to-value ratio have an influence on mortgage performance yet are censored or have missing data in the datasets for various reasons. S-M made an explicit adjustment on the credit data to back-populate it, as is described in more detail below. An area for further research would be determining if there are additional sources to better populate other types of variables for which a significant portion of the data is missing.

There are several additional potential areas for future research/testing of assumptions.

- The S-M report notes that the majority of FHA's endorsement volume is from post-2007 credit subsidy cohorts, and as a result, the data for the cohorts is not fully developed. The implicit assumption is that these younger cohorts will perform similarly to older cohorts. As more data is obtained over time, this assumption should be tested, and appropriate adjustments made if any differences in performance are seen.

- The report noted that the FHA to FHA refinance rate changed from 35% to 25% from the prior to the current model version. The sensitivity of the results to this change should be further explored since the change in the refinance rate is significant.

- The payment reduction factor used from the prior to the current version of the model changed from 25% to 22.5%. The report also noted that the factor has varied substantially over the past several years. The sensitivity of the results to this change should be further explored given the variation that has been seen in this parameter over time.

- The results use a two-year lookback period for the Return on Properties calculation. While not necessarily unreasonable, further exploration of different lookback periods and support for the two-year selection would be a reasonable approach to validation the selection.

Following are some additional sources of potential vulnerabilities in the methodology.

- Declining vs. Increasing Interest Rate Environment—while noted in the report, the historical data used in model development was collected in a generally declining interest rate environment. However, the forecast is for interest rates to increase. This introduces a potential source for uncertainty in the results since the historical data is not necessarily reflective of loan performance in the future expected interest rate environment.

- Sensitivity tests performed on home price appreciation and interest rate factors assume independence of factors and so may impact the results that would actually be seen with multiple varying parameters.

- S-M selected 1992, 1999, and 2006 cohorts due to volume and seasoning of data for performing back-testing of their model results. While this is not unreasonable, this could be a potential source of variability in results if different cohort years were selected.

- During the discussion of their modeling methodology, S-M notes that they built the Loan Performance and Loss Severity models on 80% of the data and validated them on the remaining 20% as an out-of-sample holdout. This is a reasonable approach. However, S-M did note that after they validated the performance of the model, they re-estimated it on 100% of the data. One potential vulnerability in this approach would be a significant change in the estimated model parameters between the 80% fit and the 100% fit.

- There are multiple models being used in combination, so there is the risk of error propagation across the multiple models.

Simulation

S-M performed stochastic simulation using the Monte Carlo method to provide confidence levels on the estimated performance of the FHA loan portfolio. S-M developed parametric distributions to simulate future default frequency (claim), recovery, and prepayment rates. Using the Monte Carlo method for this work is a reasonable approach. S-M evaluated multiple distributional curves based on analysis of historical data and other statistics. Based on this analysis, S-M used a gamma distribution to model claim rates, prepayment rates, and recovery rates. They performed 10,000 trials for their Monte Carlo simulation, which is a larger number of simulations than was generated by Pinnacle. Pinnacle generated 1,000 simulations of economic variables and randomly selected 100 scenarios to test variation in NPV. Finally, as noted in the report, the S-M simulations are only focused on process risk and not parameter or specification risk. This is a potential source of vulnerability of the methodology.

Through their analysis of the data, S-M recognized that the credit score is a very important component of prediction, and also that a significant amount of credit scores were missing for loans prior to 2004 due to how the FHA program was administered. Therefore, S-M attempted to supplement the credit score data from additional sources. One source was a study completed by Fannie Mae, but upon review of the data that approach still resulted in a significant number of missing scores. Next, loan level data was then appended from a CoreLogic source. S-M compared aspects of this data to the existing scores for a time period that overlapped between the CoreLogic and FHA data (2005-2013) and determined that it was reasonable to use based on the average credit scores by year for each of the datasets. Based on Pinnacle's review of the summary statistics of the data, while this is not an unreasonable approach to take to supplement missing credit scores, some degree of caution should be exercised since there is a significant difference in the average credit scores between the two sources, with the CoreLogic source showing higher scores. To help account for this, S-M included an indicator for score source in the models, which is reasonable.

Pinnacle Forward Budget Model Commentary

The following illustrates some of the similarities and differences in methodologies for the Forward budget models between the Pinnacle analysis and that done by S-M for HUD.

The Pinnacle models analyzed the forward book of loans based on separate products: 30-year FRM, 15-year FRM, refinances, and adjustable rate mortgages (ARMs). The S-M approach did not build models separately by product beyond the purchase loans vs. refinance loans for their Stage 1 model. Also, the Pinnacle models wre built on an individual loan level. S-M used individual loans for their Stage 2 models but grouped the data (cell regression) for their Stage 1 models.

Model Schema

The schema of the models is different between the S-M process and that of Pinnacle. Both reflect models for Performing (Stage 1 or Current) vs. Non-Performing (Stage 2 or Default) loans. Pinnacle further models based on product (Fixed 30, Fixed 15, ARM). The HUD models predict the likelihood of prepayment or delinquency from each of the Stage 1 or Stage 2 starting points. Pinnacle's models reflect potential transition to multiple states.

- Transitions from Current mortgage: remain current, default/claim, prepay by SR, other prepayments, cure with mortgage modification, self-cure

- Transitions from Default mortgage: prepaid, transition into a claim, self-cure, cure with mortgage modification, remain in default

Transition Models for Pinnacle are used to project how a loan will move to different statuses. Loss Severity Models are used to project the amount of loss given a claim.

Regarding the modeling process, for this year's analysis Pinnacle has moved from using a multinomial target to multiple binomial models for the Forward transition models. The main vulnerability in the models is the general vulnerability of developing predictive models: the extent to which historical patterns between target and projected results are indeed predictive. We have attempted to mitigate this potential vulnerability through a training and validation construct. For the Transition Models, we used a train/validate approach of 60%/40%. This is different than the split percentages used by S-M. For the Loss Severity Models, a train/validate approach also was used. Pinnacle did not do any out of time sample validation.

Pinnacle models were validated in general by comparing actual to predicted results in decile charts. This was done for both the Transition Models and Loss Severity Models.

Pinnacle applied random sampling for a few of the Current transition model types to improve efficiency of the modeling process. This could be a potential source of variability if not truly random, and a future area of refinement could be to test to see if using different sampling percentages result in a difference in the model results. Pinnacle did use the full data sample on many more of the transition model types with this analysis then in past reports.

For Loss Severity models, Pinnacle built a multinomial logistic model to predict claim disposition—PFS, REO, or CWCOT. S-M also included the Single Family Loan Sales (SFLS) as a type. Pinnacle also built models to predict loss severity (using Generalized Linear Models with a Gamma error structure and a log link function) for each of PFS, REO, and CWCOT, as well as a model of recovery amount if the claim is a foreclosure REO. S-M does not separately specify a recovery amount model. Finally, Pinnacle also modeled loss mitigation costs.

S-M utilized data from Moody's in their loan projections. Pinnacle uses 10 economic scenarios from Moody's, and 100 random stochastic simulations of key economic variables to develop a range of Cash Flow NPV. Both S-M and Pinnacle utilized Moody's data on a state and MSA level when possible to provide for a greater reflection of differences in home prices, etc. across the country.

Simulation

Pinnacle ultimately utilized 100 random stochastic simulation to determine the range of Cash Flow NPV estimates. The process began with a pool of 10,000 simulations that were randomly sampled down to 100. This compares to the the S-M process which used 10,000 Monte Carlo simulations. Pinnacle developed simulations of key economic variables as inputs into the Cash Flow NPV simulations, while S-M process used 10,000 simulations of target variables (default rate, prepayment rate).

Appendix G: Summary of Historical and Projected Claim Rates, Non-Claim Termination Rates and Loss Severities

The following incremental annual summaries are shown by cohort for Fixed Rate 30, Fixed Rate 15, ARM products separately, and for all products combined.

1. **Claim Rate**: number of claims divided by the number of originations for the cohort

2. **Non-Claim Termination**: number of terminations that were not by reason of maturity or claim divided by the number of originations for the cohort

3. **Loss**: Net loss severity divided by the origination volume for the cohort

Count_ClmTot INCREMENTAL
Count_ClmTot f

ANNUAL EVALUATIONS - 2019Q4 - QUARTERS OF MATURITY

Fiscal Year	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124
1990	71	2,498	8,245	10,667	9,597	7,060	5,141	4,345	3,283	2,359	1,615	1,054	727	567	446	274	203	181	160	119	157	126	111	104	67	66	77	51	33	32	1
1991	39	1,859	6,336	7,705	6,569	5,230	4,667	3,616	2,554	1,814	1,083	746	530	429	287	190	140	137	122	128	134	126	107	79	89	92	53	38	28	0	1
1992	38	1,190	3,998	5,240	5,197	5,382	4,565	3,515	2,253	1,425	985	666	463	286	203	138	154	130	118	132	121	122	85	105	101	72	44	37	35	28	6
1993	37	1,622	5,230	7,561	9,273	8,266	6,285	4,279	2,512	1,776	1,244	840	516	343	229	208	215	256	223	203	224	185	225	205	148	78	72	57	50	48	8
1994	51	2,303	7,472	11,353	12,300	9,958	6,784	4,095	2,969	2,043	1,370	871	533	391	299	348	418	355	300	383	316	269	273	203	129	93	91	80	81	66	8
1995	30	1,510	5,996	8,880	8,083	5,611	3,617	2,562	2,264	1,415	829	552	380	327	333	346	318	245	267	211	230	258	165	121	95	76	52	40	27	27	7
1996	43	2,570	9,754	12,794	10,309	6,888	5,180	4,279	2,730	1,641	1,062	728	638	573	624	567	525	493	387	485	462	310	205	161	113	107	67	59	40	39	13
1997	51	2,891	9,524	11,039	8,590	7,080	5,654	3,581	2,275	1,375	971	839	755	780	680	628	630	521	558	545	360	258	175	113	109	77	59	60	32	25	3
1998	80	3,428	9,592	10,437	9,878	8,658	5,869	3,694	2,366	1,652	1,370	1,353	1,396	1,239	1,157	1,184	916	961	896	590	363	255	256	191	183	136	125	94	73	49	11
1999	94	4,101	10,884	13,921	14,546	10,197	6,327	3,823	2,677	2,097	2,008	2,098	1,970	1,788	1,737	1,358	1,310	1,265	824	621	375	372	297	286	209	149	150	108	80	59	12
2000	115	4,272	12,725	15,694	10,946	6,434	3,886	2,655	2,210	1,815	1,799	1,534	1,367	1,284	1,030	1,025	928	674	467	299	267	264	210	177	142	99	82	61	37	31	6
2001	87	4,918	15,461	16,047	10,900	6,799	4,630	3,795	3,290	3,444	3,052	2,631	2,492	1,913	1,813	1,611	1,076	670	520	498	463	394	313	276	204	200	117	103	84	59	15
2002	132	5,260	14,439	13,513	9,466	6,760	5,701	5,191	5,250	4,565	4,274	4,111	2,923	2,781	2,449	1,544	1,070	756	786	744	618	527	415	331	259	212	157	162	100	87	18
2003	28	4,557	10,404	9,393	7,433	7,003	6,677	7,842	6,676	6,613	7,105	5,087	4,037	3,508	2,173	1,355	737	1,170	1,076	958	831	649	533	439	371	330	259	223	195	186	66
2004	428	5,592	10,090	10,847	10,939	10,518	11,369	9,552	9,616	10,189	7,615	6,180	5,288	3,381	2,097	1,140	1,635	1,492	1,416	1,176	934	755	702	535	454	369	310	269	235	184	43
2005	180	2,967	7,390	9,211	9,991	10,826	9,020	8,928	9,522	6,892	5,652	4,678	3,088	1,853	1,060	1,579	1,427	1,308	1,118	855	687	568	464	404	325	284	267	208	211	174	54
2006	71	2,630	8,037	11,301	13,202	10,506	10,249	10,986	7,873	6,215	5,215	3,444	2,314	1,234	1,737	1,326	1,277	1,076	844	569	507	423	363	323	261	225	205	161	135	107	39
2007	81	3,418	11,173	15,582	11,831	12,903	16,189	10,535	7,818	6,574	4,476	2,795	1,624	2,222	1,835	1,569	1,269	931	823	667	545	426	401	327	281	216	191	155	156	120	32
2008	144	7,482	26,360	26,706	31,815	42,979	28,009	19,789	16,212	10,698	6,548	3,953	5,997	4,901	4,059	3,100	2,272	1,840	1,566	1,190	1,038	841	717	651	547	467	395	363	282	241	71
2009	230	8,578	20,375	31,030	47,124	36,294	26,350	21,750	14,788	9,327	5,454	8,924	6,983	5,815	4,623	3,446	2,864	2,407	2,085	1,711	1,333	1,201	956	921	786	687	528	538	420	393	94
2010	138	3,385	10,876	21,305	20,827	18,077	14,853	10,700	7,245	4,402	9,813	6,330	4,932	3,813	2,746	2,090	1,720	1,409	1,071	956	853	750	574	537	470	397	340	342	283	241	55
2011	105	2,198	6,768	8,233	8,183	7,435	5,910	3,995	2,441	6,645	4,369	3,080	2,626	1,923	1,477	1,217	1,003	779	629	514	463	438	361	315	273	262	213	194	166	144	24
2012	80	1,618	3,838	5,072	5,908	4,926	3,650	2,319	5,579	4,710	3,760	2,802	1,976	1,677	1,457	1,159	980	780	636	548	487	446	390	313	306	233	219	210	195	161	76
2013	83	1,410	3,802	5,546	5,782	4,593	3,077	5,494	5,206	4,387	3,448	2,523	2,201	2,002	1,683	1,491	1,195	1,053	900	705	589	469	428	437	391	332	319	256	229	220	60
2014	19	779	2,582	3,934	3,476	2,554	4,396	3,859	3,344	2,545	1,734	1,329	1,037	805	653	529	455	410	309	293	222	186	152	156	143	105	94	85	78	62	22
2015	16	719	3,053	4,084	3,628	6,181	6,895	6,457	5,342	3,864	2,854	2,101	1,658	1,303	1,129	941	782	649	543	456	386	312	246	217	202	196	146	124	123	101	47
2016	15	865	3,173	4,091	6,291	8,156	8,327	7,128	5,640	4,181	3,107	2,320	1,788	1,418	1,107	955	870	664	591	450	384	298	277	240	210	155	160	132	112	86	37
2017	27	887	2,969	4,792	7,547	8,494	7,914	6,543	5,316	4,240	3,077	2,356	1,735	1,320	1,158	979	727	618	495	419	345	302	240	182	208	144	131	106	80	97	24
2018	25	824	3,721	6,767	8,493	8,334	7,520	6,475	5,320	4,129	3,108	2,174	1,697	1,270	994	835	673	531	472	419	296	263	222	185	131	120	117	98	65	53	25
2019	11	1,649	5,917	9,005	10,185	9,747	8,939	7,607	6,294	4,756	3,443	2,724	1,966	1,570	1,252	1,012	838	664	582	473	358	327	284	207	201	156	120	90	92	76	33

Incremental Claims as a % of Loans Active as of Beginning of Period (Conditional Probability of Claim at time Tt+1 | survival to time t)

Fiscal Year	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	32 - 36	36 - 40	40 - 44	44 - 48	48 - 52	52 - 56	56 - 60	60 - 64	64 - 68	68 - 72	72 - 76	76 - 80	80 - 84	84 - 88	88 - 92	92 - 96	96 - 100	100 - 104	104 - 108	108 - 112	112 - 116	116 - 120	120 - 124
1990	0.3%	1.2%	1.8%	2.3%	2.4%	2.0%	2.0%	1.7%	1.6%	1.3%	1.0%	0.8%	0.8%	0.8%	0.6%	0.6%	0.6%	0.6%	0.5%	0.7%	0.6%	0.5%	0.5%	0.4%	0.4%	0.5%	0.3%	0.2%	0.3%	0.0%
1991	0.3%	1.1%	1.8%	2.1%	1.9%	2.0%	1.8%	1.6%	1.4%	1.0%	0.8%	0.7%	0.8%	0.7%	0.5%	0.5%	0.6%	0.5%	0.6%	0.7%	0.7%	0.6%	0.5%	0.6%	0.6%	0.4%	0.3%	0.2%	0.0%	0.2%
1992	0.2%	0.7%	1.1%	1.2%	1.4%	1.4%	1.3%	1.1%	0.8%	0.7%	0.6%	0.6%	0.5%	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.4%	0.6%	0.6%	0.5%	0.3%	0.3%	0.3%	0.3%	0.1%
1993	0.2%	0.6%	0.9%	1.2%	1.2%	1.1%	0.9%	0.6%	0.5%	0.5%	0.5%	0.4%	0.4%	0.3%	0.3%	0.4%	0.6%	0.5%	0.5%	0.6%	0.6%	0.7%	0.7%	0.6%	0.3%	0.3%	0.3%	0.3%	0.3%	0.1%
1994	0.2%	0.7%	1.2%	1.4%	1.3%	1.1%	0.7%	0.6%	0.6%	0.6%	0.5%	0.4%	0.3%	0.3%	0.4%	0.6%	0.6%	0.5%	0.7%	0.6%	0.6%	0.7%	0.5%	0.4%	0.3%	0.3%	0.3%	0.4%	0.3%	0.1%
1995	0.3%	1.3%	2.2%	2.5%	2.2%	1.7%	1.4%	1.7%	1.5%	1.2%	1.1%	0.9%	0.9%	1.0%	1.2%	1.2%	1.0%	1.2%	1.0%	1.1%	1.4%	0.9%	0.8%	0.6%	0.5%	0.4%	0.4%	0.3%	0.3%	0.1%
1996	0.3%	1.4%	2.2%	2.2%	1.7%	1.6%	1.8%	1.7%	1.4%	1.2%	1.0%	1.0%	1.1%	1.3%	1.2%	1.3%	1.3%	1.1%	1.5%	1.5%	1.1%	0.8%	0.7%	0.5%	0.5%	0.4%	0.4%	0.3%	0.3%	0.1%
1997	0.4%	1.5%	2.2%	2.0%	2.1%	2.3%	2.2%	1.9%	1.5%	1.3%	1.3%	1.3%	1.5%	1.4%	1.4%	1.5%	1.4%	1.6%	1.6%	1.2%	0.9%	0.7%	0.4%	0.5%	0.4%	0.3%	0.4%	0.2%	0.2%	0.0%
1998	0.3%	1.1%	1.3%	1.5%	1.7%	1.9%	1.7%	1.5%	1.3%	1.2%	1.4%	1.5%	1.5%	1.5%	1.7%	1.5%	1.7%	1.7%	1.2%	0.8%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.4%	0.3%	0.1%
1999	0.4%	1.0%	1.6%	2.1%	2.4%	2.1%	1.8%	1.5%	1.4%	1.5%	1.7%	1.8%	1.7%	1.8%	1.6%	1.8%	1.9%	1.3%	1.1%	0.7%	0.7%	0.7%	0.7%	0.6%	0.5%	0.5%	0.4%	0.4%	0.3%	0.1%
2000	0.5%	2.2%	4.2%	4.7%	4.1%	3.4%	3.0%	3.0%	2.8%	3.0%	2.8%	2.7%	2.7%	2.4%	2.5%	2.5%	2.0%	1.5%	1.0%	0.9%	1.0%	0.9%	0.9%	0.8%	0.6%	0.5%	0.5%	0.3%	0.3%	0.1%
2001	0.5%	1.9%	3.5%	3.6%	3.1%	2.7%	2.6%	2.5%	3.0%	2.9%	2.7%	2.8%	2.4%	2.5%	2.4%	1.8%	1.2%	1.0%	1.0%	1.1%	1.0%	0.9%	0.9%	0.7%	0.8%	0.5%	0.5%	0.5%	0.4%	0.1%
2002	0.5%	2.0%	2.7%	2.6%	2.3%	2.3%	2.4%	2.7%	2.6%	2.7%	2.9%	2.3%	2.4%	2.4%	1.7%	1.3%	1.0%	1.1%	1.1%	1.1%	1.0%	0.9%	0.8%	0.7%	0.6%	0.5%	0.6%	0.4%	0.4%	0.1%
2003	0.5%	1.4%	1.6%	1.6%	1.7%	1.8%	2.4%	2.2%	2.4%	2.9%	2.4%	2.2%	2.1%	1.5%	1.0%	0.7%	1.1%	1.1%	1.1%	1.0%	0.9%	0.8%	0.7%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.2%
2004	0.6%	1.4%	1.8%	2.2%	2.3%	2.8%	2.6%	2.8%	3.3%	2.9%	2.7%	2.6%	1.8%	1.3%	0.8%	1.3%	1.1%	1.3%	1.2%	1.0%	0.9%	0.9%	0.7%	0.7%	0.6%	0.5%	0.5%	0.5%	0.4%	0.1%
2005	0.6%	1.8%	2.5%	3.0%	3.6%	3.3%	3.6%	4.3%	3.7%	3.4%	3.2%	2.4%	1.6%	1.0%	1.7%	1.6%	1.6%	1.5%	1.2%	1.0%	0.9%	0.8%	0.7%	0.6%	0.5%	0.6%	0.5%	0.5%	0.4%	0.2%
2006	0.7%	2.2%	3.5%	4.7%	4.2%	4.6%	5.6%	5.0%	4.6%	4.4%	3.3%	2.5%	1.5%	2.3%	1.8%	2.0%	1.8%	1.5%	1.1%	1.0%	0.9%	0.8%	0.7%	0.6%	0.6%	0.6%	0.5%	0.4%	0.4%	0.2%
2007	0.9%	3.2%	5.3%	4.6%	5.6%	8.1%	6.6%	5.8%	5.7%	4.4%	3.2%	2.1%	3.1%	2.7%	2.6%	2.3%	1.8%	1.7%	1.4%	1.2%	1.0%	1.0%	0.9%	0.8%	0.6%	0.6%	0.5%	0.6%	0.5%	0.1%
2008	0.7%	3.2%	3.8%	5.1%	8.1%	7.0%	6.0%	5.7%	4.4%	3.1%	2.1%	3.6%	3.1%	2.9%	2.4%	1.9%	1.6%	1.5%	1.2%	1.1%	0.9%	0.8%	0.8%	0.7%	0.6%	0.6%	0.6%	0.5%	0.4%	0.1%
2009	0.5%	1.3%	2.1%	3.8%	3.8%	3.2%	3.2%	2.6%	1.9%	1.3%	2.4%	2.0%	1.8%	1.6%	1.2%	1.1%	1.0%	0.9%	0.8%	0.6%	0.6%	0.5%	0.5%	0.5%	0.4%	0.3%	0.4%	0.3%	0.3%	0.1%
2010	0.2%	0.7%	1.5%	1.7%	1.7%	1.7%	1.4%	1.2%	0.8%	2.1%	1.4%	1.2%	1.0%	0.8%	0.6%	0.6%	0.5%	0.4%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.0%
2011	0.2%	0.6%	0.9%	1.0%	1.0%	1.0%	0.8%	0.6%	1.7%	1.2%	0.9%	0.9%	0.7%	0.5%	0.5%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%
2012	0.1%	0.4%	0.5%	0.7%	0.7%	0.6%	0.4%	1.2%	1.0%	0.9%	0.7%	0.5%	0.5%	0.4%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
2013	0.1%	0.3%	0.5%	0.6%	0.5%	0.4%	0.8%	0.8%	0.7%	0.6%	0.5%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%
2014	0.1%	0.4%	0.8%	0.8%	0.7%	1.4%	1.3%	1.2%	1.0%	0.7%	0.6%	0.5%	0.4%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%
2015	0.1%	0.3%	0.5%	0.5%	1.0%	1.2%	1.3%	1.1%	0.9%	0.7%	0.5%	0.4%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%
2016	0.1%	0.3%	0.4%	0.7%	1.0%	1.1%	1.0%	0.9%	0.7%	0.5%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
2017	0.1%	0.3%	0.5%	0.8%	1.0%	1.0%	0.9%	0.8%	0.7%	0.5%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2018	0.1%	0.4%	0.8%	1.1%	1.2%	1.2%	1.1%	1.0%	0.8%	0.7%	0.5%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
2019	0.2%	0.7%	1.1%	1.4%	1.4%	1.5%	1.4%	1.2%	1.0%	0.8%	0.7%	0.5%	0.4%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%

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ANNUAL EVALUATIONS - 2019Q4 - QUARTERS OF MATURITY

Fiscal Year	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
1990	807	7,688	36,529	92,300	58,370	5,013	5,676	1,016	11	8	5	9	8	2	9
1991	698	17,809	79,908	63,751	4,580	6,045	3,127	1,845	13	3	3	4	4	5	14
1992	2,203	27,043	38,963	3,710	5,400	2,851	6,718	3,991	5	3	3	3	9	25	38
1993	5,295	21,666	3,874	5,291	3,166	7,999	9,482	748	6	3	3	10	54	53	151
1994	1,545	8,730	14,372	10,271	16,892	13,517	2,471	1,045	4	7	12	79	121	232	361
1995	5,481	23,947	17,604	28,828	14,973	1,998	3,028	1,708	1	10	36	77	173	231	199
1996	1,757	19,633	54,861	35,181	4,727	6,444	7,197	3,360	7	51	137	284	420	412	280
1997	5,193	54,601	62,227	10,458	12,741	10,276	10,320	2,752	63	167	344	544	452	273	197
1998	7,706	35,765	7,868	11,838	17,086	23,251	9,930	2,301	320	629	1,069	1,250	701	449	572
1999	1,232	17,508	31,671	32,937	41,088	16,009	6,267	1,504	912	1,427	1,699	1,128	691	750	1,334
2000	20,984	128,996	82,548	39,714	13,705	5,507	1,731	886	1,091	987	512	317	361	540	349
2001	27,993	117,232	127,147	31,661	10,248	2,742	1,346	2,260	2,860	1,514	1,110	1,505	2,020	922	577
2002	42,860	177,347	55,965	15,686	5,133	2,813	4,050	5,166	3,141	2,313	3,395	4,273	2,015	1,098	850
2003	35,409	37,900	17,188	5,613	3,393	4,423	7,717	5,127	4,213	6,302	13,873	4,353	2,345	1,848	1,615
2004	11,082	30,756	12,042	6,859	6,684	9,975	6,743	5,183	7,633	16,604	7,938	3,690	2,456	1,929	1,278
2005	5,520	7,532	5,834	6,350	8,163	5,155	4,084	7,240	15,624	5,634	3,202	2,151	1,740	874	496
2006	1,185	9,273	13,739	21,825	9,984	6,948	9,765	17,212	7,277	4,060	2,634	1,890	939	458	3,937
2007	3,274	28,509	37,789	15,133	8,650	11,016	18,342	8,293	4,647	3,135	2,613	1,211	545	3,634	3,222
2008	21,345	164,375	69,775	36,038	47,097	67,653	26,562	13,661	9,723	7,563	3,437	1,561	9,036	7,440	6,866
2009	81,296	114,662	77,438	129,818	154,743	36,715	31,002	29,033	19,044	7,427	3,299	23,453	18,587	16,402	14,560
2010	16,248	44,176	74,685	80,672	10,742	25,404	27,127	18,333	7,627	3,839	34,941	28,352	24,062	20,113	19,035
2011	1,519	48,181	52,529	6,742	16,597	15,888	10,905	5,041	2,767	27,108	23,110	19,823	16,671	14,172	14,171
2012	3,574	33,009	6,670	17,106	14,658	9,595	4,898	3,146	30,176	27,011	24,996	21,131	17,556	15,545	16,045
2013	829	6,781	29,807	18,347	12,345	6,652	4,581	40,041	35,116	32,810	28,880	23,236	19,713	18,280	18,672
2014	4,512	112,410	43,388	18,653	6,254	3,500	19,066	16,308	14,590	12,617	11,160	9,743	8,475	7,659	7,741
2015	21,944	83,649	42,704	14,038	8,713	39,140	34,137	29,113	24,596	21,706	20,547	17,823	15,226	13,986	13,463
2016	18,820	52,315	20,989	14,022	56,913	51,969	46,430	38,801	32,801	30,437	28,721	24,885	21,693	19,516	18,363
2017	7,074	35,749	23,853	67,410	62,496	59,044	51,251	42,281	37,845	34,747	32,253	28,692	25,091	22,181	20,909
2018	4,730	57,172	62,796	58,882	56,455	51,172	43,539	38,211	33,412	30,002	27,790	24,408	20,881	18,374	17,135
2019	23,318	55,664	64,425	64,036	56,526	49,957	44,868	38,395	33,505	30,259	27,203	23,924	20,608	18,411	16,840

Fiscal Year	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120
1990	20	40	42	38	55	30	12	12	11	5	3	7	6	6	2
1991	35	46	57	67	30	17	13	10	7	12	1	6	3	3	0
1992	88	136	106	70	45	26	26	14	12	12	15	10	361	1,371	1,196
1993	246	264	202	99	110	94	73	42	39	39	21	629	2,160	1,865	1,541
1994	413	277	163	149	200	119	75	54	64	46	372	2,786	2,491	2,260	1,791
1995	148	80	95	108	53	46	36	30	14	414	1,200	1,194	1,115	990	804
1996	161	177	266	124	103	86	73	41	519	2,164	1,995	1,879	1,655	1,368	1,233
1997	197	240	139	123	94	99	52	676	2,075	2,065	1,889	1,735	1,587	1,377	1,132
1998	756	387	257	249	200	114	1,227	3,629	3,487	3,254	2,782	2,501	2,287	2,100	1,662
1999	683	465	385	287	195	837	4,429	4,119	3,944	3,501	3,131	2,917	2,580	2,319	2,085
2000	273	227	159	96	552	1,944	1,925	1,925	1,672	1,523	1,418	1,426	1,315	1,251	1,020
2001	488	390	198	1,265	3,604	3,411	3,271	2,866	2,633	2,442	2,313	2,200	2,093	1,912	1,618
2002	675	394	1,531	4,594	4,594	4,198	3,945	3,438	3,298	3,104	2,959	2,897	2,711	2,450	2,203
2003	910	417	6,369	5,562	5,314	4,834	4,280	4,102	3,862	3,773	3,573	3,428	3,297	3,166	2,997
2004	611	7,537	6,321	6,083	5,590	4,873	4,778	4,405	4,326	4,163	4,034	3,973	3,753	3,638	3,292
2005	4,575	3,503	3,181	2,923	2,756	2,523	2,411	2,465	2,399	2,414	2,482	2,389	2,495	2,385	2,220
2006	3,112	2,596	2,150	2,093	2,011	1,988	1,894	1,889	1,991	1,971	1,963	2,026	2,052	1,965	1,800
2007	2,759	2,216	1,852	1,736	1,698	1,707	1,717	1,726	1,629	1,797	1,863	1,908	1,783	1,803	1,685
2008	5,754	4,103	3,841	3,658	3,649	3,809	3,824	3,557	3,699	3,960	4,102	4,175	3,983	3,850	3,571
2009	12,125	9,319	8,446	8,248	8,429	8,162	8,429	8,603	8,816	8,742	8,798	8,812	8,641	8,349	8,061
2010	15,014	11,325	10,410	10,196	10,228	10,389	10,532	10,746	10,717	10,725	10,772	10,881	10,751	10,097	9,564
2011	11,257	8,395	7,841	7,471	7,673	7,618	7,850	7,812	7,918	7,981	7,822	8,068	7,996	7,624	7,176
2012	13,072	9,364	8,328	8,318	8,352	8,806	8,903	8,712	8,649	8,859	8,785	8,900	8,833	8,568	8,077
2013	15,963	13,182	12,450	12,293	12,334	12,454	12,568	12,128	11,863	11,695	11,777	11,261	11,144	10,909	10,318
2014	6,595	5,247	4,921	4,885	5,100	5,116	5,156	5,233	5,441	5,414	5,439	5,574	5,744	5,358	5,230
2015	11,878	10,130	9,472	9,284	9,482	9,547	9,758	10,064	10,126	10,062	10,274	10,348	10,336	9,945	9,576
2016	16,536	14,439	13,048	13,112	13,505	13,637	13,907	14,021	14,007	14,295	14,482	14,637	14,533	14,003	13,174
2017	18,608	15,987	14,781	14,506	15,050	15,004	15,459	15,346	15,482	15,903	15,756	15,835	15,621	15,046	13,785
2018	15,050	13,319	11,708	11,770	11,964	12,180	12,137	12,434	12,594	12,764	12,521	12,755	12,461	11,664	11,066
2019	14,808	12,821	11,892	11,719	11,983	12,101	11,996	12,015	12,192	12,212	12,291	12,349	11,946	11,220	10,630

Incremental Claims as a % of Loans Active as of Beginning of Period (Conditional Probability of Claim at time Tt+1 | survival to time t)

Fiscal Year	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	32 - 36	36 - 40	40 - 44	44 - 48	48 - 52	52 - 56	56 - 60	60 - 64
1990	1.1%	5.3%	15.5%	14.1%	1.7%	2.2%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1991	2.9%	13.8%	14.6%	1.5%	2.2%	1.3%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
1992	4.5%	7.0%	0.8%	1.3%	0.8%	2.0%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%
1993	2.3%	0.4%	0.6%	0.4%	1.2%	1.7%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.4%
1994	0.8%	1.4%	1.1%	1.9%	1.8%	0.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.4%	0.5%
1995	4.8%	3.8%	7.1%	4.7%	0.8%	1.4%	1.0%	0.0%	0.0%	0.1%	0.1%	0.4%	0.6%	0.6%	0.5%
1996	2.6%	7.7%	6.1%	1.0%	1.6%	2.2%	1.4%	0.0%	0.0%	0.2%	0.4%	0.7%	0.8%	0.6%	0.4%
1997	7.4%	9.6%	2.1%	2.9%	3.0%	4.1%	1.7%	0.1%	0.2%	0.5%	0.9%	0.8%	0.5%	0.4%	0.4%
1998	3.6%	0.9%	1.5%	2.5%	4.6%	3.2%	1.1%	0.2%	0.5%	1.0%	1.3%	0.8%	0.5%	0.7%	1.1%
1999	1.6%	3.0%	3.7%	6.0%	3.7%	2.1%	0.7%	0.5%	1.0%	1.3%	0.9%	0.6%	0.7%	1.4%	0.8%
2000	16.6%	14.5%	10.6%	5.9%	3.5%	1.5%	1.0%	1.5%	1.5%	0.9%	0.6%	0.7%	1.1%	0.8%	0.7%
2001	11.4%	15.9%	6.9%	3.3%	1.2%	0.8%	1.5%	2.2%	1.3%	1.0%	1.5%	2.3%	1.2%	0.8%	0.7%
2002	16.8%	7.7%	3.1%	1.4%	1.0%	1.6%	2.4%	1.6%	1.3%	2.1%	3.0%	1.6%	1.0%	0.8%	0.7%
2003	4.2%	2.3%	1.0%	0.7%	1.1%	2.1%	1.6%	1.4%	2.3%	5.6%	2.1%	1.3%	1.1%	1.1%	0.7%
2004	3.6%	1.7%	1.2%	1.3%	2.2%	1.7%	1.4%	2.3%	5.4%	3.0%	1.6%	1.2%	1.0%	0.8%	0.4%
2005	1.6%	1.4%	1.7%	2.5%	1.7%	1.5%	2.9%	7.0%	3.0%	1.9%	1.5%	1.3%	0.8%	0.5%	4.8%
2006	2.4%	3.8%	6.7%	3.5%	2.8%	4.4%	8.8%	4.6%	3.0%	2.2%	1.8%	1.0%	0.6%	5.2%	4.1%
2007	7.2%	10.7%	5.1%	3.4%	4.8%	9.1%	5.2%	3.5%	2.7%	2.6%	1.4%	0.7%	5.1%	4.7%	4.5%
2008	16.3%	8.5%	5.1%	7.5%	12.8%	6.6%	4.1%	3.4%	3.1%	1.6%	0.8%	5.4%	4.7%	4.9%	4.4%
2009	6.6%	4.9%	8.9%	12.4%	3.8%	3.8%	4.2%	3.3%	1.5%	0.8%	6.3%	5.2%	5.1%	4.9%	4.4%
2010	2.7%	4.7%	5.6%	0.9%	2.4%	3.0%	2.5%	1.2%	0.7%	7.3%	6.3%	6.0%	5.4%	5.4%	4.6%
2011	4.0%	4.8%	0.7%	2.0%	2.2%	1.8%	1.0%	0.6%	7.0%	6.3%	6.1%	5.5%	5.0%	5.3%	4.5%
2012	2.8%	0.6%	1.7%	1.7%	1.3%	0.8%	0.6%	6.3%	6.0%	6.0%	5.5%	4.9%	4.6%	5.0%	4.3%
2013	0.5%	2.4%	1.6%	1.3%	0.8%	0.6%	6.0%	5.4%	5.6%	5.3%	4.5%	4.0%	3.9%	4.2%	3.7%
2014	14.5%	7.1%	3.7%	1.5%	1.0%	6.1%	5.4%	5.3%	4.9%	4.6%	4.2%	3.9%	3.7%	3.9%	3.4%
2015	7.7%	4.6%	1.8%	1.3%	6.6%	6.0%	5.7%	5.1%	4.8%	4.9%	4.5%	4.0%	3.9%	3.9%	3.6%
2016	4.3%	1.9%	1.4%	6.6%	6.3%	6.2%	5.6%	5.1%	5.0%	5.0%	4.6%	4.2%	4.0%	3.9%	3.7%
2017	2.9%	2.1%	6.8%	6.5%	6.8%	6.4%	5.7%	5.5%	5.4%	5.3%	5.0%	4.6%	4.3%	4.3%	4.0%
2018	5.7%	7.2%	7.0%	7.5%	7.4%	6.9%	6.6%	6.3%	6.1%	6.0%	5.7%	5.2%	4.8%	4.7%	4.4%
2019	5.9%	7.2%	7.9%	7.6%	7.4%	7.3%	6.8%	6.5%	6.4%	6.2%	5.8%	5.4%	5.1%	5.0%	4.6%

Fiscal Year	64 - 68	68 - 72	72 - 76	76 - 80	80 - 84	84 - 88	88 - 92	92 - 96	96 - 100	100 - 104	104 - 108	108 - 112	112 - 116	116 - 120	120 -
1990	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1991	0.2%	0.2%	0.3%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1992	0.4%	0.4%	0.3%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	2.8%	10.6%	11.6%	0.0%
1993	0.5%	0.4%	0.2%	0.3%	0.3%	0.2%	0.1%	0.1%	0.1%	0.1%	3.0%	10.1%	10.9%	10.8%	0.0%
1994	0.4%	0.3%	0.3%	0.4%	0.2%	0.2%	0.1%	0.2%	0.1%	1.2%	9.4%	9.3%	10.3%	9.3%	0.0%
1995	0.3%	0.4%	0.5%	0.2%	0.2%	0.2%	0.2%	0.1%	2.8%	7.9%	9.3%	10.2%	10.2%	9.4%	0.0%
1996	0.4%	0.7%	0.3%	0.3%	0.3%	0.3%	0.2%	2.1%	8.8%	9.6%	10.6%	10.5%	9.8%	9.9%	0.0%
1997	0.6%	0.4%	0.3%	0.3%	0.3%	0.2%	2.6%	7.7%	9.2%	9.7%	10.0%	10.2%	9.9%	9.1%	0.0%
1998	0.6%	0.4%	0.5%	0.4%	0.3%	3.0%	8.8%	10.2%	10.9%	10.6%	10.8%	11.1%	11.5%	10.4%	0.0%
1999	0.6%	0.6%	0.5%	0.3%	1.6%	8.7%	9.1%	10.1%	10.1%	10.2%	10.7%	10.6%	10.8%	11.0%	0.0%
2000	0.6%	0.5%	0.3%	1.9%	6.7%	7.5%	8.7%	8.4%	8.4%	8.6%	9.6%	9.8%	10.4%	9.6%	0.0%
2001	0.7%	0.4%	2.5%	6.9%	8.0%	8.7%	8.5%	8.6%	8.8%	9.2%	9.8%	10.4%	10.7%	10.2%	0.0%
2002	0.5%	2.1%	6.2%	7.1%	7.4%	7.7%	7.4%	7.7%	7.9%	8.3%	9.0%	9.3%	9.3%	9.3%	0.0%
2003	0.4%	6.3%	5.8%	6.1%	6.0%	5.9%	6.1%	6.1%	6.4%	6.6%	6.9%	7.2%	7.5%	7.8%	0.0%
2004	5.9%	4.6%	5.6%	5.5%	5.2%	5.6%	5.5%	5.8%	6.0%	6.2%	6.7%	6.8%	7.2%	7.1%	0.0%
2005	3.8%	3.9%	3.8%	3.8%	3.7%	3.8%	4.1%	4.2%	4.4%	4.8%	5.0%	5.5%	5.6%	5.6%	0.0%
2006	4.1%	3.6%	3.7%	3.7%	3.9%	3.9%	4.1%	4.6%	4.8%	5.1%	5.6%	6.0%	6.2%	6.1%	0.0%
2007	4.0%	3.5%	3.5%	3.6%	3.8%	4.1%	4.3%	4.3%	5.0%	5.5%	6.1%	6.1%	6.6%	6.7%	0.0%
2008	3.5%	3.4%	3.4%	3.6%	3.9%	4.2%	4.1%	4.5%	5.1%	5.6%	6.1%	6.2%	6.5%	6.5%	0.0%
2009	3.6%	3.5%	3.5%	3.8%	3.8%	4.2%	4.5%	4.8%	5.0%	5.4%	5.7%	6.0%	6.2%	6.4%	0.0%
2010	3.8%	3.6%	3.7%	3.9%	4.1%	4.4%	4.7%	4.9%	5.2%	5.5%	5.9%	6.2%	6.2%	6.3%	0.0%
2011	3.6%	3.5%	3.5%	3.7%	3.8%	4.1%	4.3%	4.6%	4.8%	5.0%	5.5%	5.7%	5.8%	5.8%	0.0%
2012	3.3%	3.1%	3.2%	3.3%	3.6%	3.8%	3.9%	4.0%	4.3%	4.4%	4.7%	5.0%	5.1%	5.0%	0.0%
2013	3.3%	3.2%	3.3%	3.4%	3.6%	3.8%	3.8%	3.9%	4.0%	4.2%	4.3%	4.4%	4.6%	4.5%	0.0%
2014	2.9%	2.8%	2.9%	3.1%	3.2%	3.4%	3.5%	3.8%	4.0%	4.2%	4.5%	4.9%	4.8%	5.0%	0.0%
2015	3.2%	3.1%	3.1%	3.3%	3.5%	3.7%	4.0%	4.2%	4.3%	4.6%	4.9%	5.2%	5.3%	5.4%	0.0%
2016	3.4%	3.1%	3.3%	3.5%	3.6%	3.9%	4.1%	4.3%	4.6%	4.9%	5.2%	5.5%	5.6%	5.6%	0.0%
2017	3.6%	3.5%	3.5%	3.8%	3.9%	4.3%	4.4%	4.7%	5.1%	5.3%	5.7%	5.9%	6.1%	6.0%	0.0%
2018	4.1%	3.8%	3.9%	4.2%	4.4%	4.7%	5.0%	5.4%	5.8%	6.0%	6.6%	6.9%	7.0%	7.1%	0.0%
2019	4.2%	4.1%	4.2%	4.5%	4.8%	5.0%	5.3%	5.7%	6.1%	6.5%	7.0%	7.3%	7.4%	7.7%	0.0%

Total_Loss
Total_Loss

INCREMENTAL
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ANNUAL EVALUATIONS - 2019Q4 - QUARTERS OF MATURITY

Fiscal Year	4	8	12	16	20	24	28	32	36	40	44	48	52	56
1990	4,532,763	159,920,353	571,316,709	796,845,386	735,960,967	543,179,874	386,762,404	323,903,655	239,115,230	168,604,008	110,051,332	67,892,624	44,390,037	32,687,593
1991	2,415,614	125,421,761	471,915,241	602,812,754	530,207,481	417,397,028	379,432,755	286,604,830	196,727,527	132,419,776	77,037,944	50,356,516	33,816,253	25,328,602
1992	2,331,419	84,410,072	305,497,808	413,708,642	423,909,857	459,167,341	386,439,323	292,257,137	185,900,109	111,300,605	71,351,502	46,784,888	27,965,326	16,776,946
1993	2,769,444	127,175,221	424,347,705	642,958,271	824,072,101	733,378,873	546,619,934	364,421,266	201,449,769	135,394,144	88,183,243	54,927,439	31,664,706	20,201,534
1994	3,833,253	180,112,530	610,370,815	981,088,521	1,100,973,574	879,002,068	586,061,946	337,903,581	231,582,549	151,198,539	93,110,523	55,627,024	34,169,470	23,714,470
1995	1,681,738	115,480,080	501,537,528	769,052,887	712,957,029	487,455,722	304,790,664	201,607,352	170,329,013	100,176,665	55,361,446	36,026,601	23,520,825	20,217,641
1996	2,271,384	208,460,169	863,262,703	1,158,271,861	939,017,925	604,539,197	436,313,005	341,855,053	203,310,206	114,954,190	73,459,482	48,926,989	42,154,129	37,953,430
1997	3,164,030	259,119,720	909,784,178	1,032,464,856	770,550,695	624,970,901	479,707,491	283,351,481	170,440,718	99,899,180	68,405,706	59,034,109	53,240,973	54,213,997
1998	5,213,570	316,986,595	930,688,293	985,750,950	896,071,260	765,801,241	496,156,434	298,062,175	185,911,622	126,191,158	106,650,134	102,403,292	104,279,364	94,782,425
1999	6,747,207	394,002,669	1,059,435,629	1,349,937,477	1,397,170,109	936,516,458	554,205,603	326,695,596	223,375,557	180,699,373	170,308,325	177,273,181	164,250,410	145,804,570
2000	8,109,305	407,039,471	1,242,321,024	1,565,930,886	1,062,066,019	600,756,843	361,247,786	242,104,993	200,207,775	168,796,096	167,086,262	138,274,489	117,285,661	111,264,226
2001	6,020,091	474,411,382	1,577,746,190	1,648,160,034	1,102,847,984	678,580,884	458,627,079	379,154,870	330,932,012	342,253,057	302,210,536	248,840,794	228,346,823	160,162,985
2002	8,398,217	532,434,287	1,525,928,549	1,427,933,531	992,260,492	713,140,811	601,449,876	542,648,185	544,940,724	470,386,156	428,258,481	398,659,139	262,952,378	247,723,419
2003	1,991,670	475,773,791	1,127,402,265	1,009,038,104	819,820,938	787,237,346	748,440,544	866,787,726	739,825,522	709,839,689	730,522,716	500,930,466	389,495,369	318,727,525
2004	47,527,795	621,484,345	1,088,378,187	1,200,925,308	1,287,644,016	1,222,760,606	1,298,806,142	1,088,886,915	1,065,822,685	1,091,664,416	803,216,451	623,238,594	508,850,389	274,327,638
2005	20,178,725	308,230,381	821,237,060	1,108,531,885	1,228,223,964	1,323,037,319	1,100,876,785	1,050,369,179	1,100,280,741	783,479,647	617,782,222	476,979,040	259,146,750	137,066,459
2006	6,979,351	285,414,152	985,003,297	1,461,165,822	1,748,029,519	1,367,731,978	1,306,450,411	1,399,971,454	983,202,582	741,166,256	599,400,766	338,567,722	207,997,233	97,674,295
2007	6,260,611	425,424,095	1,522,876,795	2,202,750,031	1,632,934,053	1,796,309,050	2,319,573,875	1,471,308,757	1,035,141,274	837,506,205	501,429,175	277,840,641	143,985,937	174,524,955
2008	15,717,758	1,049,666,401	4,036,765,693	4,002,650,099	4,736,323,514	6,621,485,020	4,254,699,325	2,852,645,060	2,263,452,224	1,300,246,468	706,792,332	382,703,606	523,117,336	394,285,158
2009	24,458,477	1,237,817,343	2,993,330,410	4,467,975,951	7,075,522,204	5,466,859,217	3,795,769,607	3,022,311,309	1,760,290,087	974,306,051	522,107,102	708,432,288	488,569,935	397,594,580
2010	15,062,686	419,723,375	1,368,121,602	2,838,969,743	2,839,511,731	2,353,878,711	1,770,219,202	1,091,314,500	639,626,026	359,728,554	723,060,919	417,189,667	311,119,646	246,945,483
2011	9,394,802	242,056,213	837,011,256	1,085,898,823	1,051,344,668	861,085,525	581,054,931	330,117,356	201,125,837	479,703,231	283,230,565	190,243,242	167,606,953	124,143,526
2012	8,193,205	152,230,554	456,404,100	607,556,976	650,890,807	469,550,645	299,495,757	192,261,854	359,906,475	284,713,477	225,506,550	171,342,699	123,784,475	106,232,350
2013	5,652,748	154,738,703	432,453,404	596,371,041	561,639,008	393,248,240	267,293,439	387,441,165	340,942,955	281,527,884	225,063,719	162,263,327	148,169,821	132,685,886
2014	1,131,731	72,677,647	247,647,091	372,423,083	284,542,171	206,955,264	321,899,227	252,548,741	221,290,019	163,569,178	113,196,622	86,712,235	67,078,210	51,267,717
2015	1,179,200	55,672,540	266,314,704	337,942,627	308,938,821	481,284,745	504,146,823	473,320,762	384,903,802	289,610,715	215,621,601	159,377,555	123,924,999	98,320,995
2016	844,944	56,522,431	231,022,275	330,147,513	516,226,333	661,927,897	658,827,541	588,284,753	483,140,132	354,601,757	258,619,139	188,961,881	147,438,908	114,834,348
2017	1,375,781	55,197,058	222,955,424	463,291,962	739,542,146	842,382,451	815,735,542	681,559,357	559,924,601	444,070,237	324,362,778	241,257,311	174,382,529	135,349,781
2018	1,397,992	54,620,061	423,831,348	795,817,629	1,040,848,474	1,043,313,894	966,754,782	853,820,436	686,085,801	546,701,068	400,813,253	281,503,665	212,720,408	151,481,062
2019	505,388	172,691,300	726,702,421	1,153,049,828	1,353,317,171	1,318,789,648	1,253,262,753	1,055,662,850	871,301,212	657,563,367	469,285,438	366,058,248	261,726,204	203,064,615

Fiscal Year	60	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120
1990	23,705,830	13,889,275	10,246,650	9,300,212	7,719,074	5,717,482	8,494,647	5,961,445	5,189,562	4,984,257	2,791,178	3,329,093	3,593,389	1,706,098	1,234,568	1,085,715
1991	15,940,727	9,991,197	7,376,932	6,682,801	6,178,173	6,017,012	6,785,667	5,653,177	5,514,215	3,867,849	4,341,690	3,992,366	2,120,374	1,480,406	1,089,599	0
1992	11,754,458	7,627,006	7,890,636	7,362,488	6,150,993	6,867,808	6,198,461	6,315,001	3,721,460	5,007,666	4,752,079	3,352,249	1,581,262	1,353,134	584,771	555,768
1993	13,994,405	12,301,312	11,510,723	14,162,261	12,273,704	10,676,057	12,420,237	10,000,524	11,652,251	9,962,755	6,669,371	2,848,809	2,088,734	1,179,359	979,787	895,534
1994	18,122,003	20,416,643	24,579,559	20,363,683	15,935,898	21,297,464	16,082,879	14,094,886	15,016,057	9,377,777	5,392,089	2,975,756	2,672,085	1,946,172	2,210,982	1,711,109
1995	20,686,977	21,357,576	19,672,596	13,968,962	15,912,302	11,711,748	13,426,001	15,131,018	7,904,435	5,777,884	3,866,481	2,118,028	1,436,839	1,259,905	865,530	820,387
1996	41,408,127	36,701,450	33,123,064	32,548,128	22,611,844	29,298,485	26,808,680	15,830,494	9,383,684	6,988,073	3,527,454	3,489,228	2,541,957	2,037,409	1,403,620	1,430,327
1997	46,138,747	41,403,018	40,601,835	33,973,117	35,636,479	32,786,098	18,721,940	12,124,972	6,736,032	4,248,411	4,047,258	2,828,404	2,194,482	2,250,003	1,210,773	943,085
1998	81,889,195	84,666,742	61,642,686	65,917,059	58,028,489	33,166,507	17,235,631	10,949,393	10,024,601	7,498,370	7,641,474	5,548,590	5,737,792	4,133,436	3,375,529	2,215,031
1999	134,152,225	101,188,199	96,198,186	90,313,224	49,064,107	34,632,303	18,607,898	17,168,689	12,760,327	13,200,214	10,604,370	7,166,179	7,690,436	5,401,037	4,350,785	3,039,315
2000	84,320,669	83,748,677	70,485,598	47,514,138	30,003,910	17,658,895	13,069,725	12,824,310	11,073,063	9,179,791	7,416,347	5,580,207	4,602,029	3,885,927	2,295,976	1,640,992
2001	152,221,660	126,973,363	73,182,760	44,200,232	27,842,950	25,700,691	22,991,502	19,263,897	16,709,833	15,996,851	11,432,131	12,107,874	7,171,180	5,697,341	5,451,144	3,526,162
2002	200,912,500	110,480,308	66,722,563	42,210,302	39,305,361	38,628,381	32,894,387	28,729,840	23,236,004	19,011,661	14,782,325	13,085,476	9,251,188	10,134,584	5,925,598	5,532,497
2003	165,701,953	92,648,869	45,711,937	64,943,997	57,180,872	51,270,087	49,195,255	38,250,824	33,635,997	27,182,369	24,117,972	21,026,658	16,931,657	15,175,653	12,621,855	12,138,179
2004	152,023,996	72,624,349	92,716,870	79,589,726	80,806,725	68,286,703	59,181,785	48,399,069	43,691,701	35,560,456	28,953,500	24,569,766	21,329,349	18,339,346	14,920,648	12,294,311
2005	73,599,175	92,906,390	80,600,903	72,382,868	62,797,467	50,020,294	44,077,330	35,261,693	28,887,463	25,783,806	21,729,434	17,979,787	17,670,199	13,804,300	14,948,634	11,792,525
2006	117,040,402	83,036,525	80,110,064	65,682,561	55,412,840	38,677,851	35,522,680	29,141,096	25,932,618	23,077,354	19,794,448	16,802,656	15,488,208	10,942,838	10,292,821	8,120,326
2007	132,952,455	111,375,879	94,276,606	68,469,171	65,696,167	53,049,959	41,211,191	33,117,900	31,980,630	26,739,587	22,482,144	17,057,867	14,855,775	13,220,826	12,910,005	10,092,411
2008	321,681,351	246,474,861	178,622,167	147,334,491	128,302,585	97,205,611	86,818,037	70,949,016	61,612,827	55,583,684	49,771,394	41,901,335	33,707,567	32,212,826	24,227,018	21,494,190
2009	315,730,688	242,194,483	203,193,011	169,891,775	150,754,119	124,255,086	92,802,768	88,465,868	72,768,171	67,650,789	57,081,846	51,661,749	38,446,249	40,586,508	31,407,486	28,798,653
2010	179,468,975	135,780,160	113,851,739	93,736,114	70,805,922	65,309,791	58,144,959	49,517,474	38,666,255	36,534,607	32,384,600	27,157,509	25,500,532	25,788,495	19,230,174	17,909,985
2011	97,657,983	81,472,028	64,305,416	49,226,877	40,232,273	34,133,023	29,654,916	28,300,777	23,172,214	19,623,068	17,730,317	18,209,874	14,137,722	13,284,638	11,867,943	9,802,294
2012	91,090,406	72,769,897	61,774,060	47,104,581	40,955,852	34,614,208	29,295,953	28,594,347	25,205,821	20,254,344	20,481,512	14,751,862	14,009,930	15,009,375	12,132,874	10,906,954
2013	112,022,627	97,868,547	79,341,558	68,761,795	59,604,351	46,014,588	38,233,539	31,603,736	29,390,827	29,341,608	27,257,416	21,986,295	21,141,938	16,911,965	15,087,023	15,813,066
2014	39,190,192	33,144,138	26,923,360	25,225,606	19,073,911	17,830,177	14,518,457	11,154,107	8,983,458	9,793,721	9,437,503	5,756,580	5,429,567	4,867,870	4,934,256	3,786,191
2015	81,981,453	68,441,329	55,681,521	47,251,149	37,593,814	32,177,815	28,733,411	21,934,208	18,373,742	15,421,021	14,632,676	15,938,377	11,713,266	9,167,410	9,124,225	7,287,855
2016	85,788,232	71,908,044	65,780,375	50,820,841	47,802,422	33,745,444	29,060,845	22,495,871	21,322,674	18,440,487	16,094,547	11,359,315	11,937,667	10,521,156	8,962,291	5,739,954
2017	110,134,731	89,249,428	68,350,593	57,152,097	43,062,975	37,918,153	34,210,586	25,129,094	20,840,760	15,952,235	18,391,007	14,628,228	11,975,747	10,702,142	7,861,567	8,788,076
2018	114,351,244	90,261,957	78,286,875	57,520,039	50,202,549	43,140,214	32,909,932	28,685,017	24,896,672	19,110,712	14,322,356	13,060,250	12,782,234	13,307,089	7,882,374	6,243,673
2019	159,764,769	128,259,746	100,524,827	75,513,263	68,630,189	56,923,541	43,165,779	38,582,734	32,416,064	25,457,767	25,953,841	19,082,357	14,765,512	11,381,987	11,584,210	10,544,657

Incremental Claims as a % of Loans Active as of Beginning of Period (Conditional Probability of Claim at time Tt+1 | survival to time t)

Fiscal Year	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	32 - 36	36 - 40	40 - 44	44 - 48	48 - 52	52 - 56
1990	22349.9%	82720.8%	133551.2%	178310.2%	186832.5%	152175.8%	149270.5%	127437.7%	110855.9%	90471.5%	64143.4%	49402.4%	45479.7%
1991	20244.4%	81226.1%	137619.4%	168031.2%	149647.0%	158860.2%	139307.8%	119879.1%	101960.2%	68534.8%	53825.6%	46514.2%	46591.6%
1992	13906.2%	55055.8%	88207.0%	99173.2%	122475.0%	117822.6%	111376.8%	90547.8%	62553.4%	49165.2%	43274.1%	37234.5%	29451.8%
1993	13349.4%	47645.3%	76954.4%	108835.1%	107830.5%	95283.7%	77996.8%	49389.7%	40065.6%	35113.7%	33826.7%	26657.2%	21512.0%
1994	16422.7%	57950.5%	101012.4%	125353.4%	116920.9%	93533.6%	61454.4%	49903.4%	41432.5%	37738.7%	31062.0%	24292.1%	20443.0%
1995	23164.2%	109564.6%	189765.0%	222953.7%	191702.6%	139093.2%	113539.4%	128119.9%	109588.1%	82994.4%	69775.7%	55661.4%	55659.2%
1996	27607.0%	121902.4%	199415.6%	202758.2%	150810.9%	134271.6%	140956.6%	127050.6%	100584.7%	83931.6%	68876.3%	69160.7%	69732.7%
1997	34891.3%	140154.2%	202668.6%	177160.9%	183713.4%	192901.5%	170970.7%	143579.8%	110146.1%	93055.1%	93847.9%	94719.7%	104539.1%
1998	32306.1%	103750.2%	121042.2%	131771.9%	151951.6%	158568.6%	138018.6%	114930.5%	96439.6%	95169.8%	102480.2%	114607.8%	112972.1%
1999	35137.8%	100935.2%	151306.6%	204221.9%	217474.4%	187660.2%	150030.4%	127919.5%	121393.7%	128365.0%	147115.9%	148006.7%	142405.4%
2000	52338.9%	218195.7%	419676.6%	458016.1%	382686.7%	318058.6%	272129.0%	270131.2%	258881.8%	281626.6%	252630.0%	229580.2%	234284.9%
2001	46241.7%	197650.1%	357000.4%	360277.1%	307533.0%	262910.9%	256607.0%	254127.2%	293565.3%	284240.8%	254831.9%	256212.5%	200123.7%
2002	50482.0%	211175.8%	285434.3%	269855.3%	243113.1%	242501.5%	249058.3%	281258.3%	268110.3%	267372.5%	276660.3%	206369.9%	214860.5%
2003	52560.1%	150003.3%	174170.0%	172907.3%	192833.1%	204070.4%	262271.1%	246125.3%	258335.8%	296759.0%	240575.2%	209376.8%	191823.1%
2004	72147.5%	151834.7%	203206.7%	255175.6%	271663.0%	320076.4%	294838.0%	314297.2%	356890.7%	307115.1%	269730.2%	246015.2%	148557.4%
2005	66767.7%	198062.2%	302866.8%	372579.7%	443832.3%	406064.3%	422643.0%	495158.0%	420793.5%	374820.1%	326193.0%	199270.1%	118196.4%
2006	72345.2%	269787.0%	446630.7%	620788.8%	549888.4%	584322.0%	716985.5%	620943.9%	543173.9%	503630.4%	324905.4%	225985.7%	117965.5%
2007	107323.8%	429400.3%	744788.8%	633629.9%	776826.0%	1155718.8%	924857.0%	768570.3%	721453.2%	498428.6%	316891.1%	183316.5%	245040.2%
2008	104281.8%	494499.9%	569024.6%	756102.4%	1248604.1%	1061660.3%	860562.8%	802517.4%	538926.5%	339122.5%	206417.2%	314859.7%	249585.5%
2009	71039.8%	187848.8%	305588.9%	569162.2%	571222.2%	463383.0%	440779.0%	309225.9%	203038.0%	124097.6%	189629.8%	137889.8%	124201.0%
2010	25509.8%	86901.3%	198410.4%	235278.4%	220101.6%	197880.7%	147266.4%	102838.9%	66455.8%	151514.9%	92362.4%	77325.2%	66162.1%
2011	20331.4%	75721.5%	113965.8%	123865.5%	120677.1%	97887.6%	65981.0%	46042.9%	124478.6%	77003.7%	58112.3%	55063.9%	43546.5%
2012	12958.5%	42174.2%	61677.5%	77244.5%	65592.9%	49032.2%	35816.1%	75348.6%	62962.8%	54488.9%	44530.5%	34305.9%	31127.8%
2013	11615.7%	34157.9%	53351.0%	57657.3%	46413.6%	35701.2%	57978.1%	52816.1%	48030.9%	41004.0%	31431.3%	30210.0%	28319.8%
2014	9401.5%	40669.7%	74092.8%	67532.5%	56917.8%	102206.5%	82943.7%	80277.0%	63478.1%	46678.1%	37784.1%	30712.9%	24544.7%
2015	5136.4%	28523.1%	42539.1%	44967.2%	81473.7%	89338.0%	91985.9%	80363.8%	64500.1%	50923.0%	39851.4%	32611.8%	27078.4%
2016	4609.8%	20879.3%	33418.9%	59968.4%	79661.1%	87962.4%	84741.4%	74526.5%	58147.2%	44961.2%	34781.1%	28569.4%	23312.9%
2017	4502.2%	19806.2%	46568.6%	76465.1%	97381.3%	102292.7%	92316.6%	81212.2%	68710.5%	53411.0%	42188.9%	32246.5%	26336.5%
2018	5463.5%	48344.8%	94759.5%	137934.0%	151290.0%	153427.6%	147453.0%	128394.7%	110306.3%	86854.6%	65390.4%	52667.3%	39727.8%
2019	18331.4%	80764.9%	141665.0%	182687.1%	195646.4%	203995.2%	188325.9%	169333.6%	138508.5%	106723.7%	89507.1%	68460.1%	56453.9%

Fiscal Year	56 - 60	60 - 64	64 - 68	68 - 72	72 - 76	76 - 80	80 - 84	84 - 88	88 - 92	92 - 96	96 - 100	100 - 104	104 - 108	108 - 112	112 - 116	116 - 120	120 -
1990	42463.0%	30902.1%	28502.5%	31455.8%	28859.6%	22978.4%	36597.5%	27524.1%	25445.3%	25861.3%	15343.7%	19555.3%	22887.8%	11641.0%	9105.8%	8935.2%	0.0%
1991	37080.9%	27990.5%	26649.8%	26927.2%	26917.8%	28272.8%	33714.2%	30258.4%	31300.5%	23241.5%	27675.2%	27220.1%	15646.2%	11743.7%	9410.9%	0.0%	0.0%
1992	25522.7%	19906.1%	25391.4%	26113.7%	23508.5%	28069.7%	26998.0%	29632.6%	18707.4%	26950.5%	27538.7%	21180.6%	10998.6%	10352.2%	4538.7%	5379.6%	0.0%
1993	18112.0%	18806.5%	22856.4%	30632.4%	28693.0%	26890.5%	33670.1%	29977.6%	37740.1%	35108.6%	25642.6%	12027.4%	9888.0%	5490.5%	5708.7%	6251.5%	0.0%
1994	18197.2%	23695.6%	36778.7%	32868.0%	27648.7%	39750.4%	32645.6%	31750.2%	36500.8%	24855.6%	15645.1%	9506.6%	9025.8%	7236.2%	10093.5%	8861.3%	0.0%
1995	63262.9%	71177.7%	75192.4%	56763.6%	68700.0%	54063.4%	66128.2%	80531.3%	45425.2%	35856.3%	25888.7%	13993.3%	11180.8%	11541.8%	8950.7%	9575.0%	0.0%
1996	82963.9%	80135.9%	81305.5%	85354.2%	63781.6%	88450.9%	87157.2%	55863.1%	35836.1%	28775.3%	14424.3%	16857.8%	14377.6%	12982.9%	10052.4%	11448.1%	0.0%
1997	95410.8%	91829.2%	99800.5%	89497.1%	100424.1%	99180.5%	61180.8%	43129.4%	25823.4%	15695.3%	17983.8%	14524.0%	12601.1%	14407.4%	8669.4%	7545.3%	0.0%
1998	105576.3%	119264.1%	99011.7%	114312.3%	108983.9%	67911.3%	38420.1%	26629.8%	24263.2%	21843.9%	25580.7%	21058.1%	24676.6%	20042.8%	18515.3%	13903.9%	0.0%
1999	142565.0%	119923.9%	129808.1%	132455.2%	78599.4%	60469.9%	35289.0%	33626.5%	28328.0%	33966.9%	30681.3%	23260.8%	28159.8%	22283.3%	20222.1%	15979.6%	0.0%
2000	192896.1%	207180.8%	192022.2%	140736.8%	96058.6%	60926.4%	45024.5%	50057.8%	49869.7%	45864.6%	40856.9%	33874.9%	30838.5%	28980.0%	19091.8%	15366.5%	0.0%
2001	208061.1%	190857.0%	123448.5%	81356.6%	55305.4%	49127.7%	53717.2%	51303.4%	49424.2%	52248.3%	41262.3%	48363.8%	31975.7%	28333.7%	30451.6%	22256.9%	0.0%
2002	193324.5%	119156.1%	82483.5%	56832.1%	52871.7%	59378.9%	57785.5%	56272.3%	49894.8%	44512.3%	37828.7%	36691.0%	28680.5%	34720.6%	22539.4%	23432.9%	0.0%
2003	112474.5%	71618.2%	41208.3%	63795.7%	59636.7%	58882.4%	61032.5%	52770.7%	49797.2%	43218.0%	41174.5%	38647.7%	34257.3%	33207.8%	29963.6%	31524.5%	0.0%
2004	92500.1%	49638.3%	72520.0%	58391.3%	74032.1%	67349.2%	63010.3%	56696.0%	54748.8%	47616.5%	41482.4%	37864.3%	36045.7%	33440.3%	29432.2%	26415.0%	0.0%
2005	70232.9%	98069.8%	88290.1%	88707.8%	81740.9%	68811.3%	64064.0%	55500.5%	47734.5%	44793.1%	39697.2%	34651.8%	36821.4%	30489.2%	35191.5%	29710.8%	0.0%
2006	155564.4%	110160.2%	125011.8%	109228.8%	97482.3%	71785.2%	69397.9%	60643.7%	56709.3%	53090.4%	48111.3%	43259.0%	42661.4%	32138.5%	32406.1%	27443.7%	0.0%
2007	193531.8%	182652.3%	169160.6%	131084.1%	132883.3%	113175.7%	92642.7%	78959.3%	80367.5%	70998.9%	62975.2%	50753.9%	47315.9%	45140.8%	47244.4%	39887.8%	0.0%
2008	227386.5%	189008.7%	150455.4%	131173.9%	120316.0%	95850.3%	89921.2%	77891.5%	71295.5%	67671.1%	63985.0%	57197.7%	49264.2%	50462.6%	40758.8%	38926.1%	0.0%
2009	106026.4%	87044.2%	79118.5%	69464.4%	64502.0%	55623.7%	43532.6%	43728.5%	37770.1%	36950.3%	32931.5%	31546.7%	25062.4%	28183.1%	23308.5%	22896.1%	0.0%
2010	51379.2%	41550.9%	37737.5%	32479.7%	25582.5%	24598.3%	22875.4%	20475.1%	16772.3%	16667.1%	15574.9%	13810.5%	13815.3%	14880.1%	11859.5%	11811.6%	0.0%
2011	36306.9%	32208.7%	27598.7%	22022.3%	18720.4%	16504.7%	14938.4%	14923.2%	12778.0%	11332.0%	10750.7%	11630.1%	9564.5%	9523.0%	9041.1%	7946.2%	0.0%
2012	28110.5%	23771.2%	21900.9%	17338.6%	15598.3%	13648.6%	11973.8%	12196.1%	11198.4%	9379.0%	9897.1%	7461.0%	7466.3%	8411.3%	7166.7%	6799.4%	0.0%
2013	24993.2%	22905.1%	19717.5%	17724.5%	15918.3%	12738.0%	10987.9%	9560.7%	9264.4%	9640.7%	9344.3%	7879.0%	8035.8%	6742.7%	6310.3%	6943.4%	0.0%
2014	19557.8%	17288.9%	14839.6%	14357.4%	11196.0%	10795.5%	9098.1%	7293.9%	6090.7%	6897.5%	6937.6%	4426.4%	4424.1%	4161.3%	4442.1%	3587.4%	0.0%
2015	23572.2%	20552.3%	17571.9%	15446.3%	12710.0%	11253.3%	10417.3%	8303.8%	7235.1%	6333.7%	6287.7%	7181.3%	5588.7%	4609.1%	4847.8%	4096.2%	0.0%
2016	18190.0%	15909.6%	15264.9%	12229.4%	11895.9%	8694.6%	7770.9%	6297.7%	6219.0%	5616.9%	5143.1%	3813.3%	4252.5%	3961.4%	3576.8%	2436.1%	0.0%
2017	22458.9%	19067.5%	15368.9%	13354.8%	10438.7%	9539.4%	8963.2%	6921.0%	6005.1%	4822.1%	5855.9%	4918.0%	4287.0%	4071.1%	3192.2%	3831.6%	0.0%
2018	31622.0%	26294.5%	24090.9%	18499.1%	16808.1%	15063.8%	12021.6%	11064.3%	10095.8%	8179.4%	6491.2%	6293.6%	6596.6%	7367.4%	4700.2%	4012.3%	0.0%
2019	47031.7%	39902.2%	33095.1%	26033.6%	24733.5%	21469.7%	17093.0%	16161.0%	14322.4%	11899.3%	12883.7%	10102.6%	8407.5%	6984.3%	7689.4%	7590.0%	0.0%