

Loss Data Analysis

Tutorial 102:

Applying advanced analysis to Fannie Mae's credit risk performance data

July 30, 2015

Disclaimer

The information provided in this presentation is intended to provide an introduction to the analysis and understanding of single family mortgage loan performance data published by Fannie Mae. The tools and methods presented in the tutorials are not intended to provide comprehensive instruction as to the use and analysis of the data, and may not reveal trends in performance or other information that may be meaningful to particular users of the data. Data users, together with their financial and other advisors, must determine for themselves the most appropriate methods to use to analyze the data and should ensure they are comfortable with the sufficiency of such analysis before using the data to assist in making investment decisions. Fannie Mae shall have no liability for any errors or misunderstandings resulting from misapplication of the information presented in the tutorials. Data users should also note that all loan performance data referenced in the tutorials is historical performance data and may not be predictive of future loan performance.

Loss Data Webinar Series

- These tutorials are an accompaniment to our latest loan performance data release.
- They are designed to share best practices and methodology for using the data so that users can interpret it appropriately.

Tutorial 101

Focuses on new loss data elements and how to prepare data for analysis and create statistical summaries for analysis.

Tutorial 102

Builds off concepts featured in Tutorial 101 and introduces more advanced modeling and analysis methodology.

Goal

By the end of this second module, users should be able to:

1. Examine default, severity and loss rates across key categorical risk dimensions (Occupancy, Purpose, Number of Borrowers)
2. Examine default, severity and loss rates across key continuous risk dimensions (OCLTV, FICO, DTI)
3. Create a flag to analyze risk layering
4. Use these groups and flags to project historical experience from any vintage on to a new production pool of loans
5. Mark a loan's loan-to-value ratio to market using a home price index

Analyzing risk across categorical variables

The following categorical variables are known to be correlated with mortgage credit risk, among others:

- Occupancy
- Loan Purpose
- Number of Borrowers

Note: *All of the following tables exclude loans originated after January 2013, where we do not have many cases of completed dispositions.*

Categorical Variables – Occupancy

Default Rate (%) by Origination Year															
Occupancy	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Primary	1.0%	0.9%	0.8%	0.9%	1.3%	2.4%	5.0%	7.0%	7.2%	3.4%	0.4%	0.1%	0.0%	0.0%	1.8%
Second Home	0.5%	0.3%	0.4%	0.5%	0.9%	2.2%	5.3%	7.4%	6.8%	3.6%	0.4%	0.1%	0.0%	0.0%	1.9%
Investor	0.8%	1.5%	1.8%	2.1%	2.0%	3.8%	6.9%	9.7%	12.1%	7.3%	0.7%	0.1%	0.0%	0.0%	3.1%
Total	1.0%	0.9%	0.8%	0.9%	1.3%	2.4%	5.1%	7.1%	7.4%	3.6%	0.4%	0.1%	0.0%	0.0%	1.8%

Severity (%) by Origination Year															
Occupancy	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Primary	12.7%	15.1%	21.2%	26.4%	29.4%	34.7%	41.3%	45.1%	39.4%	28.5%	23.7%	19.1%	15.5%	13.2%	35.5%
Second Home	13.6%	15.0%	20.4%	24.4%	28.0%	36.0%	41.4%	43.9%	36.6%	28.7%	26.9%	25.0%	9.6%	57.7%	36.6%
Investor	23.8%	29.1%	45.4%	52.5%	56.6%	59.1%	54.6%	51.9%	45.8%	41.8%	39.1%	42.6%	41.3%	39.2%	48.2%
Grand Total	12.9%	15.9%	23.3%	29.2%	31.4%	36.4%	42.0%	45.5%	39.9%	30.4%	24.6%	20.5%	16.6%	17.2%	36.6%

Net Loss Rate (%) by Origination Year															
Occupancy	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Primary	0.1%	0.1%	0.2%	0.2%	0.4%	0.8%	2.1%	3.1%	2.8%	1.0%	0.1%	0.0%	0.0%	0.0%	0.6%
Second Home	0.1%	0.0%	0.1%	0.1%	0.3%	0.8%	2.2%	3.2%	2.5%	1.0%	0.1%	0.0%	0.0%	0.0%	0.7%
Investor	0.2%	0.4%	0.8%	1.1%	1.1%	2.2%	3.8%	5.0%	5.5%	3.1%	0.3%	0.0%	0.0%	0.0%	1.5%
Grand Total	0.1%	0.1%	0.2%	0.3%	0.4%	0.9%	2.2%	3.2%	3.0%	1.1%	0.1%	0.0%	0.0%	0.0%	0.7%

Categorical Variables – Loan Purpose

Default Rate (%) by Origination Year															
Loan Purpose	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Purchase	0.8%	0.7%	0.8%	1.0%	1.6%	2.4%	4.8%	5.9%	5.6%	3.1%	0.3%	0.1%	0.0%	0.0%	1.8%
Rate/Term Refinance	1.6%	1.6%	0.9%	0.9%	1.2%	2.2%	4.5%	7.3%	9.7%	3.9%	0.4%	0.1%	0.0%	0.0%	1.3%
Cash-out	1.4%	1.2%	0.8%	0.8%	1.2%	2.6%	5.7%	8.4%	8.2%	4.2%	0.5%	0.2%	0.1%	0.0%	2.6%
Unknown Refinance		0.0%	1.6%	1.5%	2.0%	4.1%	4.2%	0.0%	99.3%			0.0%		0.0%	2.2%
Total	1.0%	0.9%	0.8%	0.9%	1.3%	2.4%	5.1%	7.1%	7.4%	3.6%	0.4%	0.1%	0.0%	0.0%	1.8%

Severity (%) by Origination Year															
Loan Purpose	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Purchase	9.4%	11.2%	14.9%	20.7%	24.5%	31.1%	37.8%	39.5%	31.0%	21.1%	19.5%	14.1%	10.7%	18.0%	29.5%
Rate/Term Refinance	15.9%	18.6%	24.1%	29.8%	32.6%	37.6%	40.8%	44.5%	40.1%	32.3%	23.3%	18.6%	17.2%	11.8%	35.2%
Cash-out	20.4%	29.5%	33.8%	39.6%	37.4%	42.0%	46.1%	50.5%	46.1%	39.3%	29.5%	27.7%	23.0%	25.6%	44.2%
Unknown Refinance			23.1%	29.4%	33.3%	35.8%	43.8%		35.1%						33.0%
Total	12.9%	15.9%	23.3%	29.2%	31.4%	36.4%	42.0%	45.5%	39.9%	30.4%	24.6%	20.5%	16.6%	17.2%	36.6%

Net Loss Rate (%) by Origination Year															
Loan Purpose	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Purchase	0.1%	0.1%	0.1%	0.2%	0.4%	0.7%	1.8%	2.3%	1.7%	0.7%	0.1%	0.0%	0.0%	0.0%	0.5%
Rate/Term Refinance	0.3%	0.3%	0.2%	0.3%	0.4%	0.8%	1.8%	3.2%	3.9%	1.3%	0.1%	0.0%	0.0%	0.0%	0.5%
Cash-out	0.3%	0.4%	0.3%	0.3%	0.4%	1.1%	2.6%	4.2%	3.8%	1.7%	0.1%	0.1%	0.0%	0.0%	1.1%
Unknown Refinance		0.0%	0.4%	0.5%	0.7%	1.5%	1.8%	0.0%	34.9%			0.0%		0.0%	0.7%
Total	0.1%	0.1%	0.2%	0.3%	0.4%	0.9%	2.2%	3.2%	3.0%	1.1%	0.1%	0.0%	0.0%	0.0%	0.7%

Occupancy & Purpose by CLTV for 2006 Vintage

Default Rate (%) by CLTV for 2006 Vintage										
Occupancy	(0-60]	(60-65]	(65-70]	(70-75]	(75-80]	(80-85]	(85-90]	(90-97]	(97+)	Total
Primary	2.0%	4.9%	7.0%	7.8%	7.9%	9.3%	9.2%	9.9%	11.4%	7.0%
Second Home	1.5%	4.4%	5.2%	5.8%	6.8%	12.3%	12.7%	14.2%	28.8%	7.4%
Investor	3.1%	6.8%	10.5%	10.0%	10.7%	19.1%	12.4%	22.5%	18.3%	9.7%
Grand Total	2.0%	5.0%	7.2%	8.0%	8.0%	9.6%	9.6%	10.2%	11.5%	7.1%

Default Rate (%) by CLTV for 2006 Vintage										
Loan Purpose	(0-60]	(60-65]	(65-70]	(70-75]	(75-80]	(80-85]	(85-90]	(90-97]	(97+)	Total
Purchase	0.6%	1.7%	2.7%	3.9%	5.3%	5.9%	7.8%	9.8%	11.6%	5.9%
Rate/Term Refinance	1.7%	4.1%	5.5%	7.1%	8.1%	10.5%	11.4%	12.3%	11.1%	7.3%
Cash-out	2.7%	6.5%	8.9%	11.0%	12.1%	12.6%	13.2%	11.8%	4.4%	8.4%
Unknown Refinance						0.0%		0.0%		0.0%
Total	2.0%	5.0%	7.2%	8.0%	8.0%	9.6%	9.6%	10.2%	11.5%	7.1%

Controlling for other factors makes the relationship across the categorical variables even clearer

Categorical Variables – Number of Borrowers

Default Rate (%) by Origination Year															
Number of Borrowers	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
1	1.5%	1.5%	1.5%	1.6%	2.0%	3.3%	6.4%	8.8%	9.4%	5.2%	0.7%	0.2%	0.1%	0.0%	2.7%
2	0.7%	0.5%	0.5%	0.6%	0.9%	1.9%	4.3%	5.9%	6.0%	2.4%	0.3%	0.1%	0.0%	0.0%	1.4%
3+	0.4%	0.3%	0.3%	0.3%	0.7%	1.6%	4.3%	5.2%	5.7%	2.3%	0.2%	0.0%	0.0%	0.0%	1.3%
Missing	0.3%	0.8%	0.7%	0.3%	1.4%	4.5%	0.0%	9.1%	5.5%	9.8%	0.0%	0.0%	0.0%	0.0%	1.1%
Total	1.0%	0.9%	0.8%	0.9%	1.3%	2.4%	5.1%	7.1%	7.4%	3.6%	0.4%	0.1%	0.0%	0.0%	1.8%

Severity (%) by Origination Year															
Number of Borrowers	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
1	15.6%	16.6%	24.4%	30.7%	33.9%	39.0%	43.7%	47.2%	41.3%	31.3%	25.9%	22.3%	17.2%	19.0%	37.7%
2	9.9%	14.9%	21.7%	27.1%	28.4%	33.4%	40.4%	43.7%	38.3%	28.8%	22.9%	17.8%	15.3%	13.5%	35.3%
3+	4.3%	10.4%	16.2%	33.7%	30.2%	39.8%	40.9%	42.3%	35.4%	25.8%	29.6%	16.7%			35.2%
Missing	66.5%	11.0%	13.4%	17.6%	21.9%	1.5%		43.7%	51.0%	21.1%					18.7%
Total	12.9%	15.9%	23.3%	29.2%	31.4%	36.4%	42.0%	45.5%	39.9%	30.4%	24.6%	20.5%	16.6%	17.2%	36.6%

Net Loss Rate (%) by Origination Year															
Number of Borrowers	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
1	0.2%	0.3%	0.4%	0.5%	0.7%	1.3%	2.8%	4.2%	3.9%	1.6%	0.2%	0.0%	0.0%	0.0%	1.0%
2	0.1%	0.1%	0.1%	0.2%	0.3%	0.6%	1.7%	2.6%	2.3%	0.7%	0.1%	0.0%	0.0%	0.0%	0.5%
3+	0.0%	0.0%	0.0%	0.1%	0.2%	0.7%	1.8%	2.2%	2.0%	0.6%	0.1%	0.0%	0.0%	0.0%	0.5%
Missing	0.2%	0.1%	0.1%	0.1%	0.3%	0.1%	0.0%	4.0%	2.8%	2.1%	0.0%	0.0%	0.0%	0.0%	0.2%
Total	0.1%	0.1%	0.2%	0.3%	0.4%	0.9%	2.2%	3.2%	3.0%	1.1%	0.1%	0.0%	0.0%	0.0%	0.7%

Grouping continuous variables

- Continuous variables (such as LTV or FICO) are often grouped into named ranges so that analysis may be performed across variables. Here are some sample dimensions we often use in our analysis:

FICO	LTV	DTI	Loan Size
[780+)	(0-60]	[0-20)	[0-85k)
[740-780)	(60-65]	[20-30)	[85k-110k)
[700-740)	(65-70]	[30-40)	[110k-125k)
[660-700)	(70-75]	[40-45)	[125k-150k)
[620-660)	(75-80]	[45+)	[150k-175k)
[0-620)	(80-85]		[175k-200k)
Missing	(85-90]		[200k-417k)
	(90-97]		[417k+)
	(97+)		
	Missing		

Continuous Variables – Minimum Credit Score

Default Rate (%) by Origination Year															
FICO	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
[780+]	0.2%	0.1%	0.1%	0.2%	0.3%	0.8%	1.7%	2.5%	2.7%	1.2%	0.2%	0.0%	0.0%	0.0%	0.5%
[740-780]	0.2%	0.2%	0.2%	0.3%	0.6%	1.2%	3.2%	4.6%	5.0%	2.5%	0.4%	0.1%	0.0%	0.0%	1.0%
[700-740]	0.6%	0.5%	0.6%	0.7%	1.2%	2.2%	5.1%	7.3%	7.9%	4.6%	0.7%	0.2%	0.1%	0.0%	2.0%
[660-700]	1.2%	1.1%	1.1%	1.3%	2.0%	3.5%	7.4%	9.8%	10.2%	6.6%	1.1%	0.4%	0.2%	0.0%	3.5%
[620-660]	2.2%	2.2%	2.0%	2.0%	2.7%	4.4%	9.0%	11.9%	12.1%	8.4%	1.7%	0.6%	0.2%	0.0%	4.9%
[0-620]	3.2%	2.8%	2.4%	2.5%	2.9%	4.4%	8.1%	11.1%	11.6%	7.9%	2.1%	1.1%	0.0%	0.0%	5.1%
Missing	2.1%	2.7%	1.8%	4.3%	5.2%	5.0%	6.7%	7.4%	7.8%	3.9%	0.6%	0.2%	0.0%	0.0%	3.3%
Total	1.0%	0.9%	0.8%	0.9%	1.3%	2.4%	5.1%	7.1%	7.4%	3.6%	0.4%	0.1%	0.0%	0.0%	1.8%

Severity (%) by Origination Year															
FICO	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
[780+]	14.1%	16.6%	23.8%	31.0%	31.3%	36.2%	40.8%	43.6%	37.6%	28.2%	23.7%	18.5%	15.1%	12.1%	35.1%
[740-780]	15.0%	14.9%	24.2%	31.6%	31.8%	35.8%	40.9%	44.4%	38.3%	28.9%	23.2%	17.6%	13.2%	12.4%	35.6%
[700-740]	13.6%	15.6%	23.3%	28.8%	31.0%	35.8%	41.3%	44.8%	39.2%	29.3%	24.3%	22.6%	16.6%	13.6%	35.9%
[660-700]	12.5%	15.4%	22.5%	29.3%	31.8%	36.8%	42.6%	45.7%	39.8%	30.3%	26.6%	21.1%	22.3%	29.4%	37.0%
[620-660]	12.3%	16.2%	23.3%	29.0%	32.0%	37.1%	43.0%	46.5%	40.8%	33.8%	30.0%	30.5%	15.0%	36.6%	37.8%
[0-620]	13.3%	17.8%	24.9%	29.8%	30.3%	35.7%	42.6%	47.5%	44.4%	39.4%	28.3%	25.7%			38.4%
Missing	12.4%	10.2%	14.9%	13.8%	17.9%	26.9%	36.1%	34.0%	29.0%	26.6%	36.8%	11.2%			20.0%
Total	12.9%	15.9%	23.3%	29.2%	31.4%	36.4%	42.0%	45.5%	39.9%	30.4%	24.6%	20.5%	16.6%	17.2%	36.6%

Net Loss Rate (%) by Origination Year															
FICO	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
[780+]	0.0%	0.0%	0.0%	0.1%	0.1%	0.3%	0.7%	1.1%	1.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.2%
[740-780]	0.0%	0.0%	0.1%	0.1%	0.2%	0.4%	1.3%	2.0%	1.9%	0.7%	0.1%	0.0%	0.0%	0.0%	0.3%
[700-740]	0.1%	0.1%	0.1%	0.2%	0.4%	0.8%	2.1%	3.3%	3.1%	1.3%	0.2%	0.0%	0.0%	0.0%	0.7%
[660-700]	0.1%	0.2%	0.3%	0.4%	0.6%	1.3%	3.2%	4.5%	4.1%	2.0%	0.3%	0.1%	0.0%	0.0%	1.3%
[620-660]	0.3%	0.4%	0.5%	0.6%	0.9%	1.6%	3.8%	5.5%	4.9%	2.9%	0.5%	0.2%	0.0%	0.0%	1.9%
[0-620]	0.4%	0.5%	0.6%	0.7%	0.9%	1.6%	3.5%	5.3%	5.2%	3.1%	0.6%	0.3%	0.0%	0.0%	2.0%
Missing	0.3%	0.3%	0.3%	0.6%	0.9%	1.3%	2.4%	2.5%	2.2%	1.0%	0.2%	0.0%	0.0%	0.0%	0.7%
Total	0.1%	0.1%	0.2%	0.3%	0.4%	0.9%	2.2%	3.2%	3.0%	1.1%	0.1%	0.0%	0.0%	0.0%	0.7%

Continuous Variables – Original Loan Amount

Default Rate (%) by Origination Year															
Original Loan Size	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
[0-85k]	2.1%	2.4%	2.9%	3.3%	3.3%	4.6%	5.3%	6.3%	7.1%	5.2%	0.9%	0.4%	0.2%	0.0%	3.1%
[85k-110k]	1.2%	1.3%	1.6%	1.8%	2.3%	3.3%	4.7%	5.9%	6.6%	4.3%	0.7%	0.3%	0.1%	0.0%	2.2%
[110k-125k]	1.1%	1.0%	1.1%	1.4%	1.9%	3.0%	4.7%	6.1%	6.9%	4.0%	0.6%	0.3%	0.1%	0.0%	2.0%
[125k-1500k]	1.0%	0.8%	0.9%	1.0%	1.6%	2.8%	4.8%	6.5%	7.1%	4.0%	0.5%	0.2%	0.1%	0.0%	1.9%
[150k-175k]	0.8%	0.6%	0.7%	0.8%	1.3%	2.5%	5.1%	7.0%	7.4%	3.9%	0.5%	0.2%	0.1%	0.0%	1.9%
[175k-200k]	0.6%	0.5%	0.5%	0.6%	1.2%	2.4%	5.4%	7.8%	8.1%	4.1%	0.5%	0.2%	0.1%	0.0%	2.0%
[200k-417k]	0.4%	0.4%	0.4%	0.4%	0.8%	1.9%	5.2%	7.5%	7.8%	4.0%	0.5%	0.1%	0.0%	0.0%	1.9%
[417k+]	0.0%	0.0%	0.2%	0.3%	0.1%	0.8%	2.5%	4.8%	5.1%	1.7%	0.2%	0.0%	0.0%	0.0%	0.6%
Total	1.0%	0.9%	0.8%	0.9%	1.3%	2.4%	5.1%	7.1%	7.4%	3.6%	0.4%	0.1%	0.0%	0.0%	1.8%

Severity (%) by Origination Year															
Original Loan Size	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
[0-85k]	24.3%	29.8%	43.9%	49.5%	55.1%	61.1%	64.6%	67.9%	67.3%	60.5%	45.4%	41.5%	33.9%	29.3%	53.9%
[85k-110k]	13.0%	16.5%	27.3%	34.4%	41.8%	46.9%	53.8%	58.6%	56.0%	48.1%	36.5%	34.8%	26.6%	23.2%	43.6%
[110k-125k]	10.0%	10.2%	20.1%	28.0%	34.8%	41.3%	49.3%	54.6%	51.7%	44.2%	31.9%	27.6%	15.3%	10.4%	40.0%
[125k-1500k]	6.2%	8.2%	15.1%	23.1%	29.9%	36.6%	45.4%	51.6%	48.3%	39.5%	29.9%	21.0%	15.0%	10.2%	37.7%
[150k-175k]	7.8%	6.4%	11.7%	17.4%	25.0%	32.3%	43.4%	48.9%	45.0%	34.6%	26.1%	17.3%	13.9%	3.7%	36.4%
[175k-200k]	3.8%	6.5%	10.4%	16.6%	23.3%	31.7%	42.1%	47.7%	42.9%	33.2%	25.0%	19.7%	16.3%	15.7%	36.8%
[200k-417k]	5.9%	7.0%	10.1%	15.7%	20.0%	28.9%	38.3%	41.9%	36.0%	25.7%	21.7%	16.6%	12.1%	19.2%	33.3%
[417k+]			8.0%	60.4%	23.6%	25.0%	35.6%	34.8%	29.5%	22.9%	19.3%	9.9%	22.4%	3.1%	27.4%
Total	12.9%	15.9%	23.3%	29.2%	31.4%	36.4%	42.0%	45.5%	39.9%	30.4%	24.6%	20.5%	16.6%	17.2%	36.6%

Net Loss Rate (%) by Origination Year															
Original Loan Size	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
[0-85k]	0.5%	0.7%	1.3%	1.6%	1.8%	2.8%	3.4%	4.3%	4.8%	3.1%	0.4%	0.2%	0.1%	0.0%	1.7%
[85k-110k]	0.2%	0.2%	0.4%	0.6%	1.0%	1.6%	2.5%	3.5%	3.7%	2.1%	0.2%	0.1%	0.0%	0.0%	1.0%
[110k-125k]	0.1%	0.1%	0.2%	0.4%	0.7%	1.3%	2.3%	3.3%	3.6%	1.8%	0.2%	0.1%	0.0%	0.0%	0.8%
[125k-1500k]	0.1%	0.1%	0.1%	0.2%	0.5%	1.0%	2.2%	3.3%	3.4%	1.6%	0.2%	0.0%	0.0%	0.0%	0.7%
[150k-175k]	0.1%	0.0%	0.1%	0.1%	0.3%	0.8%	2.2%	3.4%	3.3%	1.4%	0.1%	0.0%	0.0%	0.0%	0.7%
[175k-200k]	0.0%	0.0%	0.1%	0.1%	0.3%	0.7%	2.3%	3.7%	3.5%	1.4%	0.1%	0.0%	0.0%	0.0%	0.7%
[200k-417k]	0.0%	0.0%	0.0%	0.1%	0.2%	0.6%	2.0%	3.2%	2.8%	1.0%	0.1%	0.0%	0.0%	0.0%	0.6%
[417k+]	0.0%	0.0%	0.0%	0.2%	0.0%	0.2%	0.9%	1.7%	1.5%	0.4%	0.0%	0.0%	0.0%	0.0%	0.2%
Total	0.1%	0.1%	0.2%	0.3%	0.4%	0.9%	2.2%	3.2%	3.0%	1.1%	0.1%	0.0%	0.0%	0.0%	0.7%

Continuous Variables – Original Loan Amount

Default Rate (%) by Original Loan Amount and FICO for 2006 Vintage

Orig. Loan Size/FICO	[780+]	[740-780]	[700-740]	[660-700]	[620-660]	[0-620]	Missing	Total
[0-85k]	1.7%	4.6%	6.2%	8.5%	9.9%	9.9%	7.7%	6.3%
[85k-110k]	2.1%	3.5%	5.6%	8.0%	10.1%	9.7%	12.0%	5.9%
[110k-125k]	2.1%	3.7%	6.1%	8.2%	10.0%	10.1%	3.7%	6.1%
[125k-1500k]	2.3%	4.1%	6.5%	8.6%	10.4%	10.4%	5.7%	6.5%
[150k-175k]	2.4%	4.6%	6.8%	9.6%	10.9%	11.1%	7.6%	7.0%
[175k-200k]	2.9%	5.0%	7.8%	10.3%	12.6%	12.3%	11.9%	7.8%
[200k-417k]	2.7%	4.9%	7.9%	10.6%	12.8%	11.6%	7.0%	7.5%
[417k+]	1.8%	3.3%	5.5%	6.9%	9.6%	9.5%	0.0%	4.8%
Total	2.5%	4.6%	7.3%	9.8%	11.9%	11.1%	7.4%	7.1%

Controlling for other factors makes the relationship across the categorical variables even clearer

Continuous Variables – CLTV

Default Rate (%) by Origination Year															
OCLTV	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
(0-60]	0.2%	0.2%	0.1%	0.1%	0.2%	0.5%	1.3%	2.0%	1.7%	0.6%	0.1%	0.0%	0.0%	0.0%	0.4%
(60-65]	0.4%	0.4%	0.2%	0.3%	0.6%	1.4%	3.5%	5.0%	4.3%	1.7%	0.2%	0.0%	0.0%	0.0%	1.0%
(65-70]	0.4%	0.5%	0.4%	0.5%	0.9%	1.9%	5.1%	7.2%	6.0%	2.8%	0.3%	0.1%	0.0%	0.0%	1.6%
(70-75]	0.9%	0.7%	0.6%	0.7%	1.1%	2.3%	5.5%	8.0%	7.5%	3.2%	0.5%	0.1%	0.0%	0.0%	1.4%
(75-80]	0.6%	0.6%	0.7%	0.8%	1.5%	2.7%	5.9%	8.0%	7.2%	3.2%	0.6%	0.1%	0.1%	0.0%	1.8%
(80-85]	1.8%	1.6%	1.5%	1.7%	2.3%	3.6%	6.9%	9.6%	11.2%	5.7%	0.9%	0.3%	0.1%	0.0%	2.9%
(85-90]	1.5%	1.3%	1.6%	1.9%	2.5%	3.9%	7.3%	9.6%	11.3%	6.3%	1.0%	0.2%	0.1%	0.0%	3.7%
(90-97]	1.7%	1.7%	2.0%	2.3%	3.3%	4.4%	7.8%	10.2%	12.2%	7.5%	1.6%	0.5%	0.2%	0.0%	3.8%
(97+)	0.0%	1.0%	1.0%	1.5%	2.6%	4.2%	6.1%	11.5%	12.2%	6.6%	1.6%	0.9%	0.0%	0.1%	4.1%
Missing	0.0%	0.0%													0.0%
Total	1.0%	0.9%	0.8%	0.9%	1.3%	2.4%	5.1%	7.1%	7.4%	3.6%	0.4%	0.1%	0.0%	0.0%	1.8%

Continuous Variables – CLTV

Severity (%) by Origination Year															
OCLTV	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
(0-60]	22.5%	19.8%	24.8%	23.5%	21.5%	24.6%	33.0%	40.5%	39.5%	31.7%	19.2%	22.8%	14.5%	21.4%	33.3%
(60-65]	25.3%	30.1%	31.0%	30.9%	28.8%	33.7%	42.0%	48.4%	45.0%	38.6%	24.8%	34.9%	28.9%	30.6%	41.0%
(65-70]	14.5%	28.0%	36.4%	40.2%	35.5%	41.4%	45.2%	50.1%	48.5%	41.0%	30.1%	27.4%	16.8%	23.7%	44.4%
(70-75]	19.6%	30.1%	37.0%	41.9%	38.3%	42.0%	47.9%	52.9%	48.9%	40.7%	29.7%	29.8%	35.1%	28.4%	44.8%
(75-80]	18.9%	24.7%	33.7%	38.8%	38.4%	43.8%	48.5%	51.7%	48.2%	39.2%	28.8%	25.3%	22.9%	33.8%	44.3%
(80-85]	12.2%	17.9%	25.9%	33.7%	36.3%	39.0%	42.0%	43.6%	39.9%	30.8%	22.6%	19.1%	15.5%	15.8%	36.5%
(85-90]	10.3%	11.7%	16.7%	23.5%	26.8%	32.0%	36.3%	38.3%	33.3%	23.2%	17.7%	10.3%	6.8%	4.5%	30.3%
(90-97]	8.5%	8.7%	11.8%	15.9%	20.2%	25.8%	32.4%	34.3%	27.6%	17.0%	12.7%	7.1%	4.8%	3.3%	23.7%
(97+)		11.0%	12.1%	16.1%	24.9%	35.7%	37.9%	46.6%	42.2%	19.2%	11.3%	24.4%		11.6%	36.0%
Missing															
Total	12.9%	15.9%	23.3%	29.2%	31.4%	36.4%	42.0%	45.5%	39.9%	30.4%	24.6%	20.5%	16.6%	17.2%	36.6%

Net Loss Rate (%) by Origination Year															
OCLTV	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
(0-60]	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.4%	0.8%	0.7%	0.2%	0.0%	0.0%	0.0%	0.0%	0.1%
(60-65]	0.1%	0.1%	0.1%	0.1%	0.2%	0.5%	1.5%	2.4%	1.9%	0.6%	0.0%	0.0%	0.0%	0.0%	0.4%
(65-70]	0.1%	0.1%	0.2%	0.2%	0.3%	0.8%	2.3%	3.6%	2.9%	1.2%	0.1%	0.0%	0.0%	0.0%	0.7%
(70-75]	0.2%	0.2%	0.2%	0.3%	0.4%	1.0%	2.7%	4.2%	3.7%	1.3%	0.1%	0.0%	0.0%	0.0%	0.6%
(75-80]	0.1%	0.1%	0.2%	0.3%	0.6%	1.2%	2.9%	4.1%	3.5%	1.3%	0.2%	0.0%	0.0%	0.0%	0.8%
(80-85]	0.2%	0.3%	0.4%	0.6%	0.8%	1.4%	2.9%	4.2%	4.5%	1.8%	0.2%	0.1%	0.0%	0.0%	1.1%
(85-90]	0.1%	0.2%	0.3%	0.4%	0.7%	1.2%	2.6%	3.7%	3.8%	1.5%	0.2%	0.0%	0.0%	0.0%	1.1%
(90-97]	0.1%	0.1%	0.2%	0.4%	0.7%	1.1%	2.5%	3.5%	3.4%	1.3%	0.2%	0.0%	0.0%	0.0%	0.9%
(97+)	0.0%	0.1%	0.1%	0.2%	0.6%	1.5%	2.3%	5.3%	5.2%	1.3%	0.2%	0.2%	0.0%	0.0%	1.5%
Missing	0.0%	0.0%													0.0%
Total	0.1%	0.1%	0.2%	0.3%	0.4%	0.9%	2.2%	3.2%	3.0%	1.1%	0.1%	0.0%	0.0%	0.0%	0.7%

Continuous Variables – DTI

Default Rate (%) by Origination Year															
DTI	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
[0-20)	0.6%	0.7%	0.6%	0.6%	0.7%	1.2%	2.3%	3.4%	3.7%	1.5%	0.1%	0.0%	0.0%	0.0%	0.7%
[20-30)	0.8%	0.7%	0.6%	0.7%	0.9%	1.7%	3.2%	4.5%	4.4%	1.7%	0.2%	0.1%	0.0%	0.0%	0.9%
[30-40)	1.0%	0.9%	0.9%	0.9%	1.4%	2.5%	5.0%	6.5%	6.7%	3.0%	0.4%	0.1%	0.1%	0.0%	1.6%
[40-45)	1.1%	1.1%	1.1%	1.1%	1.7%	2.9%	6.2%	8.2%	8.4%	4.0%	0.6%	0.2%	0.1%	0.0%	2.1%
[45+)	1.3%	1.0%	1.1%	1.2%	1.8%	3.0%	6.5%	8.8%	9.5%	5.4%	0.7%	0.1%	0.0%	0.0%	3.5%
Missing	0.9%	0.9%	0.9%	1.1%	1.5%	2.8%	5.2%	8.2%	8.9%	5.4%	0.7%	0.0%	0.1%	0.0%	3.0%
Total	1.0%	0.9%	0.8%	0.9%	1.3%	2.4%	5.1%	7.1%	7.4%	3.6%	0.4%	0.1%	0.0%	0.0%	1.8%

Severity (%) by Origination Year															
DTI	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
[0-20)	18.6%	24.7%	32.1%	36.4%	35.9%	40.3%	45.2%	47.6%	41.5%	35.3%	25.9%	26.9%	23.0%	13.2%	38.6%
[20-30)	13.2%	18.6%	26.0%	30.5%	32.4%	37.2%	43.2%	47.3%	41.8%	33.3%	25.4%	20.9%	19.0%	12.1%	37.1%
[30-40)	14.3%	14.9%	22.2%	28.9%	31.0%	36.8%	42.5%	46.3%	41.2%	31.0%	23.7%	19.6%	17.5%	12.6%	36.8%
[40-45)	11.0%	13.9%	21.1%	27.3%	30.5%	35.5%	42.6%	45.6%	40.2%	29.6%	23.7%	19.7%	14.5%	22.9%	36.5%
[45+)	10.5%	14.6%	21.2%	27.7%	30.5%	35.7%	41.1%	44.6%	38.8%	29.6%	25.4%	23.9%	14.9%	32.4%	36.4%
Missing	15.9%	15.7%	23.8%	28.5%	30.1%	35.5%	39.7%	42.3%	36.9%	29.4%	23.4%	70.6%	74.9%		34.8%
Total	12.9%	15.9%	23.3%	29.2%	31.4%	36.4%	42.0%	45.5%	39.9%	30.4%	24.6%	20.5%	16.6%	17.2%	36.6%

Spread at Origination (SATO)

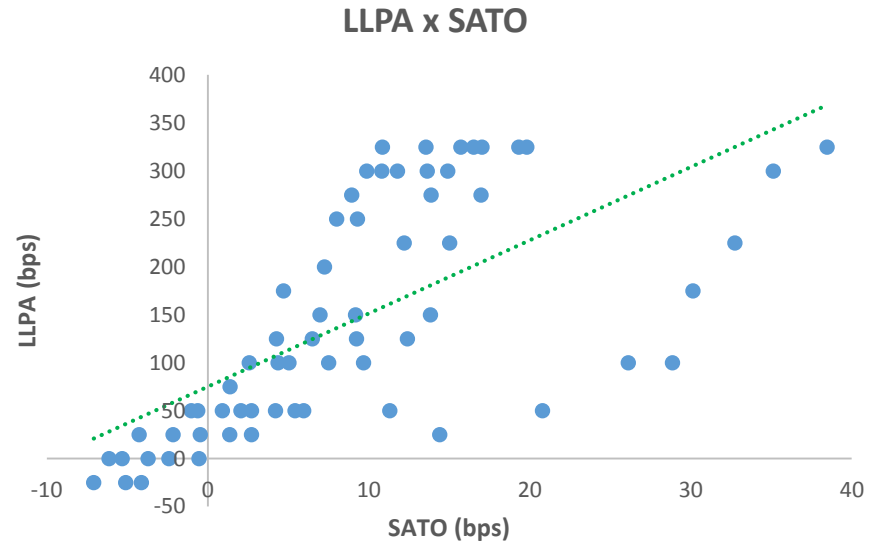
Fannie Mae Loan-Level Price Adjustment Grid								
FICO/LTV	[0-60]	(60-70]	(70-75]	(75-80]	(80-85]	(85-90]	(90-95]	(97+]
[740+]	-	25	25	50	25	25	25	75
[720-739]	-	25	50	75	50	50	50	100
[700-719]	-	50	100	125	100	100	100	150
[680-699]	-	50	125	175	150	125	125	150
[660-679]	-	100	225	275	275	225	225	225
[640-659]	50	125	275	300	325	275	275	275
[620-639]	50	150	300	300	325	325	325	350
<620	50	150	300	300	325	325	325	375



Weighted-Average Origination Rates for the 2010 Vintage								
FICO/LTV	[0-60]	(60-70]	(70-75]	(75-80]	(80-85]	(85-90]	(90-95]	(97+]
[740+]	4.87%	4.91%	4.97%	4.96%	4.97%	4.99%	5.01%	5.18%
[720-739]	4.90%	4.96%	5.02%	5.03%	5.01%	5.02%	5.03%	5.22%
[700-719]	4.91%	5.03%	5.09%	5.13%	5.08%	5.09%	5.12%	5.37%
[680-699]	4.96%	5.08%	5.21%	5.27%	5.14%	5.14%	5.19%	5.48%
[660-679]	5.01%	5.19%	5.38%	5.45%	5.29%	5.29%	5.33%	5.68%
[640-659]	5.11%	5.27%	5.52%	5.56%	5.57%	5.56%	5.61%	
[620-639]	5.16%	5.36%	5.60%	5.64%	5.58%	5.70%	5.63%	
<620	5.35%	5.49%	5.70%	5.70%	6.18%	5.66%	6.02%	



Post 2008, SATO is primarily driven by loan-level pricing, and not by “borrower intangibles” as was often the case prior to and through the crisis



Interacting Risk Attributes

Default Rate (%) by FICO/CLTV for the 2006 Vintage										
FICO/CLTV	(0-60]	(60-65]	(65-70]	(70-75]	(75-80]	(80-85]	(85-90]	(90-97]	(97+)	Total
[780+)	0.5%	1.8%	2.3%	2.5%	3.1%	3.2%	4.3%	5.1%	8.6%	2.5%
[740-780)	1.1%	3.0%	4.5%	5.0%	5.4%	6.3%	6.5%	6.3%	8.2%	4.6%
[700-740)	2.0%	4.9%	6.9%	7.6%	8.7%	8.2%	9.7%	9.6%	12.4%	7.3%
[660-700)	2.8%	6.1%	9.2%	10.5%	11.2%	12.7%	12.3%	12.7%	13.9%	9.8%
[620-660)	4.3%	8.2%	11.3%	13.0%	12.9%	14.2%	15.5%	16.8%	13.9%	11.9%
[0-620)	5.3%	10.0%	12.0%	13.3%	12.8%	15.5%	13.4%	17.7%	17.0%	11.1%
Missing	2.5%	0.0%	5.5%	3.4%	5.2%	2.8%	11.9%	20.3%	13.7%	7.4%
Total	2.0%	5.0%	7.2%	8.0%	8.0%	9.6%	9.6%	10.2%	11.5%	7.1%

Net Loss Rate (%) by FICO/CLTV for the 2006 Vintage										
FICO/CLTV	(0-60]	(60-65]	(65-70]	(70-75]	(75-80]	(80-85]	(85-90]	(90-97]	(97+)	Total
[780+)	0.2%	0.7%	1.0%	1.3%	1.5%	1.4%	1.6%	1.9%	4.9%	1.1%
[740-780)	0.4%	1.3%	2.1%	2.4%	2.7%	2.5%	2.6%	2.3%	3.5%	2.0%
[700-740)	0.8%	2.2%	3.4%	3.9%	4.4%	3.7%	3.7%	3.5%	6.0%	3.3%
[660-700)	1.1%	2.9%	4.6%	5.6%	5.9%	5.6%	4.8%	4.4%	5.9%	4.5%
[620-660)	1.8%	4.4%	5.9%	7.2%	6.9%	6.5%	6.0%	5.3%	6.2%	5.5%
[0-620)	2.4%	5.2%	6.6%	7.5%	6.8%	6.1%	4.2%	4.7%	9.2%	5.3%
Missing	1.0%	0.0%	1.4%	1.8%	2.0%	1.4%	2.9%	6.8%	9.3%	2.5%
Total	0.8%	2.4%	3.6%	4.2%	4.1%	4.2%	3.7%	3.5%	5.3%	3.2%

Crossing risk attributes can compound their effect.

Measuring Risk through Risk Layers

- A good way to measure risk without a complex model is by analyzing risk layers.
- To do this, first create binary (1/0) flags for the following risk attributes:
 - Cash-out refinances
 - Investor properties
 - Debt-to-income > 45% (or missing)
 - Single Borrower Loan
- Summing the resulting 1/0 flags yields a range from 0 to 4, enabling analysis across this additional dimension.

Measuring Risk through Risk Layers

Default Rate (%) by Origination Year															
Risk Layer	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
0	0.6%	0.5%	0.5%	0.5%	0.8%	1.5%	3.2%	4.0%	4.1%	1.4%	0.2%	0.1%	0.0%	0.0%	0.8%
1	1.2%	1.1%	0.9%	1.0%	1.4%	2.5%	5.1%	6.8%	7.0%	3.4%	0.4%	0.1%	0.1%	0.0%	1.8%
2	1.5%	1.5%	1.3%	1.4%	1.8%	3.2%	6.6%	9.2%	9.6%	5.5%	0.7%	0.2%	0.1%	0.0%	3.3%
3	2.0%	1.8%	1.6%	1.8%	2.1%	3.7%	7.2%	10.4%	11.4%	7.3%	1.1%	0.3%	0.0%	0.0%	4.8%
4	1.4%	2.1%	2.7%	3.7%	3.3%	6.6%	9.3%	13.3%	15.9%	11.7%	1.6%	0.3%	0.1%	0.0%	6.9%
Total	1.0%	0.9%	0.8%	0.9%	1.3%	2.4%	5.1%	7.1%	7.4%	3.6%	0.4%	0.1%	0.0%	0.0%	1.8%

Severity (%) by Origination Year															
Risk Layer	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
0	8.1%	11.7%	16.9%	22.1%	25.4%	29.6%	36.9%	39.4%	34.0%	23.4%	19.3%	12.7%	12.4%	10.7%	29.6%
1	13.6%	14.7%	21.2%	26.4%	29.6%	34.7%	40.8%	43.7%	37.7%	26.7%	23.3%	18.9%	13.9%	14.8%	34.3%
2	17.2%	20.6%	27.5%	33.2%	34.8%	39.2%	44.0%	47.5%	41.6%	31.9%	28.2%	28.9%	26.9%	30.1%	39.4%
3	19.8%	25.7%	39.3%	46.1%	46.0%	47.4%	48.2%	51.6%	46.5%	39.9%	30.5%	36.2%	29.6%	55.3%	45.8%
4	-0.3%	51.6%	51.6%	59.4%	68.4%	66.6%	61.0%	61.1%	54.8%	50.7%	34.8%	38.0%	28.5%		56.4%
Total	12.9%	15.9%	23.3%	29.2%	31.4%	36.4%	42.0%	45.5%	39.9%	30.4%	24.6%	20.5%	16.6%	17.2%	36.6%

Net Loss Rate (%) by Origination Year															
Risk Layer	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
0	0.1%	0.1%	0.1%	0.1%	0.2%	0.4%	1.2%	1.6%	1.4%	0.3%	0.0%	0.0%	0.0%	0.0%	0.2%
1	0.2%	0.2%	0.2%	0.3%	0.4%	0.9%	2.1%	3.0%	2.6%	0.9%	0.1%	0.0%	0.0%	0.0%	0.6%
2	0.3%	0.3%	0.4%	0.5%	0.6%	1.3%	2.9%	4.4%	4.0%	1.7%	0.2%	0.1%	0.0%	0.0%	1.3%
3	0.4%	0.5%	0.6%	0.8%	1.0%	1.7%	3.5%	5.4%	5.3%	2.9%	0.3%	0.1%	0.0%	0.0%	2.2%
4	0.0%	1.1%	1.4%	2.2%	2.2%	4.4%	5.6%	8.1%	8.7%	5.9%	0.6%	0.1%	0.0%	0.0%	3.9%
Total	0.1%	0.1%	0.2%	0.3%	0.4%	0.9%	2.2%	3.2%	3.0%	1.1%	0.1%	0.0%	0.0%	0.0%	0.7%

Estimating Credit Risk through “Comping”

- Each vintage’s performance is broken out into cohorts across three dimensions:
 - Credit Score
 - Combined LTV
 - Risk Layers

- This method results in 210 unique cohorts where risk can be measured. A sample of these cohorts are shown below.

Original UPB Percentage, for the 2007 Vintage

FICO	Risk Layer	CLTV Bucket									
		(0-60]	(60-65]	(65-70]	(70-75]	(75-80]	(80-85]	(85-90]	(90-97]	(97+)	All
[780+)	0	1.1%	0.3%	0.4%	0.5%	1.9%	0.1%	0.7%	0.5%	0.0%	5.4%
	1	1.8%	0.5%	0.7%	0.6%	2.5%	0.2%	1.0%	0.7%	0.0%	7.9%
	2	1.1%	0.3%	0.4%	0.4%	1.2%	0.1%	0.5%	0.2%	0.0%	4.2%
	3	0.3%	0.1%	0.1%	0.1%	0.2%	0.0%	0.1%	0.0%	0.0%	0.9%
	4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
[740-780)	0	0.8%	0.3%	0.4%	0.5%	2.1%	0.3%	1.1%	1.0%	0.0%	6.4%
	1	1.5%	0.5%	0.8%	0.8%	2.9%	0.3%	1.5%	1.2%	0.0%	9.5%
	2	1.0%	0.4%	0.6%	0.5%	1.7%	0.2%	0.9%	0.4%	0.0%	5.8%
	3	0.3%	0.1%	0.3%	0.2%	0.4%	0.1%	0.2%	0.0%	0.0%	1.6%
	4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%

Default Rates, by Cohort, for the 2007 Vintage

FICO	Risk Layer	CLTV Bucket									
		(0-60]	(60-65]	(65-70]	(70-75]	(75-80]	(80-85]	(85-90]	(90-97]	(97+)	All
[780+)	0	0.1%	0.3%	0.6%	0.9%	1.1%	1.7%	2.5%	2.8%	0.0%	1.1%
	1	0.3%	1.1%	1.4%	2.5%	2.7%	3.7%	4.2%	6.4%	5.6%	2.4%
	2	0.7%	1.9%	3.2%	4.4%	5.1%	9.3%	8.7%	9.5%	14.3%	4.3%
	3	1.0%	4.0%	4.1%	8.1%	8.2%	11.2%	15.2%	0.0%		5.8%
	4	1.3%	10.1%	6.6%	8.0%	16.8%	34.3%				8.6%
[740-780)	0	0.1%	0.6%	0.7%	1.2%	1.8%	2.6%	3.3%	4.8%	3.7%	2.2%
	1	0.5%	1.7%	2.7%	3.9%	4.1%	6.0%	7.3%	9.2%	15.0%	4.5%
	2	1.5%	3.5%	4.6%	7.1%	8.3%	9.9%	12.4%	13.9%	17.2%	7.4%
	3	1.6%	4.5%	7.2%	10.5%	12.4%	18.8%	18.8%	17.6%		9.5%
	4	2.2%	9.2%	9.6%	20.6%	21.8%	27.4%	96.2%			13.7%

Estimating Credit Risk through “Comping”

UPB Percentage, for 2015-C02 Group 1

FICO	Risk Layer	CLTV Bucket							Total
		(60-65]	(65-70]	(70-75]	(75-80]	(80-85]	(85-90]	(90-97]	
[780+)	0	0.6%	1.0%	1.6%	6.8%	0.1%	0.5%	0.1%	10.7%
	1	0.9%	1.5%	3.2%	8.5%	0.1%	0.4%	0.1%	14.7%
	2	0.4%	0.7%	1.8%	1.7%	0.0%	0.0%	0.0%	4.6%
	3	0.1%	0.2%	0.4%	0.1%	0.0%	0.0%	0.0%	0.7%
	4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
[740-780)	0	0.5%	0.8%	1.5%	6.8%	0.2%	1.0%	0.3%	11.1%
	1	0.7%	1.2%	2.7%	7.3%	0.2%	0.5%	0.2%	12.8%
	2	0.4%	0.8%	1.9%	2.0%	0.0%	0.0%	0.0%	5.1%
	3	0.1%	0.2%	0.4%	0.1%	0.0%	0.0%	0.0%	0.8%
	4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
[700-740)	0	0.3%	0.5%	1.0%	4.7%	0.2%	0.7%	0.3%	7.6%
	1	0.5%	0.9%	1.7%	5.9%	0.2%	0.4%	0.2%	9.7%
	2	0.3%	0.6%	1.2%	1.8%	0.1%	0.0%	0.0%	4.0%
	3	0.1%	0.2%	0.3%	0.0%	0.0%	0.0%	0.0%	0.5%
	4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
[660-700)	0	0.2%	0.4%	0.6%	2.6%	0.1%	0.2%	0.1%	4.1%
	1	0.3%	0.7%	1.1%	3.6%	0.1%	0.1%	0.1%	5.9%
	2	0.2%	0.5%	0.8%	1.1%	0.0%	0.0%	0.0%	2.6%
	3	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.3%
	4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
[620-660)	0	0.1%	0.1%	0.2%	0.9%	0.0%	0.0%	0.0%	1.3%
	1	0.2%	0.4%	0.4%	1.2%	0.0%	0.0%	0.0%	2.2%
	2	0.1%	0.2%	0.3%	0.3%	0.0%	0.0%	0.0%	0.9%
	3	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	Total	5.9%	11.1%	21.1%	55.4%	1.3%	3.9%	1.3%	100.0%

Projected Default Rate (%), for 2015-C02 Group 1, based on 2007 Vintage Experience

FICO	Risk Layer	CLTV Bucket							Total
		(60-65]	(65-70]	(70-75]	(75-80]	(80-85]	(85-90]	(90-97]	
[780+)	0	0.3%	0.6%	0.9%	1.1%	1.7%	2.5%	2.8%	1.1%
	1	1.1%	1.4%	2.5%	2.7%	3.7%	4.2%	6.4%	2.5%
	2	1.9%	3.2%	4.4%	5.1%	9.3%	8.7%	9.5%	4.3%
	3	4.0%	4.1%	8.1%	8.2%	11.2%	15.2%	0.0%	6.7%
	4	10.1%	6.6%	8.0%	16.8%	34.3%			7.6%
[740-780)	0	0.6%	0.7%	1.2%	1.8%	2.6%	3.3%	4.8%	1.8%
	1	1.7%	2.7%	3.9%	4.1%	6.0%	7.3%	9.2%	4.0%
	2	3.5%	4.6%	7.1%	8.3%	9.9%	12.4%	13.9%	7.0%
	3	4.5%	7.2%	10.5%	12.4%	18.8%	18.8%	17.6%	8.8%
	4	9.2%	9.6%	20.6%	21.8%	27.4%	96.2%		15.4%
[700-740)	0	1.3%	2.1%	3.4%	3.1%	4.7%	5.4%	7.1%	3.4%
	1	3.3%	4.0%	5.9%	6.5%	9.5%	10.4%	13.2%	6.3%
	2	4.9%	7.1%	10.5%	11.2%	12.6%	15.8%	17.1%	9.9%
	3	6.3%	10.9%	14.8%	15.6%	19.6%	20.1%	45.7%	12.7%
	4	12.7%	15.8%	23.9%	23.4%	28.2%			18.9%
[660-700)	0	1.9%	3.4%	4.2%	4.8%	9.1%	7.2%	10.3%	4.8%
	1	4.0%	4.8%	7.5%	8.8%	12.8%	13.6%	15.8%	8.0%
	2	6.6%	8.1%	11.0%	12.7%	15.2%	17.8%	21.2%	10.8%
	3	7.3%	11.8%	14.2%	17.1%	22.3%	23.2%	23.1%	12.7%
	4	12.1%	21.7%	26.2%	28.1%	32.5%			22.2%
[620-660)	0	1.8%	3.9%	6.0%	7.6%	12.2%	11.7%	14.5%	7.1%
	1	7.0%	6.9%	9.2%	10.5%	14.9%	16.3%	19.9%	9.6%
	2	7.6%	10.3%	12.4%	13.4%	19.4%	20.2%	23.6%	11.6%
	3	10.8%	12.7%	16.1%	15.6%	22.8%	25.2%	72.9%	13.9%
	4	23.0%	28.3%	31.0%	30.8%	43.3%			30.7%
Total	Total	2.6%	3.8%	5.3%	4.6%	6.5%	5.6%	8.0%	4.7%

Estimating Credit Risk through “Comping”

60-80 LTV Historical Performance Through June 2015

Orig Year	Remaining UPB	Pool Factor	Net CE Rate ¹	C-Deal Structure Loss ²	CAS 2015-C02 Equivalent Perf	
					Re-Weighted Net CE Rate	Re-Weighted Structure Loss
1999	\$0.1 B	0.9%	1.3%	0.2%	0.7%	0.1%
2000	\$0.4 B	0.5%	1.0%	0.1%	0.6%	0.1%
2001	\$2.6 B	1.2%	1.1%	0.1%	0.6%	0.1%
2002	\$6.6 B	2.9%	1.4%	0.2%	0.9%	0.1%
2003	\$23.8 B	7.7%	2.6%	0.6%	1.9%	0.3%
2004	\$13.3 B	10.4%	5.0%	1.5%	3.2%	0.8%
2005	\$18.7 B	13.6%	10.1%	3.5%	6.7%	2.2%
2006	\$14.1 B	12.3%	13.4%	4.9%	8.6%	2.9%
2007	\$18.9 B	13.6%	13.6%	5.0%	8.2%	2.8%
2008	\$17.6 B	11.1%	6.9%	2.2%	5.0%	1.5%
2009	\$62.0 B	23.8%	1.3%	0.2%	1.7%	0.2%
2010	\$66.9 B	34.6%	0.5%	0.0%	0.9%	0.1%
2011	\$65.4 B	44.2%	0.3%	0.0%	0.5%	0.0%
2012	\$189.7 B	75.6%	0.1%	0.0%	0.2%	0.0%
2013	\$171.4 B	83.8%	0.1%	0.0%	0.1%	0.0%
2014	\$34.1 B	81.0%	0.0%	0.0%	0.0%	0.0%

Actual outcomes are re-weighted based on the profile of the CAS 2015-C02 Reference Pool

Only loans with LTV between 60-80 are included. Excludes loans with CLTV > 97

¹ Net CE rate is computed as the sum of the last reported UPB for any loan that triggered a CAS credit event within 10 years of first payment date (less the UPB for those loans that were ultimately repurchased), divided by the original total UPB for each vintage

² C-Deal Loss equivalent applies the CAS 10%/20%/40% severity schedule to the Net CE Rate outcome for each vintage.

³ The CAS 2015-C02 Group 1 Equivalent Performance is computed by the re-weighting each vintage's outcome across specified cohorts to the UPB distribution of the CAS 2015-C02 Group 1 profile across the same cohorts (as specified below).

Performance Re-Weighting

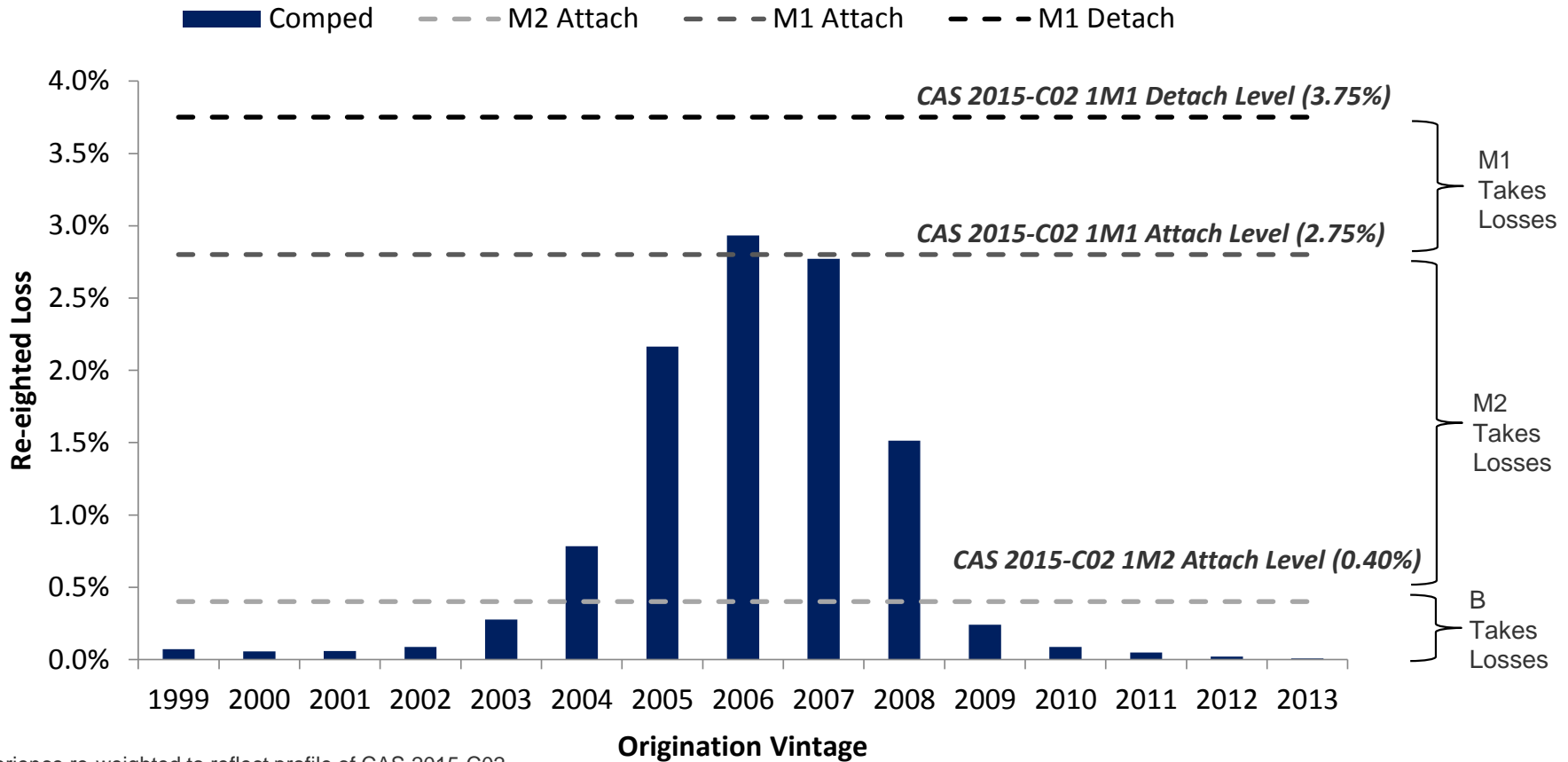
The CAS 2015-C02 Group 1 Equivalent Performance represented in this table was computed using a simple methodology to project each historical vintage's performance onto the CAS 2015-C02 Group 1 acquisition book's credit profile

This methodology employs two steps:

1. Each vintage's performance is broken out into cohorts across three dimensions: FICO, CLTV, and “# of Additional Risk Layers”
2. The target profile's equivalent performance is then computed as the sum-product of the historical cohort outcomes and the representation of UPBs across the same cohorts for the target population

Estimating Credit Risk through “Comping”

Comped Loss Experience Group 1



Loss experience re-weighted to reflect profile of CAS 2015-C02 reference pool. See prior page for methodology.

Source: Fannie Mae Historical Data Release (June 2015 Update)

Marking an LTV to Market

- Next up → how to mark a loan's OLTV or CLTV to market using a home price index.
- A marked-to-market Loan-to-Value (LTV) provides a more accurate representation of a loan's credit risk than Original LTV.
- The process involves updating loan balance and home price inputs to create a new LTV that reflects amortization and home price change to-date.

Marking an LTV to Market

- The MTM process requires a home price index to account for changes in property value.
- For this exercise, FHFA's recently published 3-Digit-Zip Home Price Index (HPI) aligns well with the 3-digit ZIP Code included in Fannie Mae's dataset:

Link to Excel file:

http://www.fhfa.gov/DataTools/Downloads/Documents/HPI/HPI_AT_3zip.xlsx

Key Formulas:

1. **HPI Factor:** *Current HPI / HPI at Loan Origination*
2. **Current Property Value:** *ORIG_VAL * HPI Factor*
3. **MTM LTV:** *Current UPB / Current Property Value*

Marking an LTV to Market

- Marking-to-market the LTVs of the 2007 vintage illustrates the impact of home price prices on loan performance.

2007 Origination - MTM LTV at Liquidation

Status	OLTV	MLTV
Current	74%	78%
Foreclosed	80%	109%
Prepaid	72%	80%
Other Default	80%	116%

- From the 2007 origination vintage, default outcomes were largely the result of borrowers being underwater on their mortgages.

Conclusion

Main concepts presented in Tutorial 102:

- Analyzing **default**, **severity**, and **loss rates** across key dimensions:
 - Categorical risk:** Occupancy, Purpose, and Number of Borrowers
 - Continuous risk:** OCLTV, FICO, DTI
- “Comping analysis” and the process of applying historical experience to estimate the performance of new loan pools
- Marking a loan’s LTV ratio to market using home price index

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If there was anything in this webinar that you would like to discuss one-on-one, please feel free to reach out to any of the above contacts.

Appendix

Downloading CAS Pool Tapes

The screenshot shows the FannieMae website navigation. On the left sidebar, 'Transactions' is circled with a '2'. In the main content area, 'News' is circled with a '1', and a specific news item 'Fannie Mae to Enhance Connecticut Avenue Securities Listed on the C-Deals Transaction Page' is circled with a '3'. Below this, 'CAS Series 2015-C03' is circled with a '3', and 'At-Issuance Data *' and 'Ongoing (Monthly) Data *' are circled with a '3'. A '4' is circled in the bottom right, pointing to the CTSLink.com interface. The CTSLink.com interface shows a search for 'CAS 2015' and a table of documents with a 'Zip Download' button.

Document Name	Format(s) ?	Current Cycle	Next Cycle	Next Available	History ?
CAS Series 2015-C02 Payment Date Statement	Please Sign In	06/25/2015	07/27/2015	07/27/2015 10:00AM EDT	Additional History
CAS Series 2015-C02 Monthly Reference Pool File Group 1	Please Sign In	06/25/2015	07/27/2015	07/27/2015 10:00AM EDT	Additional History
CAS Series 2015-C02 Monthly Reference Pool File Group 2	Please Sign In	06/25/2015	07/27/2015	07/27/2015 10:00AM EDT	Additional History

CAS reference pool files available through www.ctslink.com, with CAS series number, or connect directly via www.fanniemae.com (note: login required for either method)