

# Re-default Risk of Modified Mortgages

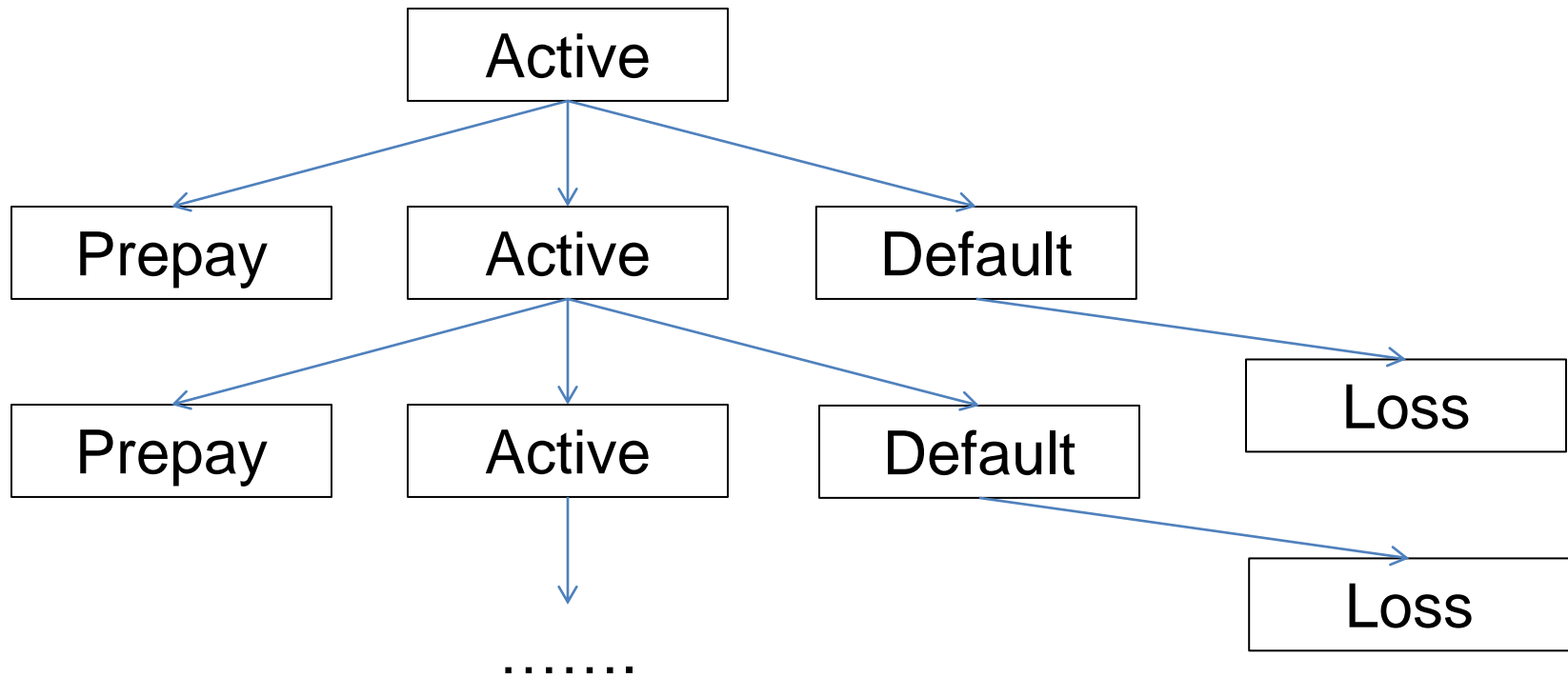
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May 2014

# Mortgage Risk Analysis Framework

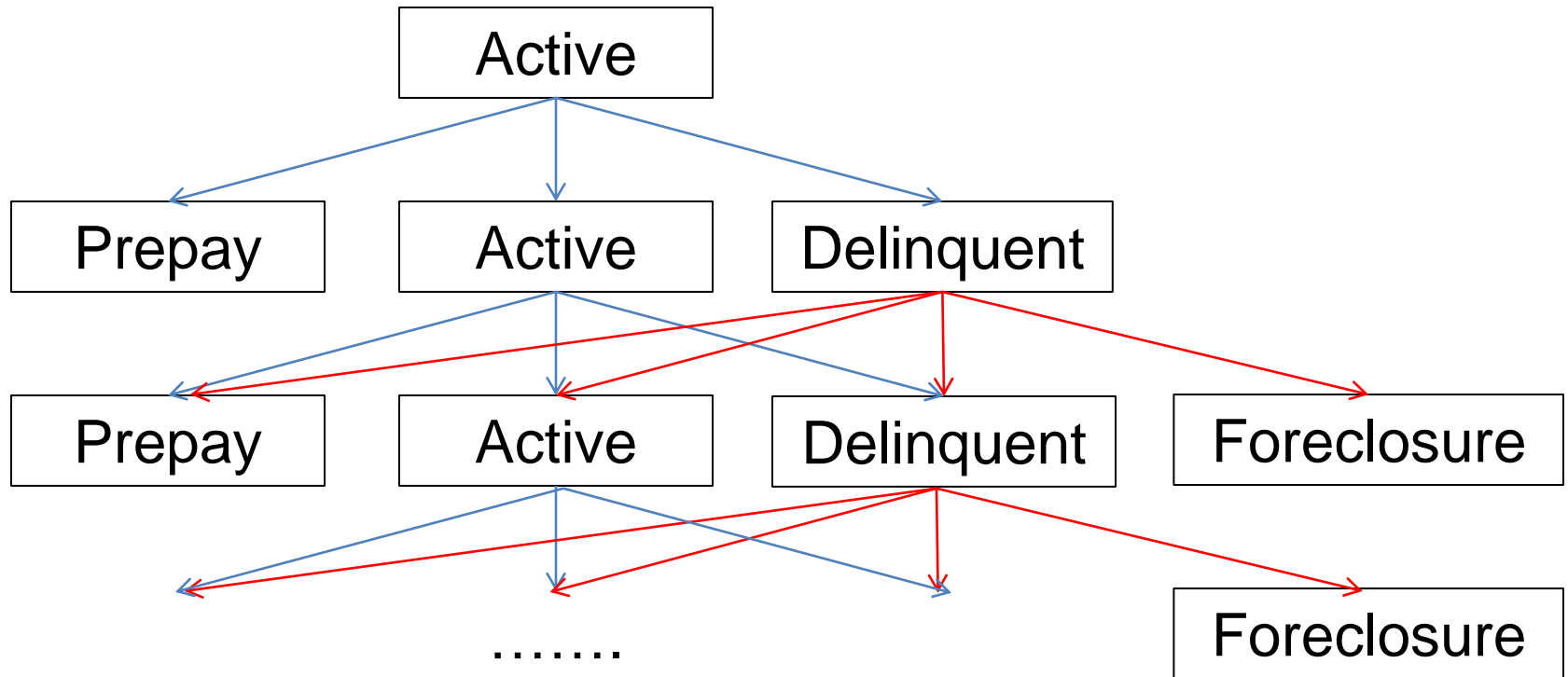
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► Competing risk approach

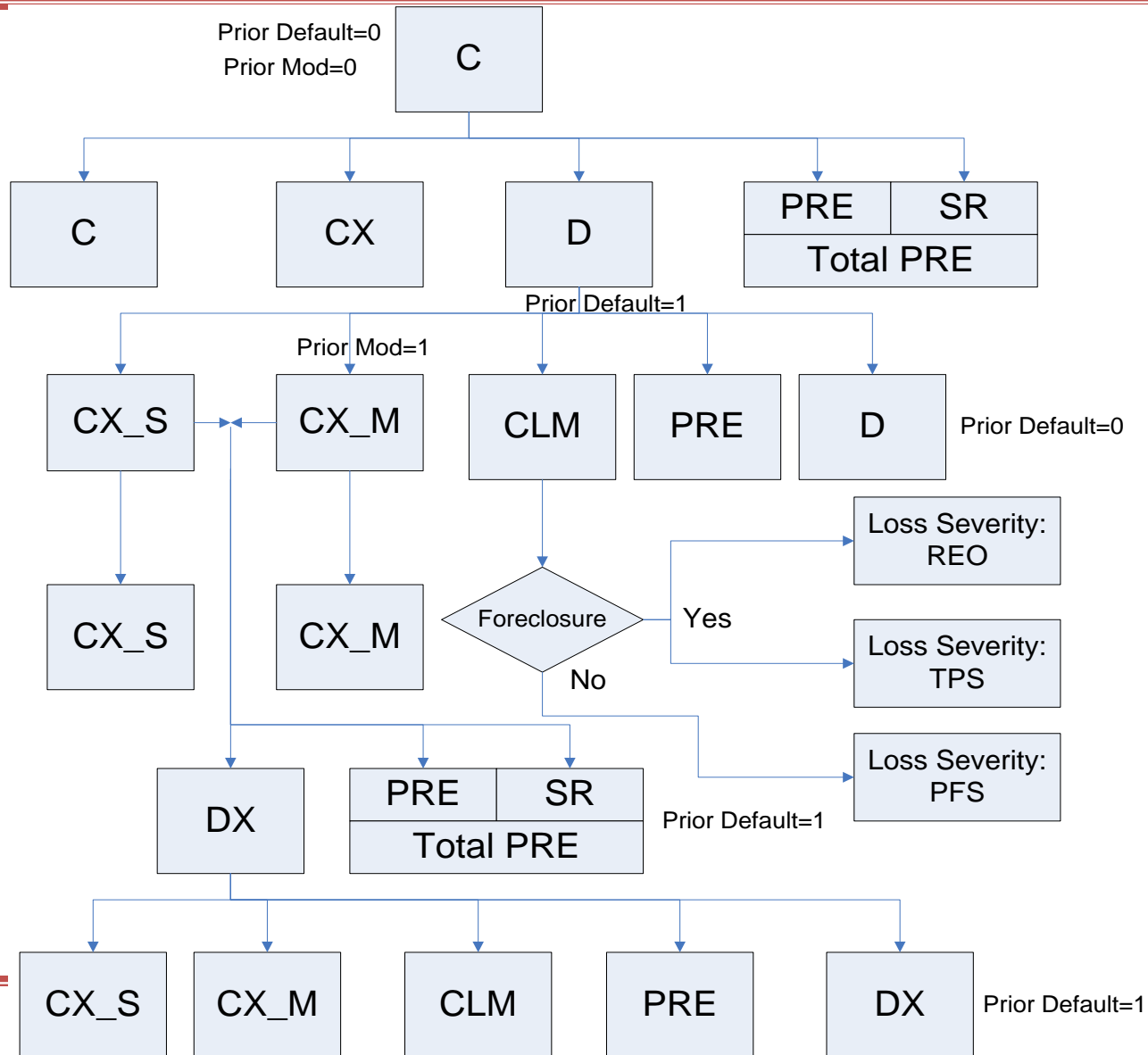


# Status Transition Approach

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# Incorporate Path Memory



# Data

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- ▶ FHA loans originated between 1996-2012
- ▶ Quarterly loan performance panel observations
  - ▶ Avoided sensor problem
  - ▶ Incorporate local market economic condition
  - ▶ Capture prior modification and cure history
- ▶ Two sets of multinomial logistic regression
  - ▶ C\_D, C\_CX, C\_PRE, C\_SR, C\_C
  - ▶ D\_CXS, D\_CXM, D\_PRE, D\_CLM, D\_D

# Choice Based Sample

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- ▶ 10% of good loans; 100% of bad loans
- ▶ 10% of quarters before ever-default; 100% of quarters after 1<sup>st</sup> default.

	Sample Observations	Total Original Observations	Sample Rate
C to C	20,024,231	158,984,465	13%
C to CX	186,815	186,815	100%
C to D	2,550,952	2,586,844	99%
C to PRE	584,758	3,756,763	16%
C to SR	201,556	1,741,915	12%
D to PRE	159,939	159,939	100%
D to CLM	658,541	694,433	95%
D to CX_M	324,789	324,789	100%
D to CX_S	747,035	747,035	100%
<b>Total</b>	<b>25,438,616</b>	<b>169,182,998</b>	<b>15%</b>

# Modification as Loss Mitigation

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- ▶ As an alternative way to enable refinance
  - ▶ Otherwise constrained by LTV or DTI to qualify for refinance loan
  - ▶ To avoid realizing default loss on book
  - ▶ Hope house price recovery will bailout default loss
- ▶ Policy objectives
  - ▶ Help borrowers keep their homes
  - ▶ Avoid massive default wave bring banking system down
  - ▶ Reduce number of REO sales on market, which could exacerbate housing market deterioration

# Research Issues with Modification

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- ▶ Which loans benefits from modification the most?
  - ▶ To minimize potential default loss = eventual PD x LGD
- ▶ What type of modifications to offer?
  - ▶ Forbearance, Rate Reduction, Term extension, Principal forgiveness
- ▶ **What's the re-default risk of modified mortgages?**
  - ▶ OCC reports 5-year re-default rate  $\approx 70\%$
  - ▶ What are the main risk drivers after modification
- ▶ What's the LGD of modified mortgages?
  - ▶ Higher LGD due to more deterioration in physical condition and longer expenses



# Current to Delinquent Transition (PD)

Variable	Name	Values	current_default	
Number of living units	liv_units_34	X=0/1		0.0789
Downpayment assistant types	dpa_govt	X=0/1		0.1726
	dpa_nonprof	X=0/1		0.3402
	dpa_relative	X=0/1		0.1097
Relative loan size	loansize	linear function		0.0007
LTV	ltv100	X=0/1		-0.0290
	ltv95	X=0/1		0.0720
Spread at origination	sato1	Spline function	0	-0.0596
	sato2		>0	0.3891
Credit score	credit_score1	Spline function	600	-0.0025
	credit_score2		660	-0.0094
	credit_score3		>660	-0.0128
Missing credit score	credit_score_000	X=0/1		-0.1338
No credit score returned	credit_score_999	X=0/1		-0.6088
FHA credit score indicator	fha_score	X=0/1		-0.1757
Front-end Ratio	ratio_tmp_tei1	Spline function	28	0.0296
	ratio_tmp_tei2		>28	0.0095
Missing front-end ratio	dti000	X=0/1		-0.0691

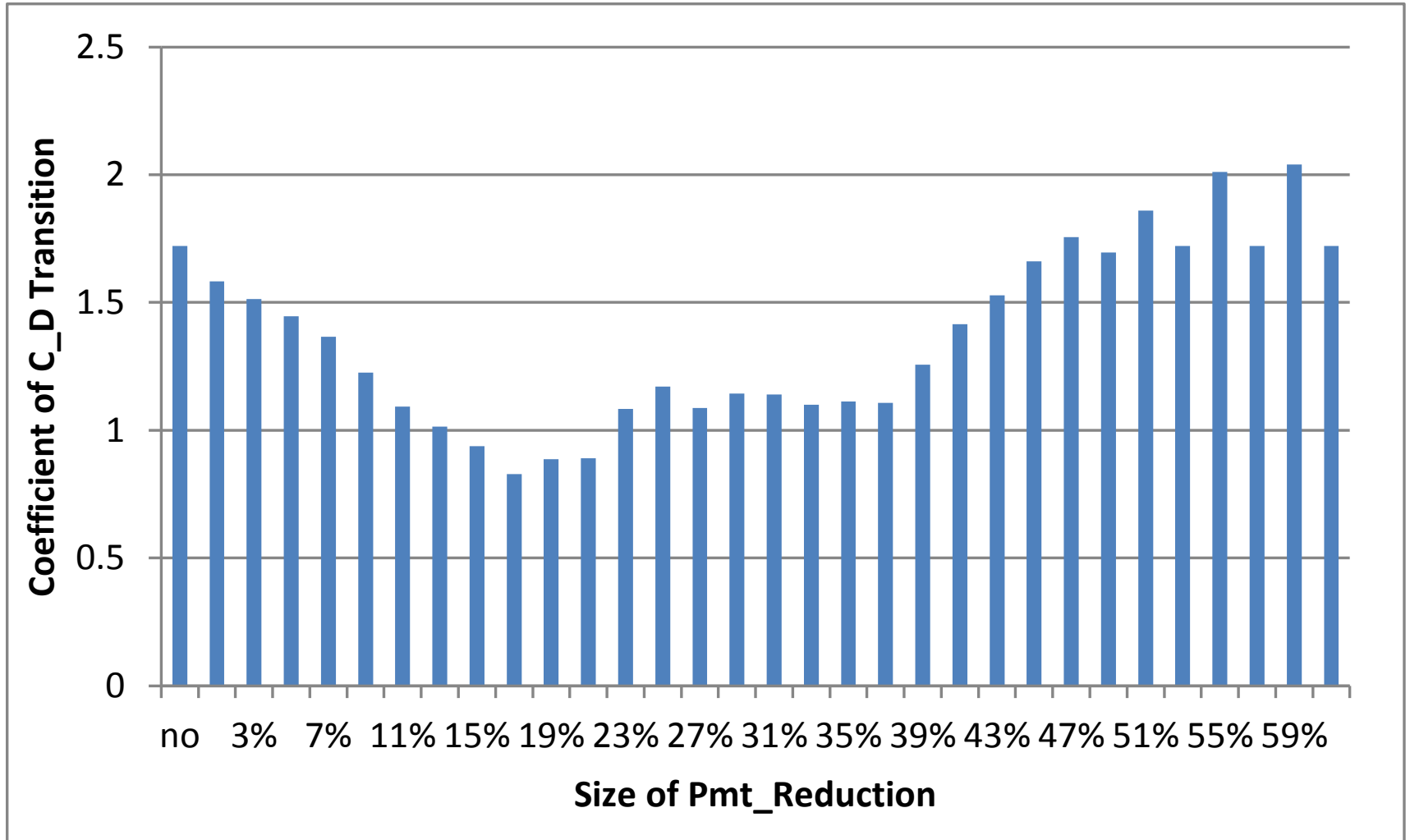
# Dynamic Variables

Variable	Name	Values	current_default	
Current LTV	<b>ltv_current1</b>	Spline function	1	1.3791
	<b>ltv_current2</b>		1.2	0.8968
	<b>ltv_current3</b>		1.4	1.4451
	<b>ltv_current4</b>		>1.4	0.0000
House price appreciation local level	<b>hpa2y_n</b>	linear function		-0.0128
Burnout factor. Prior cumulative number of quarters prepayment option in the	<b>burnout1</b>	Spline function	9	0.0007
	<b>burnout2</b>		>9	-0.0015
Cumulative number of quarters under water	<b>c_burnout1</b>	Spline function	6	0.0077
	<b>c_burnout2</b>		>6	-0.0252
Unemployment rate change in last two quarters	<b>delta_ue1</b>	Spline function	0	0.1183
	<b>delta_ue2</b>		>0	0.1771
Difference of 10 year and 1 year CMT rates	<b>ycslope</b>	linear function		0.0280
Effective GSE refinance interest rate	<b>GSE_refi_ince_PMT1</b>	Spline function	0	0.0082
	<b>GSE_refi_ince_PMT2</b>		25	0.0234
	<b>GSE_refi_ince_PMT3</b>		>25	-0.0317

# Modification Variables

Variable	Name	Values	current_default	
Prior loan modification	<b>prior_mod</b>	X=0/1		0.1446
Percentage monthly payment reduction of loan modification	<b>mod_pay_pct_rdct1</b>	Spline function	0.16	-5.7670
	<b>mod_pay_pct_rdct2</b>		0.36	3.1272
	<b>mod_pay_pct_rdct3</b>		>0.36	1.8231
Missing payment reduction	<b>mis_mod_pay_pct_rdct</b>	X=0/1		-0.1508
Mortgage age function	<b>age1</b>	Spline function	2	1.4014
	<b>age2</b>		5	0.1524
	<b>age3</b>		>5	-0.0030
Number of quarters since end of last default episode	<b>cx_time1</b>	Spline function	1	2.2639
	<b>cx_time2</b>		10	-0.1108
	<b>cx_time3</b>		25	-0.0286
	<b>cx_time4</b>		>25	-0.0041
Season of year	<b>season_fall</b>	X=0/1		0.3024
	<b>season_spring</b>	X=0/1		-0.0726
	<b>season_summer</b>	X=0/1		0.1606
Intercept Term	<b>constant</b>			-7.9545

# Payment Reduction Dummy Variables



# Implications

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- ▶ If house price growth = 0 for the next x years, the percent of re-default rate of modified loans would be

Quarterly	1-Year	2-Year	5-Year	10-Year
5%	18.5%	33.7%	64.2%	87.1%
10%	34.4%	57.0%	87.8%	98.5%
15%	47.8%	72.8%	96.1%	99.8%
20%	59.0%	83.2%	98.8%	100.0%
25%	68.4%	90.0%	99.7%	100.0%

- ▶ Optimal size of payment reduction is about 15-20%. Further reduction leads to increase in re-default risk

# Implications

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- ▶ A modified loan with no payment reduction has re-default risk similar to a never defaulted loan with 200 points lower FICO score
- ▶ Modification of 18% payment reduction reduces re-default rate similar to the magnitude of 100 points higher FICO score
- ▶ Competing risk: re-default risk increases when refinance option is deep in the money
- ▶ Credit burnout: re-default risk decreases when continue payment through a period of underwater

# Further Questions

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- ▶ Why does higher payment reduction increase re-default risk?
  - ▶ Implication of income shock to the family; harder to recover drastic income reduction
  - ▶ Rate reduction to below market rate implies borrower cannot afford the house
- ▶ LGD of modified loan
  - ▶ Correlation between payment reduction and LGD?
  - ▶ Does increase in LGD in modified loan offset the reduction in eventual PD?
- ▶ Is modification a good loss mitigation policy? In a rising interest rate environment?