

Flawed Models or Misused Models

The Role of Modeling in the Mortgage Meltdown



Basic Modeling Tenets

- Use it Appropriately
- Validate It Properly
- Stress It
- Understand it and Explain it
- Simplify It

Structure of Practical Mortgage Modeling

- A environment (E_i) that represents the exogenous variables to the mortgage/mortgage holder
- An nth order inhomogeneous Markov chains (X_n) which describes the monthly evolution of the borrower's mortgage status on the state space S.
- A cash flow vector (CF_n) that represents the payment cash flows from each path of the Markov Chains

Exogenous Environment

- A sequence of monthly projections to allow valuation, stress testing and analysis.

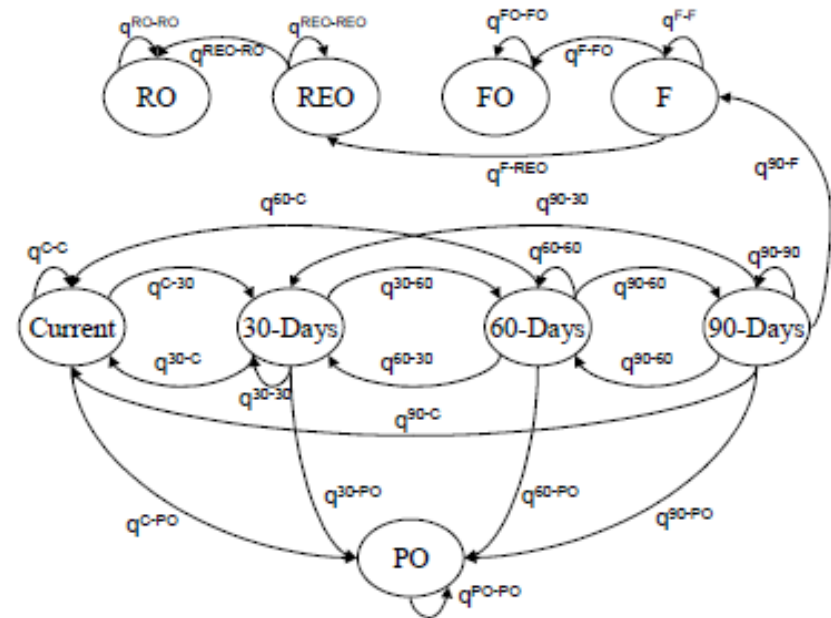
Exogenous Variables	Credit/Prepayment
Interest Rate Levels. Volatility, Slope, Skew	Prepayment/Credit
House Price Appreciation	Credit /Prepayment
Unemployment	Credit/Prepayment
Inflation/Divorce Rate	Credit/Prepayment

State Space

- Choice of State Space based upon collateral type and use:



State Space A: Three States, Two terminating



State Space B: Form Loan Performance Technical Paper: 9 states, 2 terminating

Transition Probabilities

Combinations of Environmental variables (interest rates, HPI) and borrower variables (FICO, LTV, etc.)

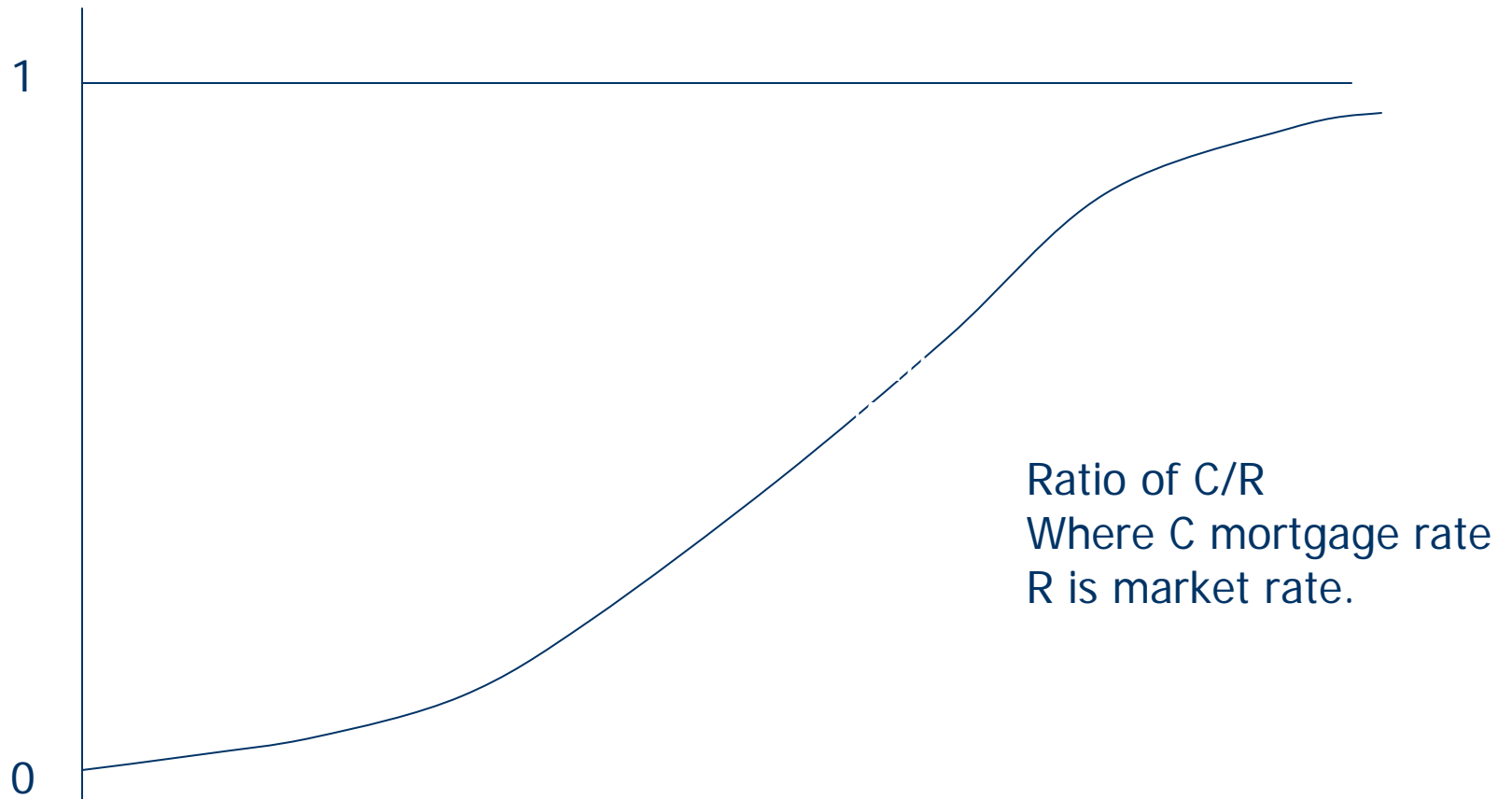
- Historical Roll Rates – Still Very Common
- Single Logistic Regressions
- Multinomial Logit Models:
 - $CP_{i,t} = \exp(x(i, t)' \beta_p) / A$ and
 - $CD_{i,t} = \exp(x(i, t)' \beta_d) / A$
 - where $A = 1 + \exp(x(i, t)' \beta_p) + \exp(x(i, t)' \beta_d)$
 - $x(i,t)$ independent variables: age, seasonality, refi function, FICO score
- Custom Functions

Prepayment

- $P(X_{n+1}=\text{Prepayment} \mid X_n = \text{Current, etc}) = \text{SMM}_i$
- $\text{SMM}_i = \text{Refinancing Activity} + \text{Housing Turnover}$
 - Refinancing Activity usually consists of
 - Refinancing incentive
 - Seasoning
 - Seasonality
 - Burnout
 - Media Effect

$$\text{Refinancing Activity} = \text{burnout} * \text{seasoning}_i * \text{seasonality}_t * \text{refi}_{n,t} * \text{Media Effect}$$

Refinance: S Curve



OTS Prepayment Structures

$$\text{Seasonality}_i = 1 + 0.200 * \sin \left\{ 1.571 * \left[\frac{(\text{month} + t - 3)}{3} \right] - 1 \right\}$$

$$\text{Seasoning}_i = \max(i * .0333, 1)$$

$$\text{refi}_{n,t} = 0.2406 - 0.1389 * \arctan \left[5.952 * \left(1.089 - \frac{C}{m_{n,t}} \right) \right]$$

Media

Sensitivities:

Sensitivity	Description	Industry Grade
df/dhp	Sensitivity of Foreclosures to House Prices	B
dp/dt	Evolution of House Prices over time	D
dp/dl	Sensitivity of Prepayments to Interest Rates	B
df/dp	Sensitivity of Foreclosures to Prepayments	E
dhp/df	Sensitivity of House Prices To Foreclosures	Unknown
dU/dt	Evolution of Unemployment Over Time	Unknown
df/dU	Sensitivity of Foreclosures to Unemployment	Unknown

Five Model Qualities

- Correct Usage:
 - Payment Option ARMs:
- Validate It Properly:
- Stress It
- Understand it:
- Simplify It: