



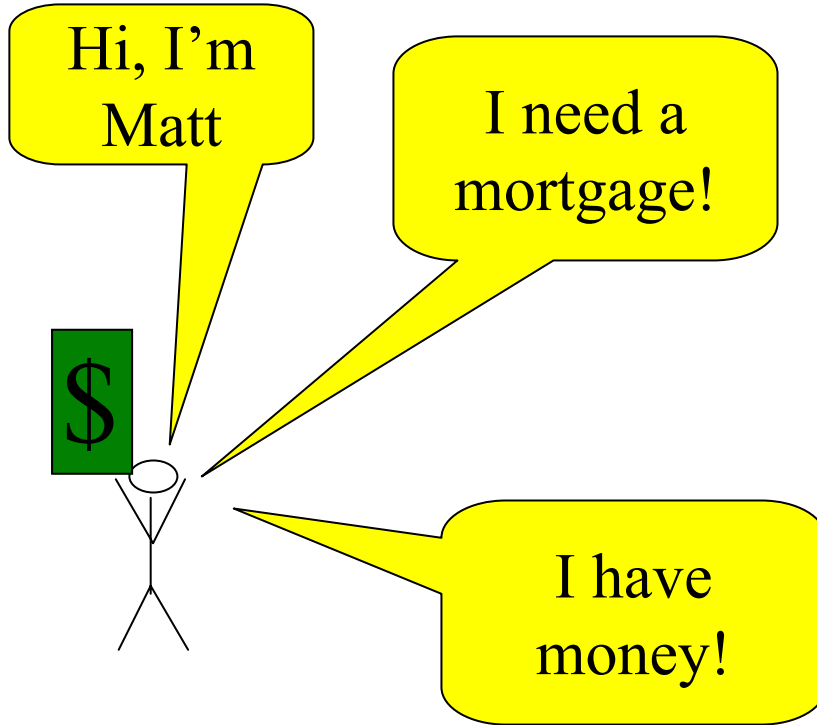
Mortgage-Backed Securities

Jay Webb

Managing Director, Information Technology
UBS Investment Bank

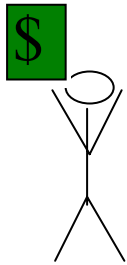


Mortgage Origination





Mortgage Origination



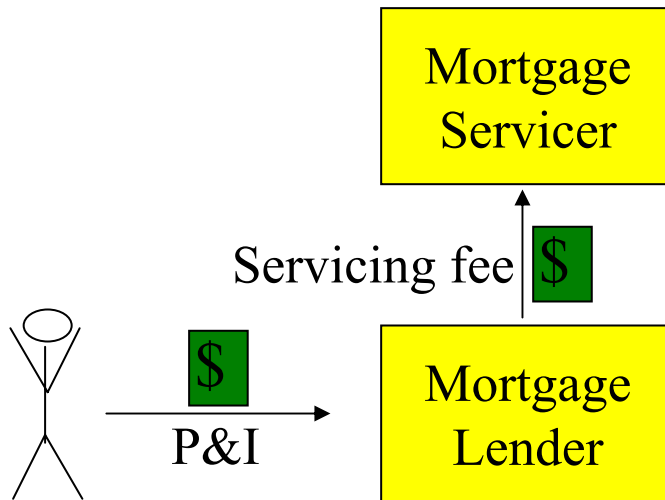
I need a mortgage!

Mortgage Lender

- Applies underwriting standards
 - PTI Ratio
 - LTV Ratio
 - Credit Score
- Lender will take piece of Matt's hide



Mortgage Cash Flows

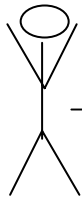


- All loans must be serviced
 - Payment notices
 - Overdue notices
 - Maintaining principal balances
 - Administering escrow account
 - Initiating foreclosure proceedings
 - Furnishing tax information



Mortgage Cash Flows – Scenario 1

- \$100,000 Loan, 8% 30-year



Month	P & I	I	P	Balance
1	733.76	666.67	67.10	99932.90
2	733.76	666.22	67.55	99865.36
3	733.76	665.77	68.00	99797.36
4	733.76	665.32	68.45	99728.91
5	733.76	664.86	68.91	99660.01
6	733.76	664.40	69.36	99590.64
7	733.76	663.94	69.83	99520.82
8	733.76	663.47	70.29	99450.52
9	733.76	663.00	70.76	99379.76
10	733.76	662.53	71.23	99308.53
11	733.76	662.06	71.71	99236.82
12	733.76	661.58	72.19	99164.64
...

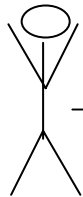


Mortgage Lender



Mortgage Cash Flows – Scenario 2

- 100,000 Loan, 8% 30-year



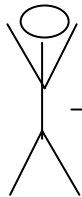
Month	P & I	I	P	Balance
1	733.76	666.67	67.10	99932.90
2	733.76	666.22	67.55	99865.36
3	733.76	665.77	68.00	99797.36
4	733.76	665.32	68.45	99728.91
5	1467.53	664.86	802.67	98926.24
6	733.76	659.51	74.26	98851.99
7	733.76	659.01	74.75	98777.24
8	733.76	658.51	75.25	98701.99
9	733.76	658.01	75.75	98626.23
10	733.76	657.51	76.26	98549.98
11	733.76	657.00	76.76	98473.21
12	733.76	656.49	77.28	98395.94
...

Mortgage
Lender



Mortgage Cash Flows – Scenario 3

- 100,000 Loan, 8% 30-year



Month	P & I	I	P	Balance
1	733.76	666.67	67.10	99932.90
2	733.76	666.22	67.55	99865.36
3	733.76	665.77	68.00	99797.36
4	733.76	665.32	68.45	99728.91
5	100393.77	664.86	99728.91	0.00
6	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00

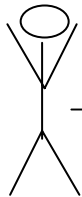


Mortgage Lender



Mortgage Cash Flows – Scenario 4

- 100,000 Loan, 8% 30-year



Month	P & I	I	P	Balance
1	733.76	666.67	67.10	99932.90
2	733.76	666.22	67.55	99865.36
3	733.76	665.77	68.00	99797.36
4	733.76	665.32	68.45	99728.91
5	0.00	0.00	0.00	100393.77
6	0.00	0.00	0.00	101063.06
7	0.00	0.00	0.00	101736.82
8	0.00	0.00	0.00	102415.06
9	0.00	0.00	0.00	103097.83
10	0.00	0.00	0.00	103785.15
11	0.00	0.00	0.00	104477.05
12	0.00	0.00	0.00	105173.56
...

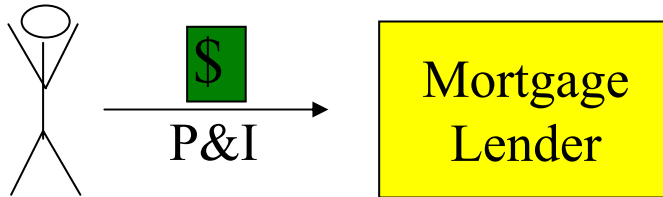


Mortgage Lender



Risks to Lender

- Lender has committed capital
- Loan is secured by property (and perhaps mortgage insurance)
- Rate of interest is higher than “risk-free” investments
- What can happen?
 - Prepayment – borrower generally (but not always) has the right to prepay the loan
 - Partial prepay
 - Relocation
 - Refinance
 - Divorce
 - “Trade up”
 - Default – although loan is secured, there is still risk to the lender (unless loan is insured)
 - Falling property value
 - Loan structure (GPM’s)
 - Both risks are enhanced if lender has regional bias



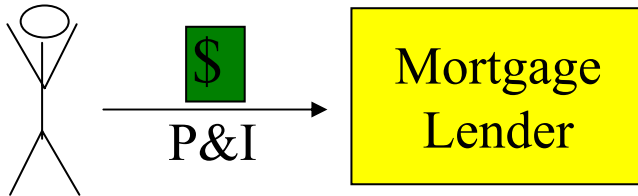
Prepayments (and defaults) shorten the length of the loan – lender is not certain about timing of principal repayment



Lender Options

Hold the loan

- Keep as a long-term investment
- Hold for a short time and sell later

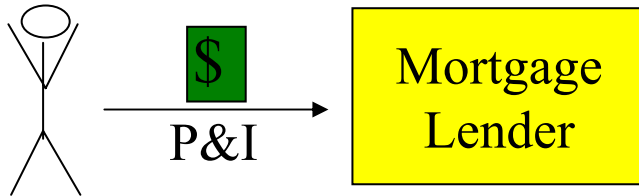




Lender Options

Securitize the loan

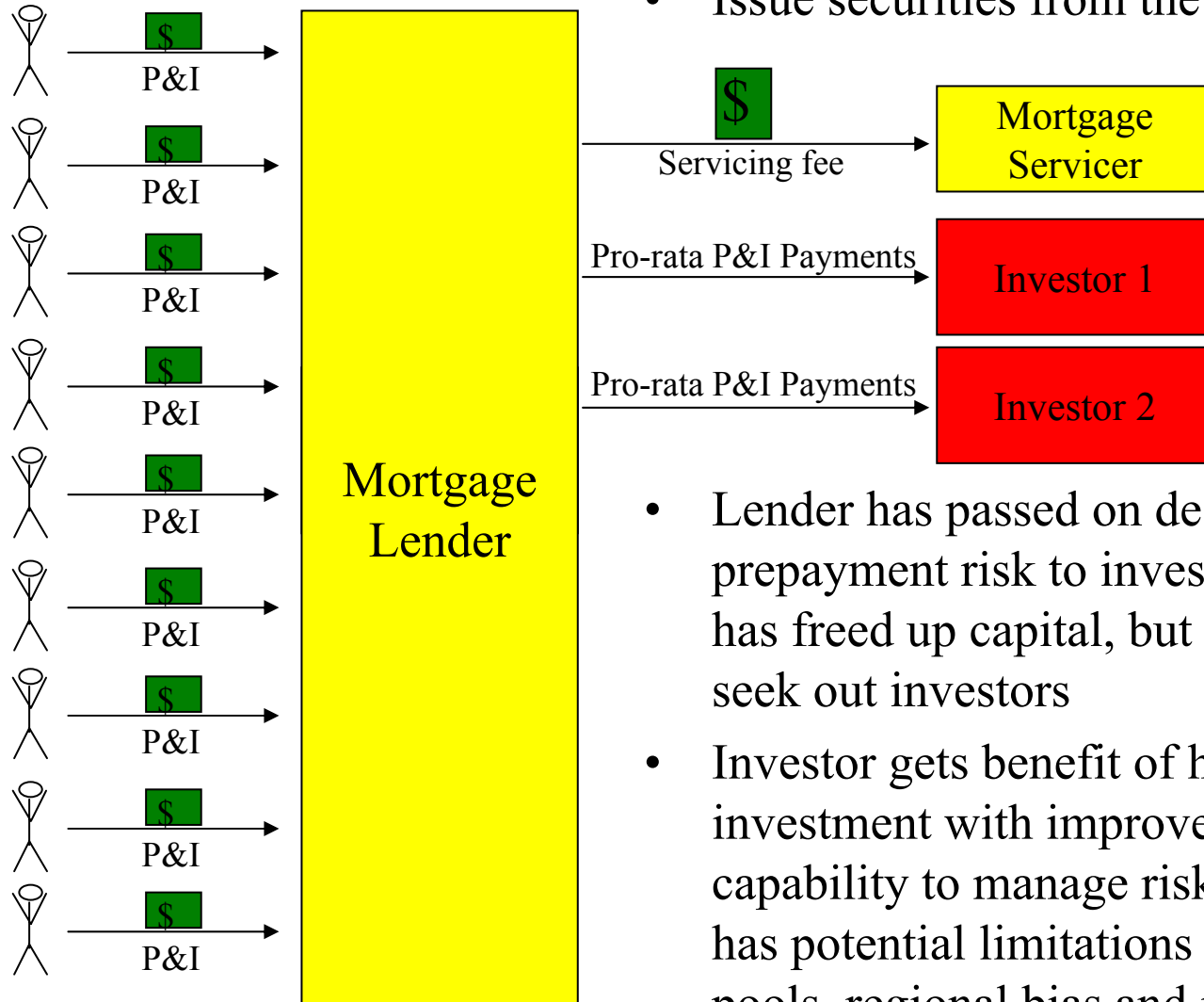
- Pool a set of mortgages
- Issue securities from the pool





Lender Options

Securitize the loan



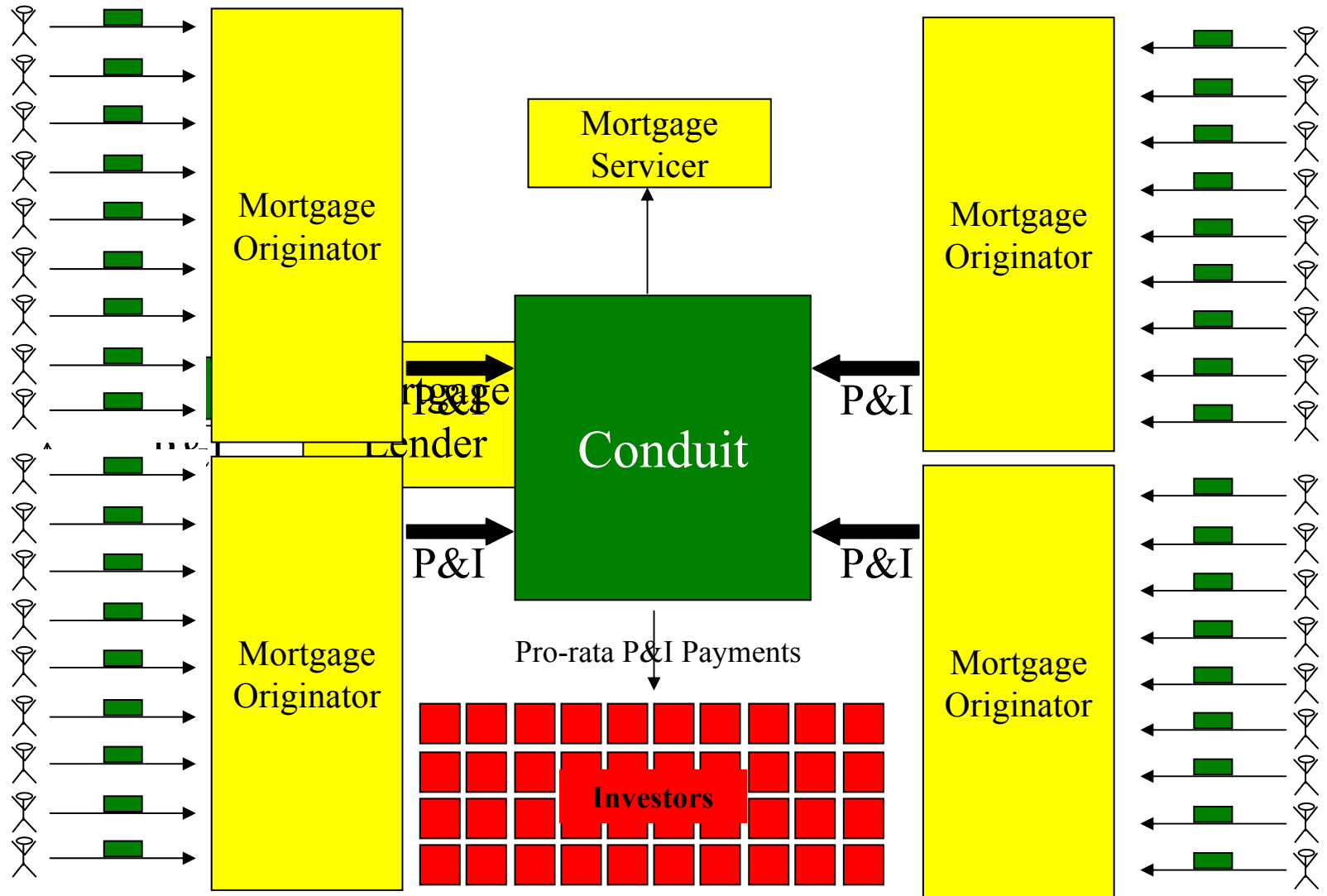
- Pool a set of mortgages
- Issue securities from the pool

- Lender has passed on default and prepayment risk to investors and has freed up capital, but has had to seek out investors
- Investor gets benefit of higher yield investment with improved capability to manage risk, but still has potential limitations of small pools, regional bias and illiquidity



Lender Options

Sell the loan to a conduit





Conduits

- There are 3 agencies – FNMA, FHLMC, GNMA – and a handful of private companies that act as conduits
- GNMA issues the first “pass-through” security in 1970
- MBS issued by private companies are rated securities
- Lenders will typically apply the underwriting standards of an intended take-out investor to ensure that a loan can be sold. Loans that conform to the underwriting standards of FNMA and FHLMC are called “conforming” loans
- Private conduits will purchase both conforming and non-conforming loans



Agency Pass-Through Securities

- Agency pass-through MBS have an explicit (GNMA) or implicit (FNMA) credit guarantee. There is no default risk to the investor – defaults are just like prepayments
- Agency pools can be VERY large – less regional sensitivity
- Agency pools have reasonably low variation in WAM and WAC
- The large pool size and similar loan characteristics allow for statistical study of borrower behavior and, therefore, more accurate risk assessment

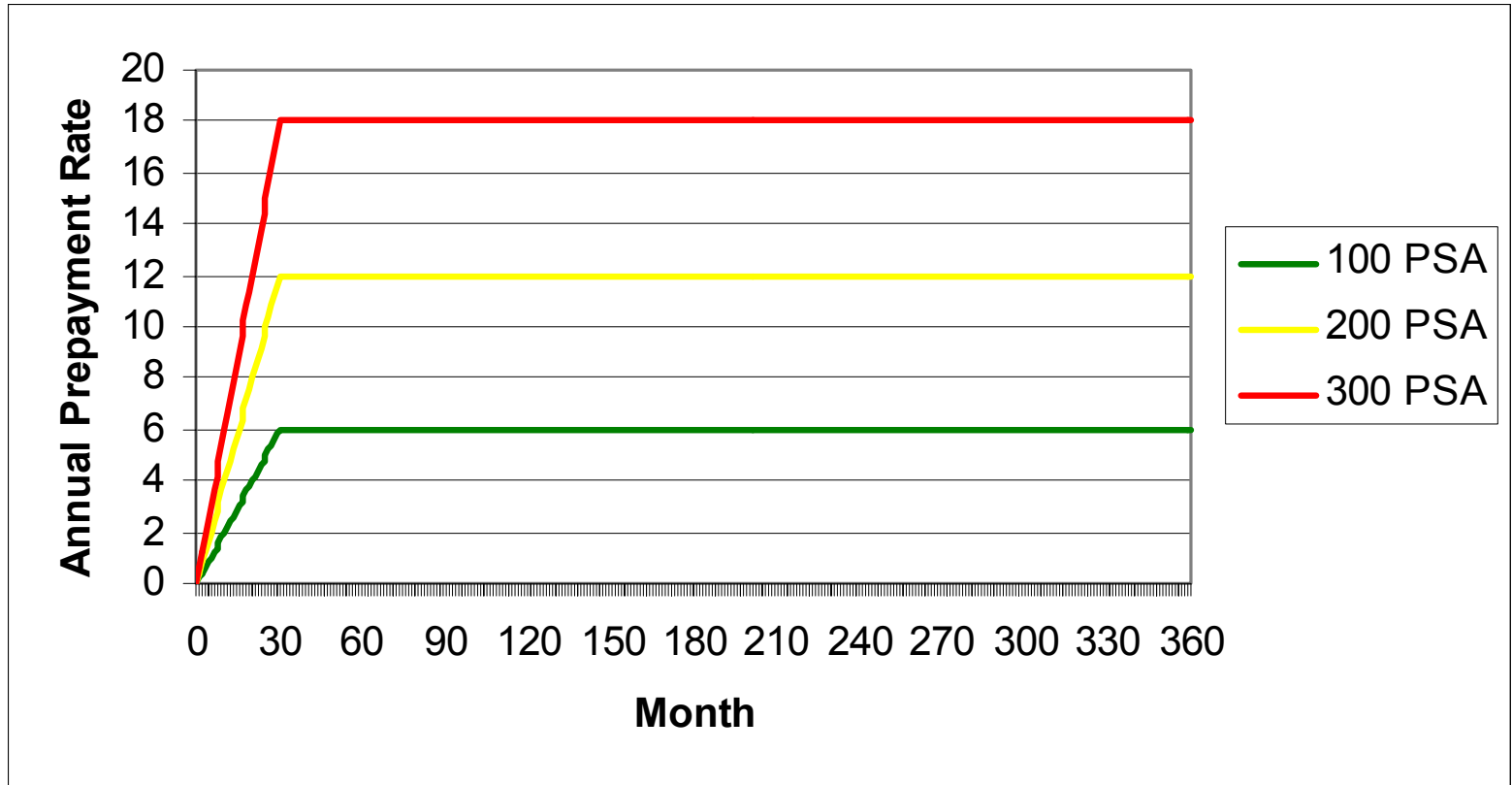


Modeling of Prepayments

- Prepayment modeling is a crucial aspect of valuing Mortgage-Backed Securities and their derivatives
- Refinancing, clearly, is strongly correlated with interest rates
- “Trading up” also increases when interest rates are low
- Prepayments due to housing turnover have strong seasonal characteristics



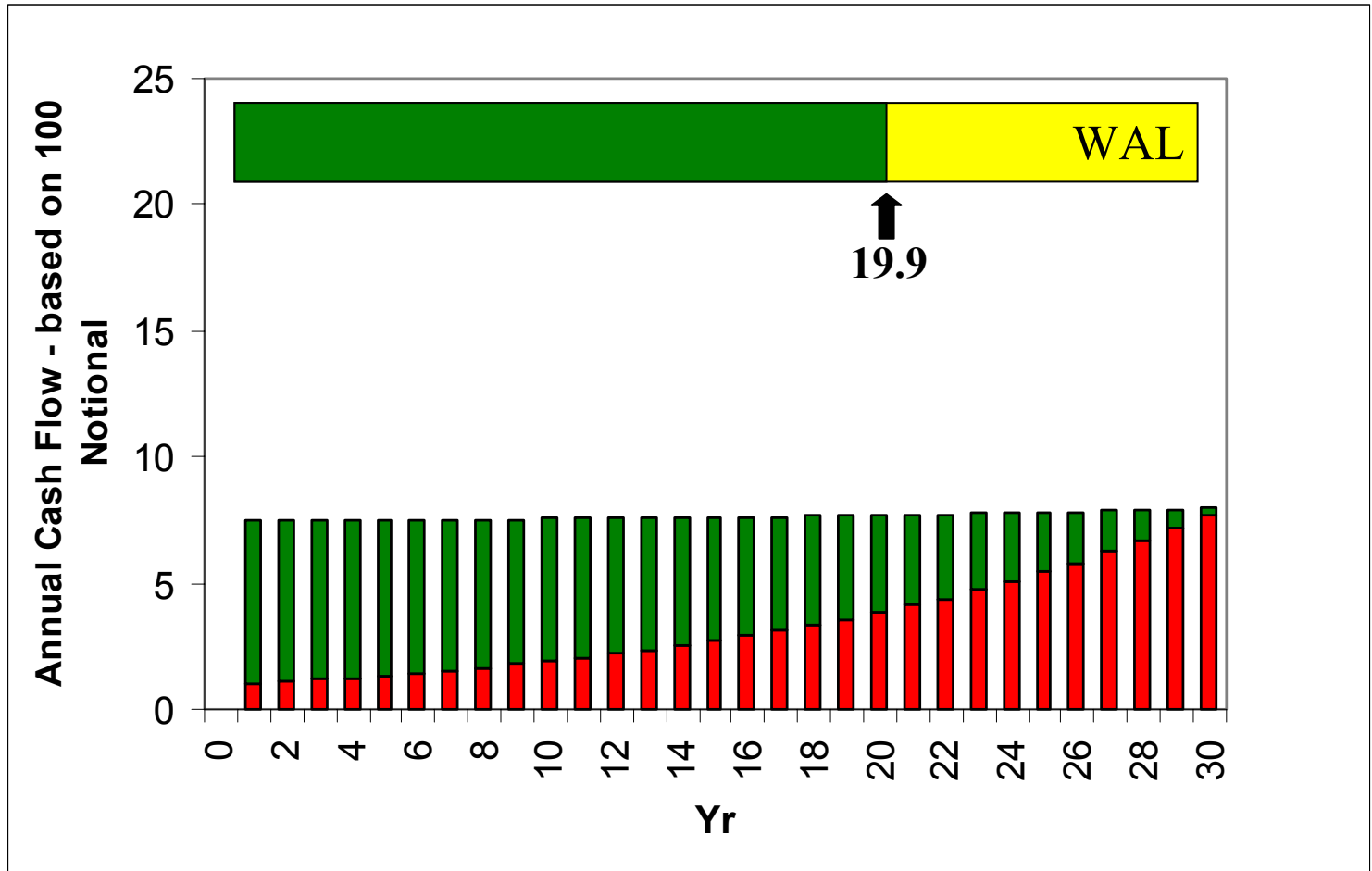
The PSA Model (Industry Standard)



100% PSA - Linear increase from from month 1 to month 30 to a plateau of 6% Annual Prepayment Rate



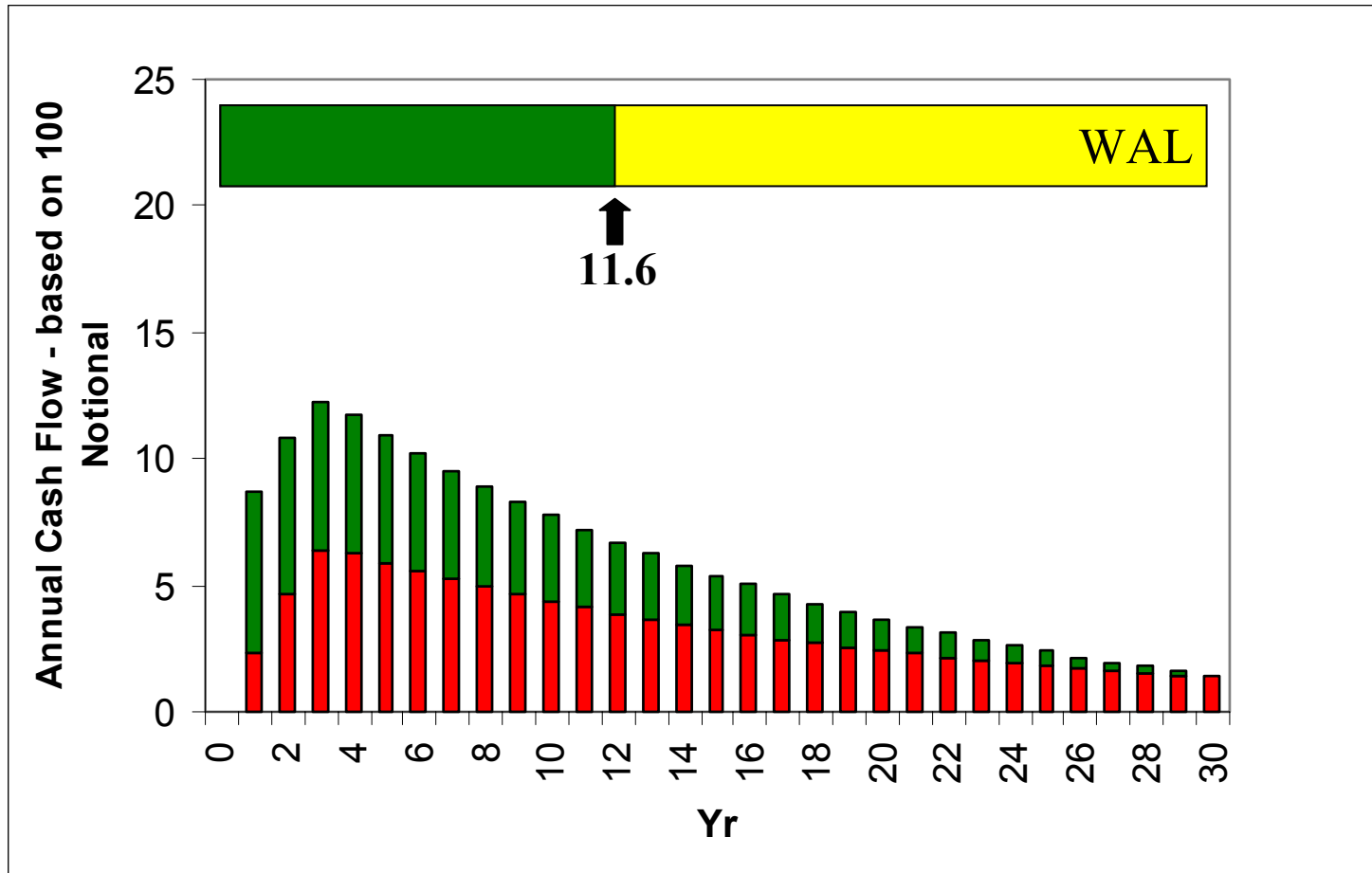
MBS Cash Flows



FNMA 30 Yr, 7% WAC, 0% PSA



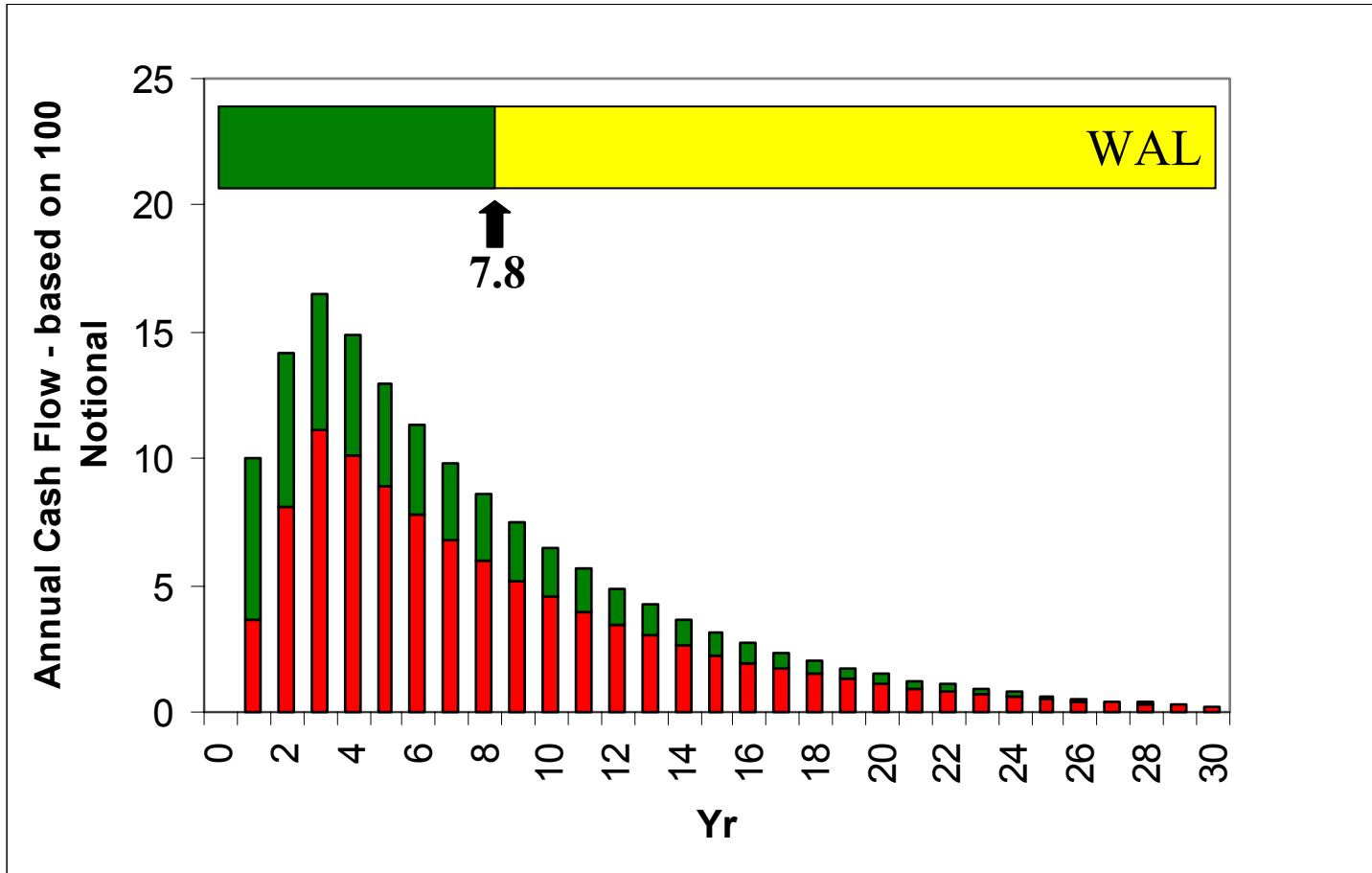
MBS Cash Flows



FNMA 30 Yr, 7% WAC, 100% PSA



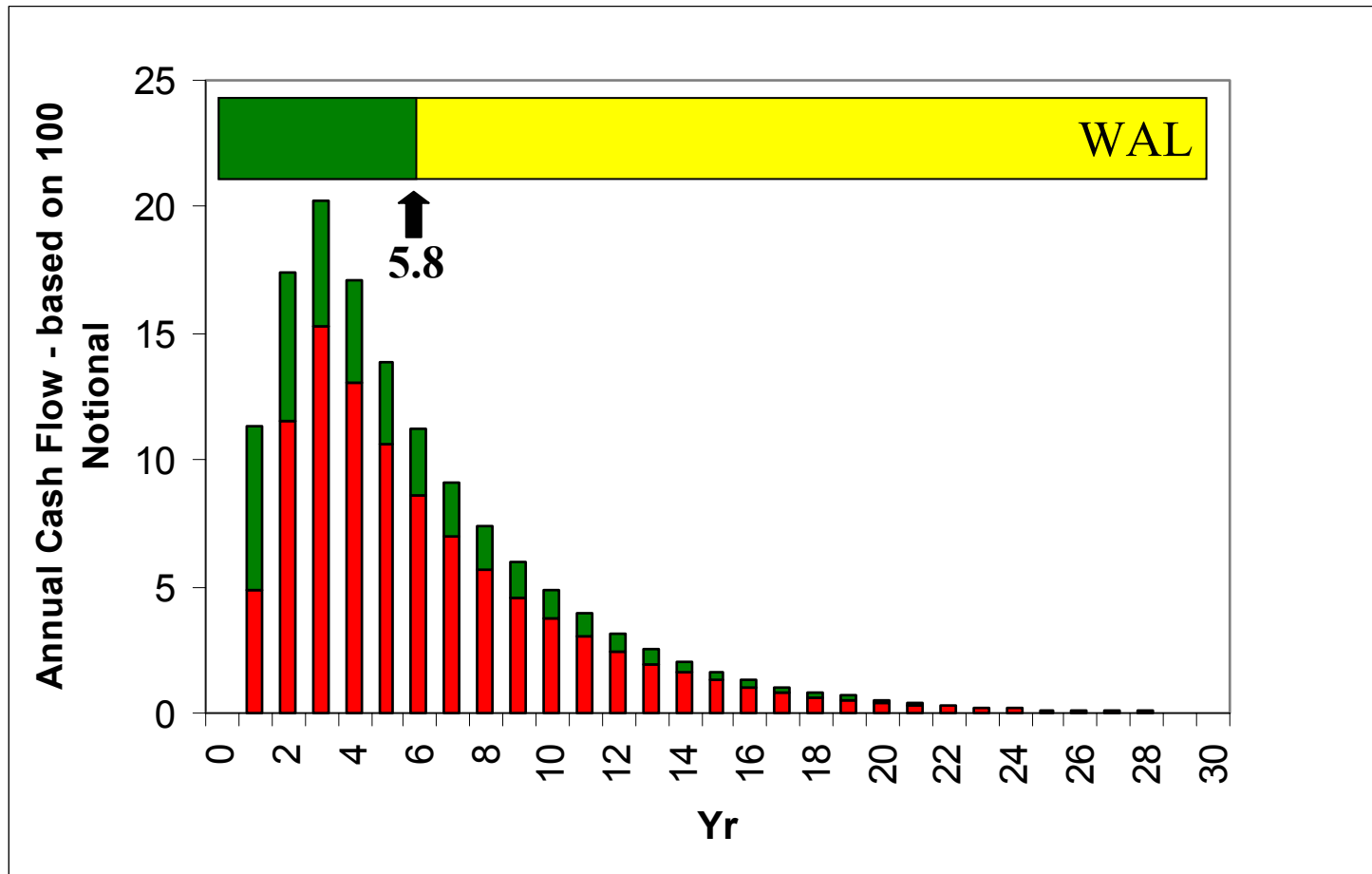
MBS Cash Flows



FNMA 30 Yr, 7% WAC, 200% PSA



MBS Cash Flows

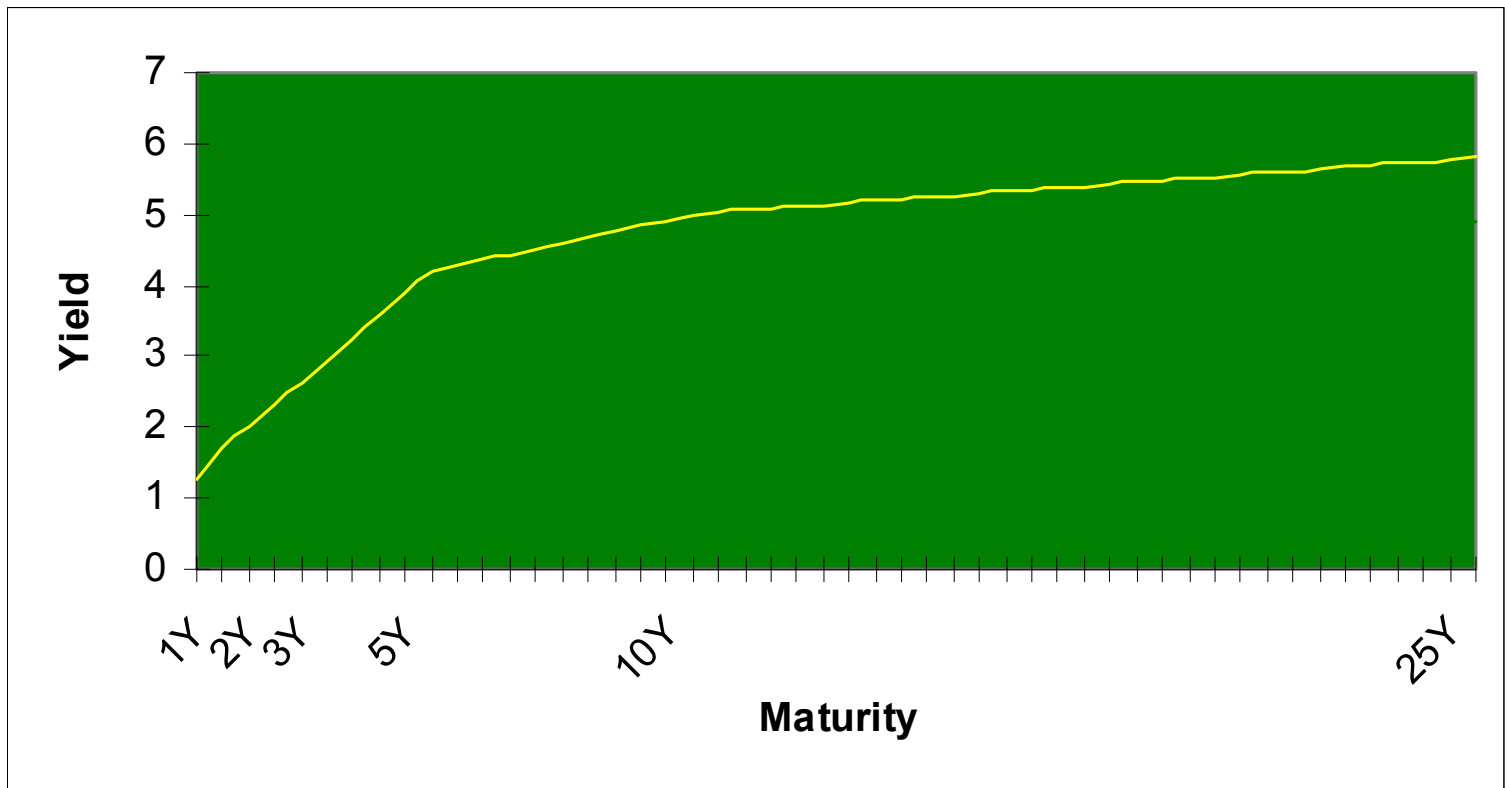


FNMA 30 Yr, 7% WAC, 300% PSA



Modeling of Prepayments - Qualitative

Consider the following Yield Curve



10Y Treasury is yielding 5%



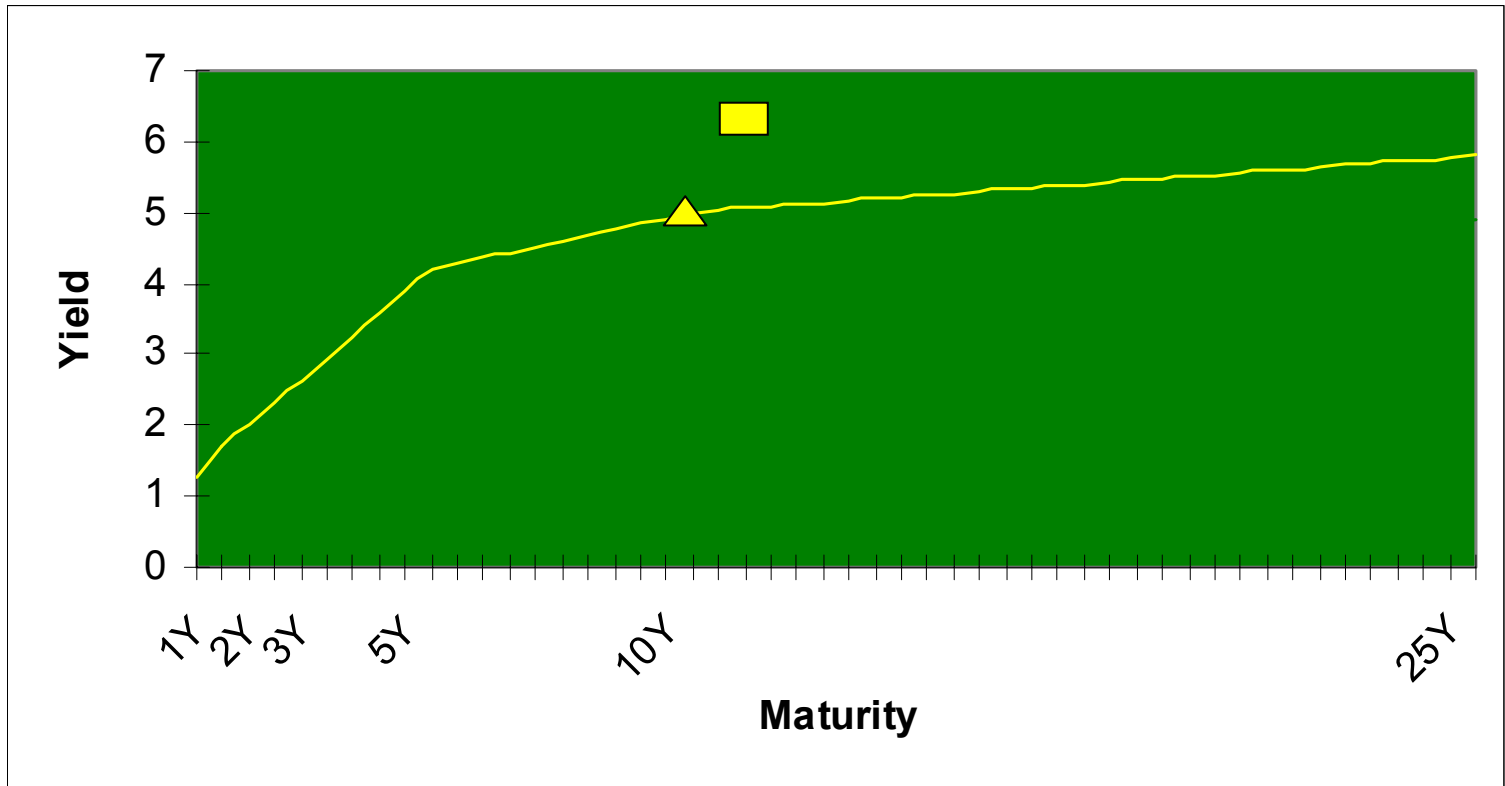
Modeling of Prepayments - Qualitative

Consider two alternative investments

- A 10-Yr Treasury Note :
 - 5% coupon,
 - priced at par (\$100)
 - Yield to Maturity : 5%
- A 30-Yr FNMA 7% WAC
 - 6.5% Coupon
 - Spread to 10Y : 140 bps (6.4% Yield)
 - Priced at 100% PSA to be \$100.73
 - WAL : 11.6 years



Modeling of Prepayments - Qualitative



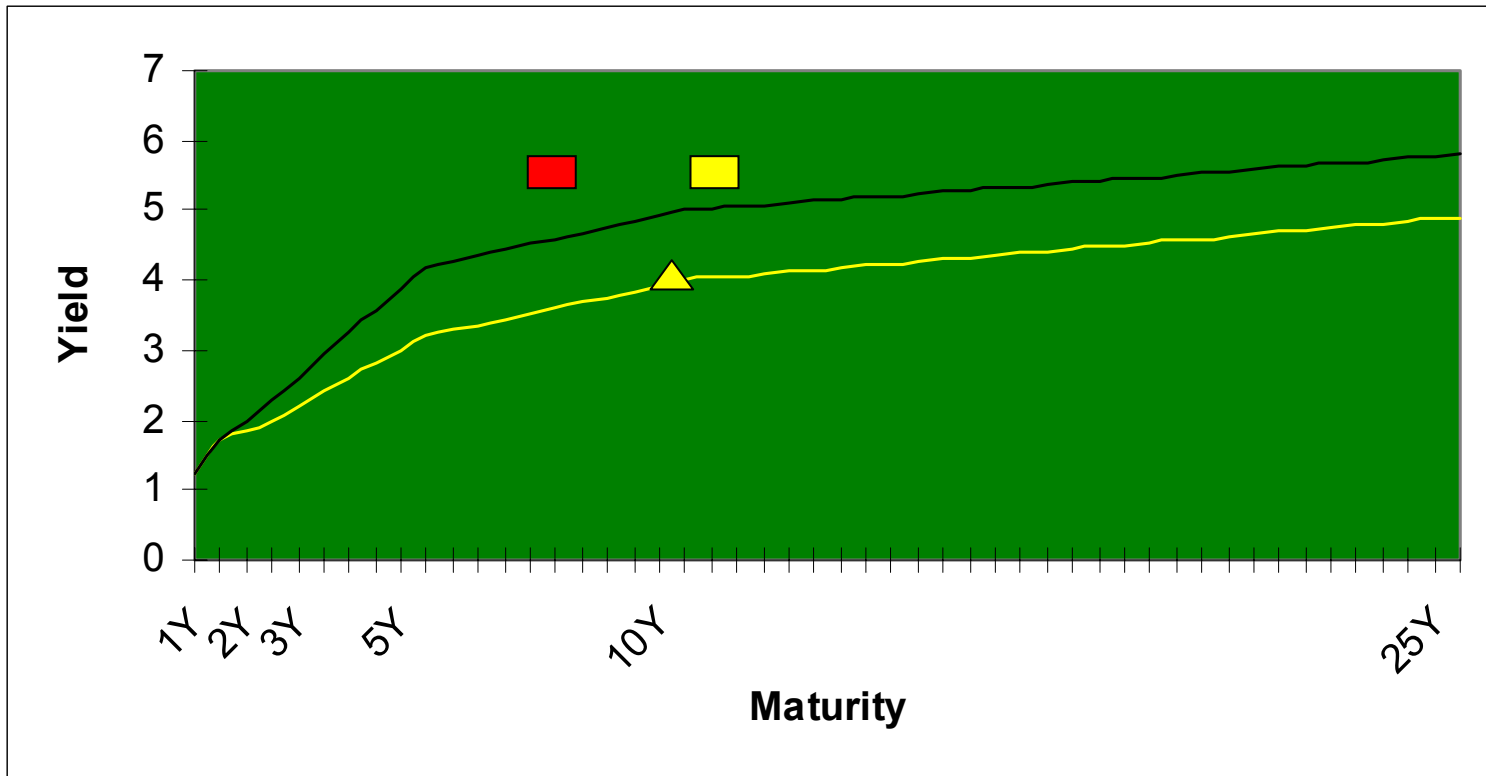
▲ T-Note

■ FNMA : 11.6Y WAL



Modeling of Prepayments - Qualitative

Consider an immediate downward yield curve shift (100 bps in the 10 yr)



- ▲ T-Note : Priced at 4% yield is now worth 108.18
- FNMA : At 5.4% yield, 100% PSA, worth 108.55
- FNMA : At 5.4% yield, 200% PSA, worth 106.36

WAL dropped to 7.8 years! I'm getting my money back in a lower rate environment.



Modeling of Prepayments

- Investment banks and many large buy-side firms will have proprietary econometric prepayment models which
 - Are sensitive to interest rates
 - Are aware of seasonal effects in housing turnover
 - Consider mortgage age variations
- These models will statistically model each prepayment component separately:
 - Refinancing
 - Partial Prepayments
 - Housing Turnover
 - Defaults

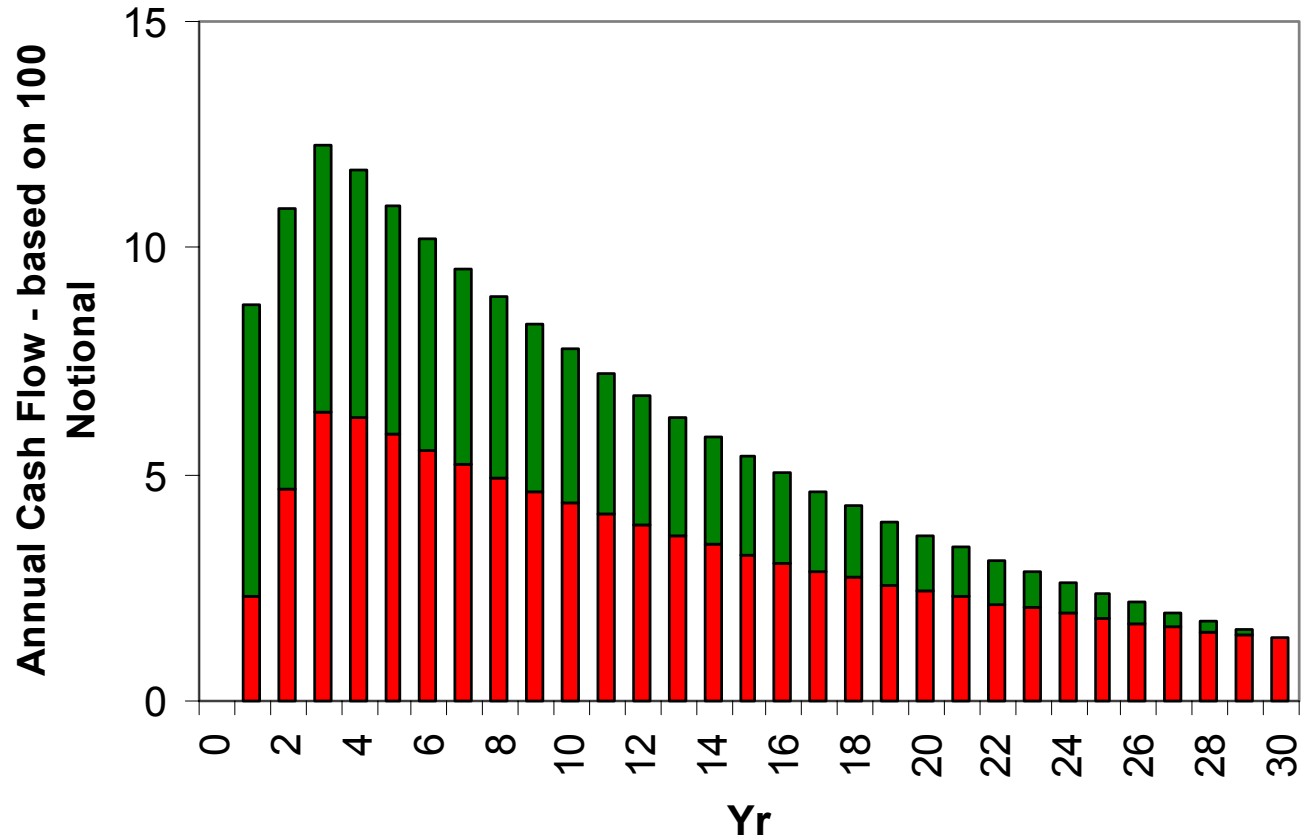


MBS Derivatives



MBS Derivatives Example IO/PO

Recall this picture

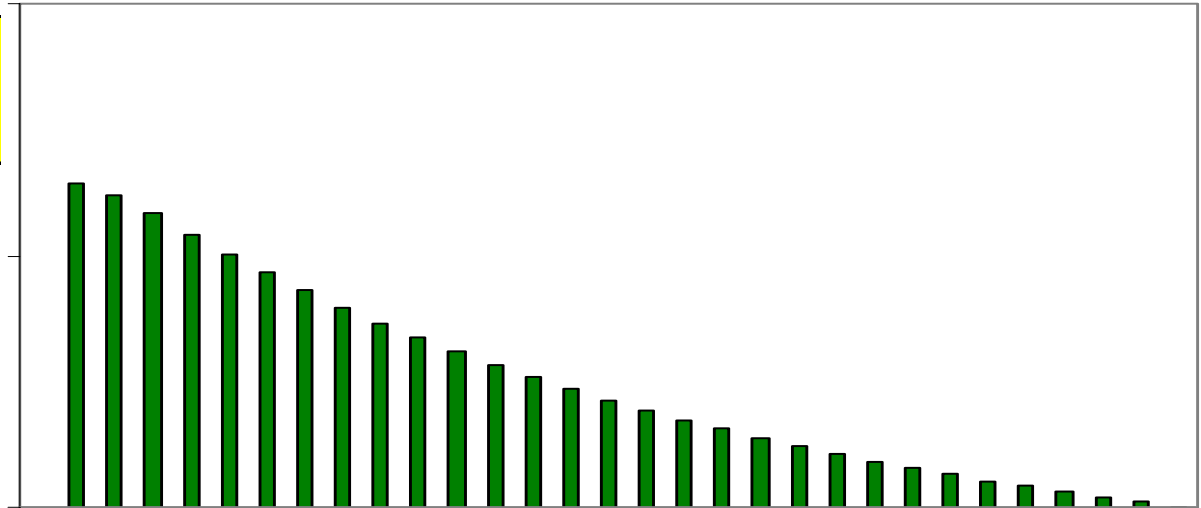


FNMA 30 Yr, 7% WAC, 100 PSA

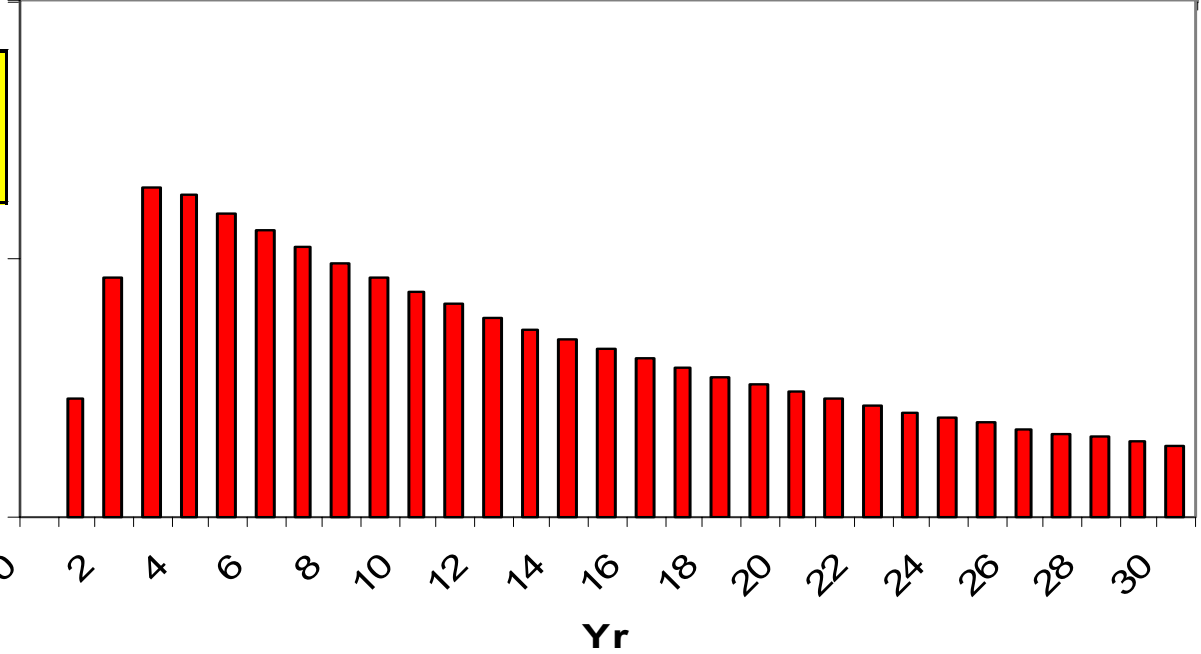


MBS Derivatives Example IO/PO – 100 PSA

Interest Flows	
Non-discounted	75.53
Discounted	47.15



Principal Flows	
Non-discounted	100
Discounted	52.85

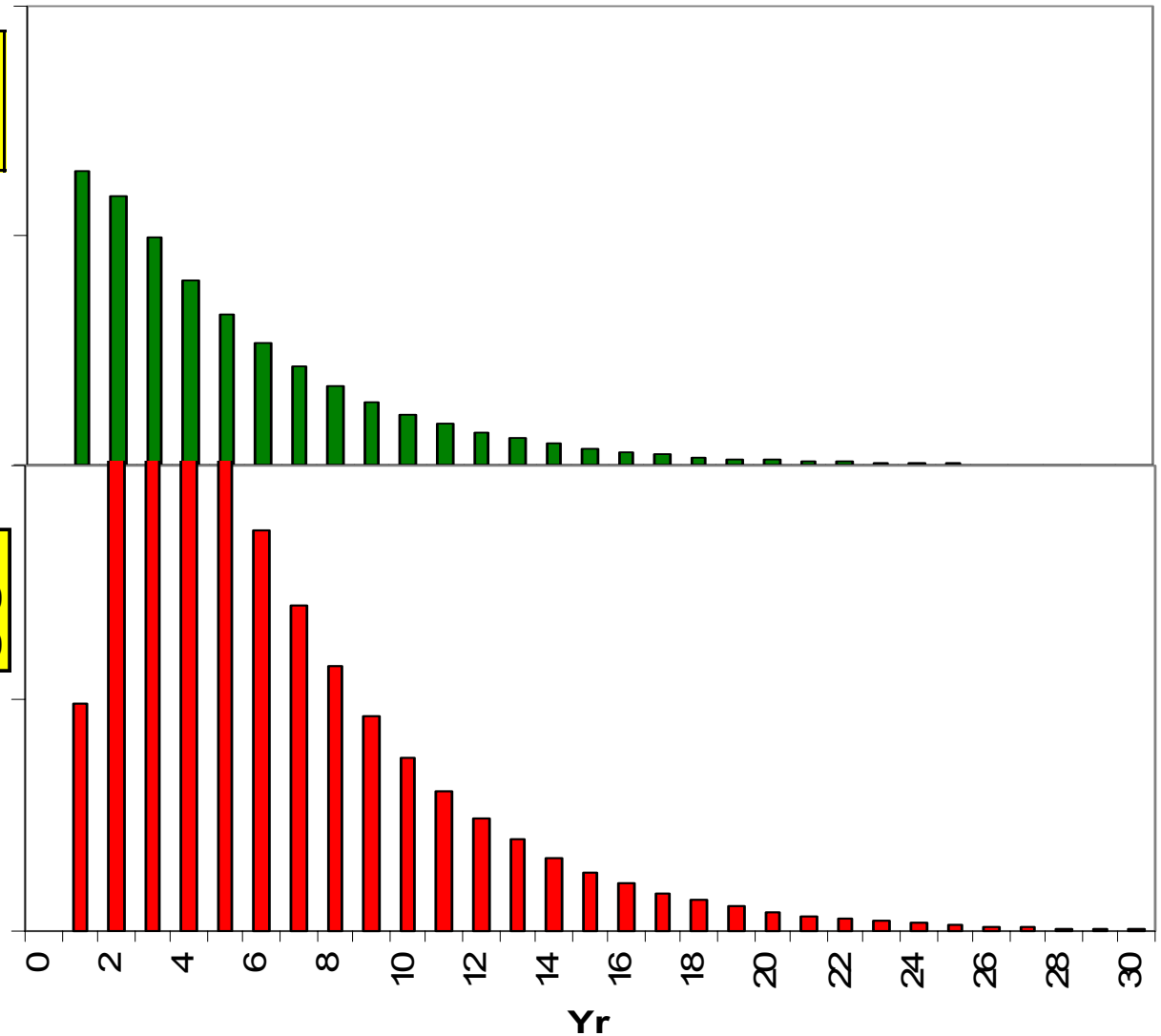




MBS Derivatives Example IO/PO – 300 PSA

Interest Flows	
Non-discounted	37.7
Discounted	28.8

Principal Flows	
Non-discounted	100
Discounted	71.20

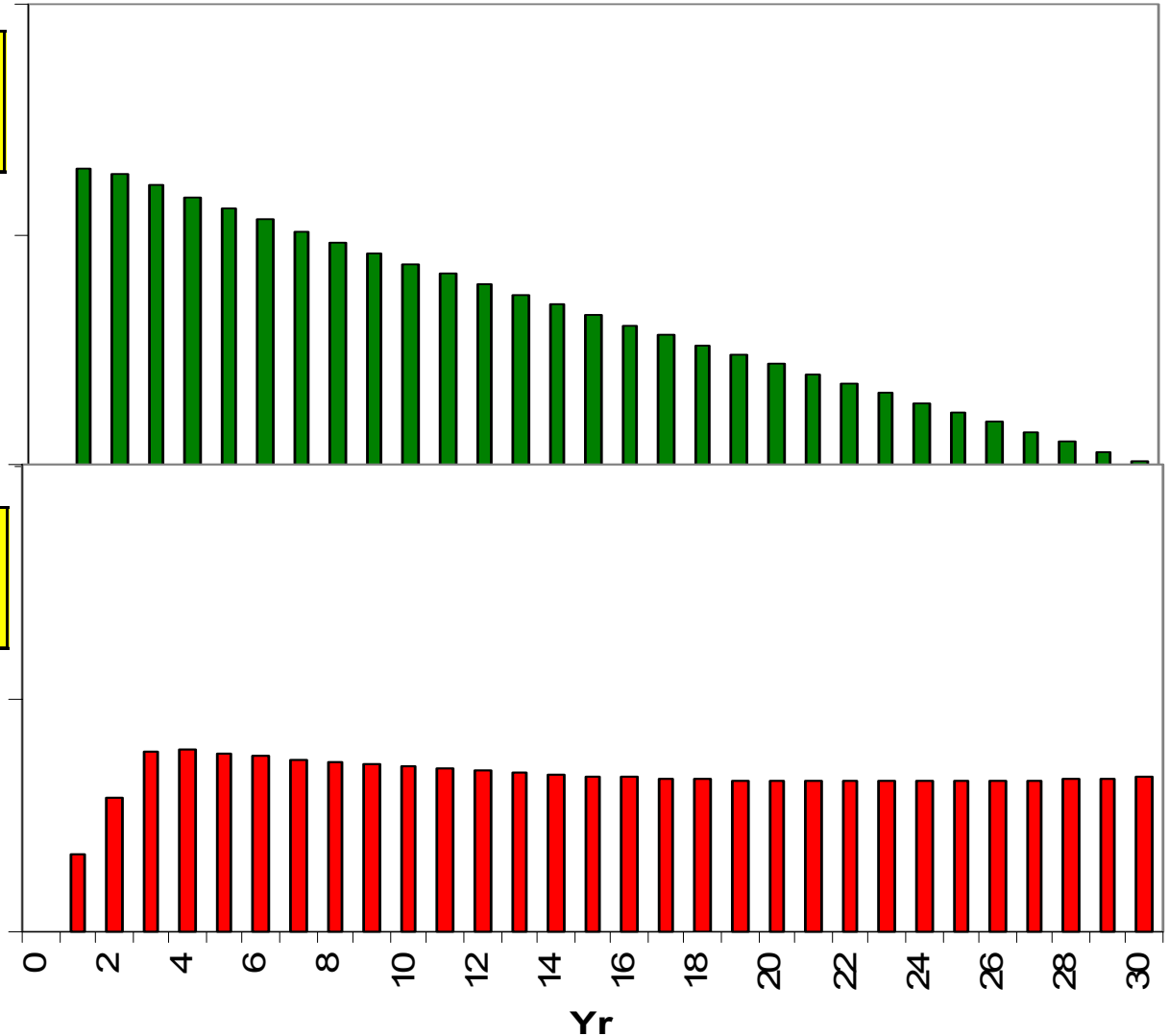




MBS Derivatives Example IO/PO – 50 PSA

Interest Flows	
Non-discounted	97.03
Discounted	56.01

Principal Flows	
Non-discounted	100
Discounted	43.99





Valuation Steps – Monte Carlo Simulation

- Define starting (today's) yield curve
- Start Scenario
 - Loop
 - Use interest rate model to advance the yield curve forward 1 month
 - Use prepayment model to determine single month prepayment rate
 - Determine Principal & Interest for all underlying mortgages/MBS
 - Apply Cash-flow model to generate derivative cash flows for each impacted security class
 - Continue
 - Discount cash flows for each security along the interest rate path that has been generated
- End Scenario
- Repeat for N (large) scenarios and compute averages