Events, Corporate Bonds and Securitizations

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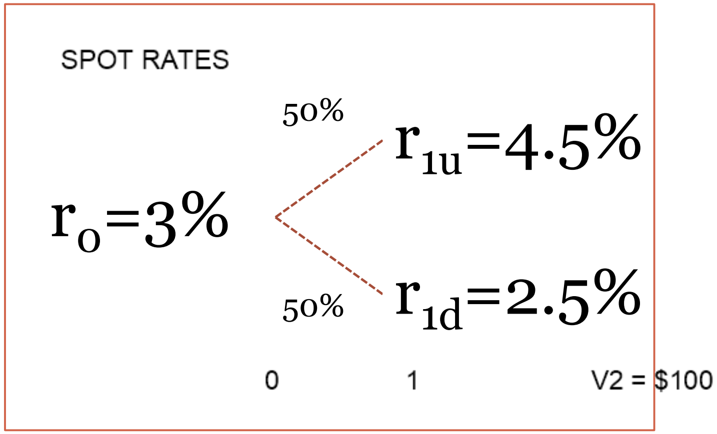
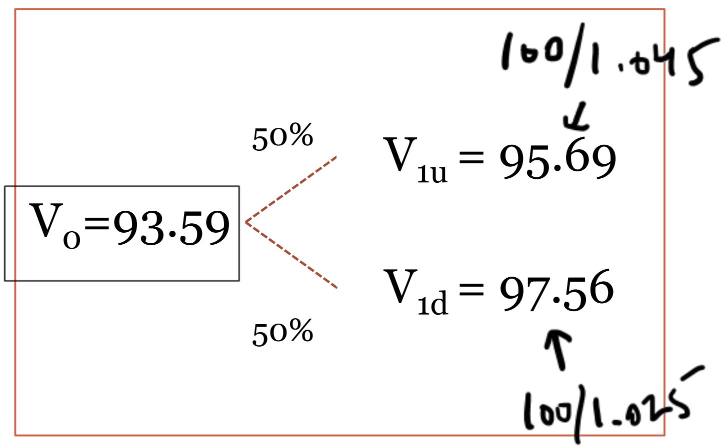
VL04

Valuation for Financial Engineers

Review: GVE and the binomial interest model

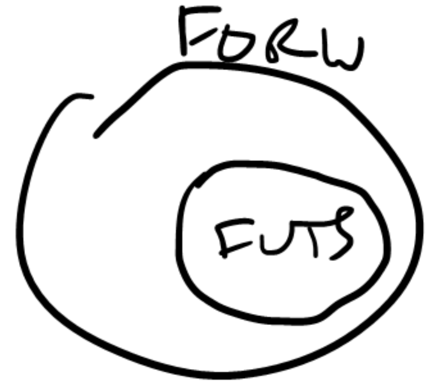




- Assumptions
  - Equally likely outcomes (σ_r=1%)
  - ZCB pays $100 at time 2
  - k = 25%
  - $\sigma_V = 0.5(V_{up} - V_{down})$
  - $\boxed{GVE: \quad V_0 = \frac{E[V_1]-k\sigma_V}{1+r_0}}$
  - $V_0 = \frac{avg(95.69,97.56)+0.25(0.5(95.69-97.56))}{1.03}$ $-\sigma_v$

Value a barrel of oil received in one year

CAPM $\qquad \dfrac{E(\theta)}{1+r+p}$



GVE $\qquad \dfrac{E(\theta)-k\sigma}{1+r}$

BEST $\qquad \dfrac{\text{OIL FUTURES PRICE}}{1+r}$

Now take it one step further!

π^*

62.5% $V_{1u} = 95.69$

$V_0 = 93.59$ $\times 1.03$ CEQ = 96.39

37.5% $V_{1d} = 97.56$

Risk-neutrality ---- "trick" to imagine we are in a risk-neutral world for pricing convenience, but really pricing in a risky world

- Certainty-equivalent V_1
  - 93.59(1.03) = 96.39
- Reset probabilities to get $E[V_1]$=CEQ
  - $\pi^* = (96.39-97.56)/(95.69-97.56) = 62.5\%$
  - $1 - \pi^* = 37.5\%$
- Then, the forward rate is the expected spot rate using these risk-neutral probabilities
  - $\boxed{0.625 \cdot 0.045 + 0.375 \cdot 0.025 = 3.75\%}$
- And the valuation can be done with no risk adjustment
  - $(0.625 \cdot 95.69 + 0.375 \cdot 97.56)/1.03 = 93.59$

* *Please note: Usually a tree is defined for forward rates, so no risk adjustment is ever needed*

Tips for mini project 2

Step 1. Modify each row of your bond dataset to include some additional columns (see below).
Step 2. I recommend creating an integer maturity date code to avoid dealing with months that have different day counts. Every interval of "1" in my code corresponds to two weeks in calendar time.
Step 3. Accrued interest is computed using the Treasury Direct formula in the assignment.
Step 4. "t" is time measured in years, and d(t) is the discount factor associated with date t, continuously compounded.
Step 5. Compute the theoretical bond prices based on your chosen d(t), and then then find the function d(t)to fit as closely as possible.

				Bid/Ask/Avg	2					Days	365			
				Today	9/7/2022					Settlemer	0			
LC code	Last coup	Next coup	Mat Code	Maturity	Yld to Mty (A	Bid Price	Ask Price	Cpn	Accr %	Invoice	t (mat)	d(t)	Fitted	SSQ comp
1	3/15/2022	9/15/2022	13	9/15/2022	0.27	99.96	100.02	1.50	0.96	100.74	0.02	0.9992	100.67	0.00
2	3/31/2022	9/30/2022	14	9/30/2022	1.82	99.85	99.90	0.13	0.87	99.95	0.06	0.9978	99.84	0.01
2	3/31/2022	9/30/2022	14	9/30/2022	2.12	99.93	99.98	1.75	0.87	100.74	0.06	0.9978	100.65	0.01
2	3/31/2022	9/30/2022	14	9/30/2022	1.80	99.95	100.00	1.88	0.87	100.82	0.06	0.9978	100.72	0.01
3	4/15/2022	10/15/2022	15	10/15/2022	2.37	99.84	99.90	1.38	0.79	100.44	0.10	0.9964	100.32	0.01
4	4/30/2022	10/31/2022	16	10/31/2022	2.49	99.61	99.66	0.13	0.71	99.70	0.15	0.9948	99.55	0.03
4	4/30/2022	10/31/2022	16	10/31/2022	2.43	99.85	99.92	1.88	0.71	100.58	0.15	0.9948	100.42	0.03

Determining the cash flow map

- Step 6: For each maturity code, determine if the bond makes a coupon payment on that date (1) or does not (0)
- Step 7: You now have enough information to price the bonds

Mat code	1	2	3	4	5	6	7	8	9	#	#	#	13	14	15	16	17	18
Date	#	#	#	#	#	#	#	#	#	#	#	#	9/15/22	9/30/22	10/15/22	10/31/22	11/15/22	11/30/22
	1	2	3	4	5	6	7	8	9	#	#	#	13	14	15	16	17	18
t	#	#	#	#	#	#	#	#	#	#	#	#	0.02	0.06	0.10	0.15	0.19	0.23
y(t)	0	0	0	0	0	0	0	0	0	0	0	0	0.035	0.035	0.035	0.035	0.035	0.035
d(t)	0	0	0	0	0	0	0	0	0	0	0	0	0.99923317	0.99779695	0.9963628	0.9948353	0.9934054	0.99197756
SUM																		
1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

And now…returning to the lecture!

The GVE and Events

- Assume capital gains or cash flows might be affected by an event that happens with a constant probability of π per period
  - Capital gains: The asset may drop to zero due to termination or default
    - If the event triggers the loss of the entire asset, then the capital gain is the negative of the asset value
    - The asset may drop to a "recovery value" of $(1-\lambda)V$

λ = loss given default = LGD = loss rate

  - Cash flows: The level of cash flows might be subject to a windfall

- Even if there is no pricing for risk, we still need to account for expected gains or losses

Case 1

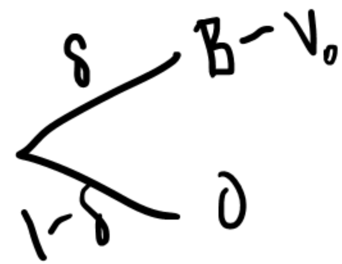
- An automobile insurance policy pays C in the event of a claim, and 0 otherwise
- Assume
  - Maximum one event per year, probability π per year
  - Perpetual auto policy
  - No risk charge, but expected losses should be considered
- In this case we can write the GVE as
  - $rV_0 = (V_1 - V_0) + \pi C$
    - Since the payment or non-payment of the claim does not change the asset value, the capital gain is zero, i.e. $V_1 = V_0$
    - This was true for simple perpetuities as well
  - $V_0 = \frac{\pi C}{r}$
    - This is a perpetuity of the expected cash flow each period

$EV = \pi C$

$V_0 = \pi C / r$

Case 2

- A life insurance policy pays $B at death (“B” for benefit) but can only be exercised once. *Except sometimes in Brooklyn…*
- Assume
  - The policy is paid in full at inception
  - The conditional probability of death in every year is δ
  - Theoretically, a perpetual contract without aging effects
  - No risk charge, just expected values



- The GVE suggests
  - $rV_0 = (V_1 - V_0) + \delta(B - V_0)$
    - Interpret V as the value of the asset while it is in force (i.e. alive)
    - Again, because this is a perpetuity, the capital gain must be zero
  - $V_0 = \frac{\delta B}{r+\delta}$

    ex. I am buying a call option on Enron stock, use option pricing model to value it.
    BUT if I assume Enron has a constant probability of dropping to zero (delta)
    - This is interpreted as a perpetuity of the expected cash flow every year, but discounted at a higher rate r+δ to reflect “termination” risk

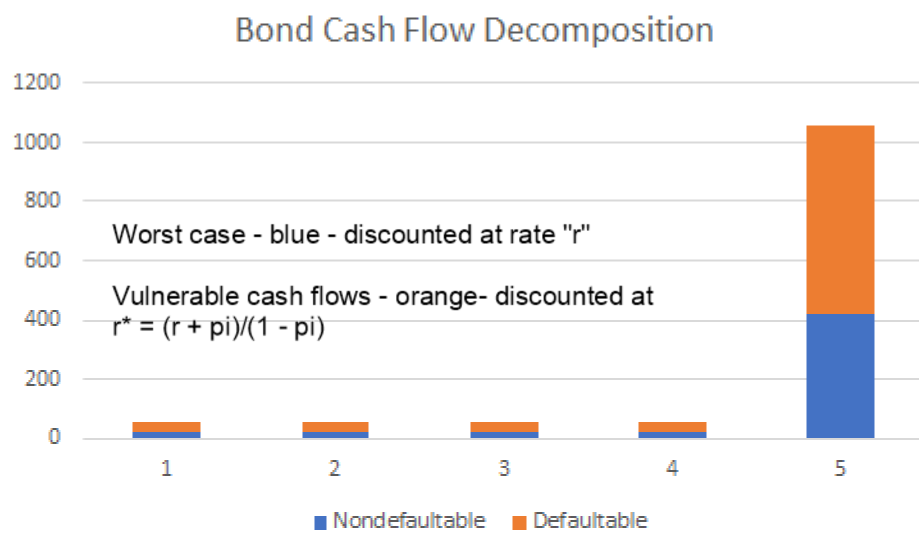
Case 3

- A corporate bond has a constant periodic default rate.
- Assume
  - In the event of default with probability π, conditional on non-default before that date, a fraction λ of the loan value is lost
  - There is no risk compensation, just an adjustment for expected losses
  - Hint: Divide the bond into a non-defaultable portion and a defaultable portion
- Then
  - The nondefaultable portion is assumed to be $(1-\lambda)$ times the bond's present value at the risk free rate…
  - PLUS λ times the present value of the risky part
    - As in VL02, the expected payments decline at an exponential rate of π
    - The IRR on these cash flows is $\frac{r+\pi}{1-\pi}$

The BIS Defaultable Bond Model

- Parameters
  - Face value = 1000
  - Coupon = 5.5%
  - Lambda = 60%
  - Pi = 3%
  - r = 4%
- Cash flows contingent on default date

Recovery = 40%



		Calendar year					
	Default	1	2	3	4	5	PV
3.00%	1	22	22	22	22	422	426.71
2.91%	2	55	22	22	22	422	458.44
2.82%	3	55	55	22	22	422	488.95
2.74%	4	55	55	55	22	422	518.29
2.66%	5	55	55	55	55	422	546.50
85.87% over		55	55	55	55	1055	1,066.78
ECF		54.01	53.05	52.12	51.21	965.58	984.73

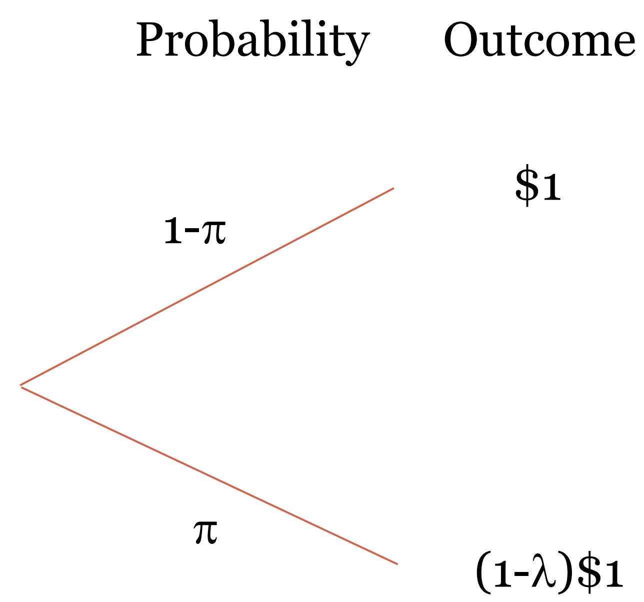
PV(nondef) = \$426.71
PV(def) = \$558.02
Value = \$984.73 see textbook

YTM = 5.86% (Excel)
Spread = 1.86% Credit spread
Spread ≈ $\pi\lambda/(1-\pi)$

Incorporating default risk – 1 period

π = probability of default

λ = loss given default



Expected present value

$$\frac{(1-\pi)+\pi(1-\lambda)}{(1+r)} = \boxed{\frac{1-\pi\lambda}{1+r}} \approx \frac{1}{1+(r+\pi\lambda)}$$

$\pi\lambda$ = Approximate *credit spread (no risk premium)*

Exact credit spread (one period) = $\frac{\pi\lambda(1+r)}{(1-\pi\lambda)}$

GVE and Credit Risk

- Let's include the possibility that the market requires a risk premium k (as a percentage) in addition to expected losses
- Then for a one-period bond promising to pay C
  - $rV_0 + kV_0 = (0 - V_0) + (1 - \pi\lambda)C \qquad V_0 \approx \frac{C}{1+r+k+\pi\lambda}$
- These names are applied for coupon bonds and ZCBs:
  - Bond (promised) yield = $r + k + \pi\lambda$
  - Credit spread = $k + \pi\lambda$

Bonds vs Loans Review

- Bonds
  - Traded on a public market
  - Monitored by a trustee
  - Indentures – requirements for issuer
  - Impossible to negotiate or change
- Loans
  - Private transaction with bank
  - Heavy monitoring
  - Covenants – promises to keep
  - Much higher recoveries in default (lower LGDs)

Types of bonds

- Debenture (straight bond) general obligation of company
- Callable bond ←
- Nonrefundable bond
- Putable bond
- Perpetual debenture
- ZCB (Zero Coupon Bond)
- STRIPs
- Convertible bond
- Adjustable bond terms changeable over time
- Structured bond securitizations

Issuer has right to repurchase (call) for a fixed price --- two reasons
(1) Corporate interest rate has fallen, making it profitable to refinance (market rates fall or company credit spread falls)
(2) Call if indenture requires it, e.g. before acquisition or major change, bond must be refinanced

NONREF- like a callable bond, but cannot be refinanced because of (1)

r(callable) > r(nonref) > r(debenture)

Putable - Investor has the right to sell bond back to issuer at fixed price

r(putable) < r(debenture)

Investor has the option to convert bond to shares at fixed ratio
r(convertible) < r(debenture)

OAS: Option-adjusted spread

- Callable bonds

debenture

  - Value of callable bond = Value of noncallable bond – Value of issuer's call option
- Convertible bond
  - Value of convertible = Value of nonconvertible bond + Value of investors' call
- OAS = yield of bond with options if held to maturity – yield of bond without options

Important bond abbreviations

- Courtesy BIS

Basel accords
IFRS

  - Bank for International Settlements
- PD = π = Annual conditional default probability
- LGD = λ = Loss given default (percentage)
- EL = expected loss = $\pi\lambda$

- Corporate bond YTM

government bond of

- = Risk-free rate(same maturity) + Expected loss rate + Additional market credit risk premium

Corporate Bonds

Most Active Investment Grade Bonds

Issuer Name	Symbol	Coupon	Maturity	Moody's®/S&P	High	Low	Last	Change	Yield%
GE CAP INTL FDG CO MEDIUM TERM NTS BOOK	GE4373444	2.342%	11/15/2020	A2/AA-	99.24900	98.91400	99.00900	-0.296000	2.708436
CITIGROUP INC	C4114236	2.550%	04/08/2019	Baa1/BBB+	100.45400	100.08000	100.15000	-0.009000	2.422841
TRANSCANADA PIPELINES LTD	TRP4566319	2.125%	11/15/2019	A3/	99.60000	99.48800	99.48800	-0.138000	2.413118
JPMORGAN CHASE & CO	JPM4260166	2.750%	06/23/2020	A3/A-	100.66400	100.23840	100.50500	-0.130000	2.526826
WELLS FARGO BK N A SAN FRANCISCO CALIF M	WFC4432931	2.150%	12/06/2019	Aa2/AA-	100.04700	99.46300	99.48200	-0.374000	2.432825
PNC BK N A PITTSBURGH PA MEDIUM TERM SR	PNC4341038	1.950%	03/04/2019	A2/A	99.70700	99.64300	99.67500	-0.020000	2.243243
GE CAP INTL FDG CO MEDIUM TERM NTS BOOK	GE4373445	4.418%	11/15/2035	A2/AA-	106.11400	105.10300	105.29900	-1.266000	3.999004
GENERAL ELEC CO	GE4105158	4.500%	03/11/2044	A2/AA-	107.78600	106.69200	107.31300	-0.813000	4.043973
JPMORGAN CHASE & CO	JPM4203225	2.250%	01/23/2020	A3/A-	100.35900	99.54400	99.62900	-0.107000	2.440085
BOARD TRUSTEES LELAND STANFORD JR UNIV	STUY4236061	3.460%	05/01/2047	/AAA	100.49200	100.26400	100.49200	0.751000	3.433025

Credit rating may differ according to which bond is issued by the company

i.e. credit rating of issue, not issuer

Corporate Yield= Treasury yield
+ Premium for expected losses
+ Additional risk premium

$$r_f + \pi\lambda + r.p.$$

$k\sigma$

Date	1 Mo	2 Mo	3 Mo	6 Mo	1 Yr	2 Yr	3 Yr	5 Yr	7 Yr	10 Yr	20 Yr	30 Yr
9/29/2017	0.96	N/A	1.06	1.2	1.31	1.47	1.62	1.92	2.16	2.33	2.63	2.86

Data is from September 2017, including term structure

Decomposition of yield:

- Citigroup YTM = 2.42%
- Risk-free rate (1.5 years) = 1.39%
- Total credit spread = 2.42% - 1.39% = 1.03%

- Probability of default = 0.22% (Moody's Baa 1 year)
- LGD = 60% (assumed)
- Expected loss = 0.0022 x 0.60 = 0.13%
- Additional risk premium = 1.03% - 0.13% = $\boxed{0.90\%}$

Implied risk premium

Credit ratings

- Key concepts
  - Investment grade
  - Short & long term
  - Implications of ratings
  - Impact of ratings on bond value

Moody's		S&P		Fitch		Rating description
Long-term	Short-term	Long-term	Short-term	Long-term	Short-term	
Aaa	P-1	AAA	A-1+	AAA	F1+	Prime
Aa1		AA+		AA+		High grade
Aa2		AA		AA		
Aa3		AA−		AA−		
A1		A+	A-1	A+	F1	Upper medium grade
A2		A		A		
A3	P-2	A−		A−	F2	
Baa1		BBB+	A-2	BBB+		Lower medium grade
Baa2	P-3	BBB		BBB	F3	
Baa3		BBB−	A-3	BBB−		
Ba1	Not Prime	BB+	B	BB+	B	Non-investment grade speculative
Ba2		BB		BB		
Ba3		BB−		BB−		
B1		B+		B+		Highly speculative
B2		B		B		
B3		B−		B−		
Caa1		CCC+	C	CCC+	C	Substantial risks
Caa2		CCC		CCC		
Caa3		CCC−		CCC−		
Ca		CC		CC		Extremely speculative
		C		C		Default imminent
C		RD	D	DDD	D	In default
/		SD		DD		
/		D		D		

INVESTMENT GRADE

NONINVESTMENT GRADE

SPECULATIVE

HIGH YIELD

JUNK BONDS

Bond ratings

Estimate PD (pi)

Moody's	Nov 2006 Special Comment p 14		
	20-year	1-year	1-month
INV GRADE Aaa	0.64%	0.03%	0.0027%
Aa	0.65%	0.03%	0.0027%
A	1.55%	0.08%	0.0065%
Baa	4.27%	0.22%	0.0182%
Ba	13.84%	0.74%	0.0620%
B	25.20%	1.44%	0.1209%
Caa-C	41.23%	2.62%	0.2212%

S&P	2015 Annual Global Corporate Default Study p 10	
	1-year	1-month
AAA	0.01%	0.0008%
AA	0.02%	0.0017%
A	0.06%	0.0050%
BBB	0.19%	0.0158%
BB	0.73%	0.0610%
B	3.77%	0.3197%
CCC/C	26.36%	2.5176%

Moody's and S&P are the leading bond rating agencies for corporate debt (though there are other significant players, like Fitch)

They both put out regular studies of realized default rates by rating class

These ratings can be very important – institutional investors/creditors are often restricted to investing in obligors meeting a minimum rating standard

In particular, bonds are typically segregated into "Investment Grade" (Moody's Baa & up/ S&P BBB and up) or "High Yield" (rest). High Yield is sometimes referred to as "Junk"!

Credit – Loss Given Default

The table on the right shows prices at default for bonds at various levels of seniority. "Seniority" is the relative ranking in the capital structure – e.g., how much preference the bonds would get when it comes to handing out money under default.

This can be taken as being the effective recovery rate, or 1-λ. You can see that there is a lot of variation in the numbers, as measured by standard deviation.

LGD will also vary by other factors – most notably industry and state of the economy.

est recovery rate

Investment Grade vs. Non-Investment Grade (Original Rating)
Prices at Default on Public Bonds (1978 - 2008)

Bond Seniority	Number of Issues	Median Price %	Average Price %	Weighted Price %	Standard Deviation %
Senior Secured					
Investment Grade	142	50.50	53.85	57.97	26.94
Non-Investment Grade	245	39.00	44.05	44.42	29.23
Senior Unsecured					
Investment Grade	374	43.50	44.84	38.75	24.92
Non-Investment Grade	519	32.50	36.04	34.79	23.31
Senior Subordinated					
Investment Grade	16	27.31	37.10	34.29	27.48
Non-Investment Grade	402	27.90	32.74	30.20	24.16
Subordinated					
Investment Grade	18	4.00	24.27	6.38	29.52
Non-Investment Grade	204	28.92	32.54	29.64	22.68
Discount					
Investment Grade	1	17.15	13.63	13.63	25.13
Non-investment Grade	96	18.00	27.31	26.94	23.38

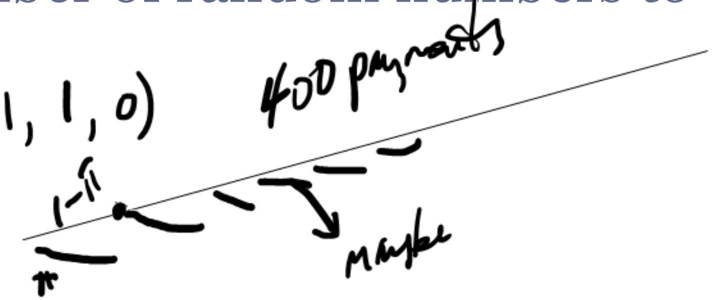
Source: NYU Salomon Center Default Database

Simulating Event Occurrence

- The hard way:
  - Every period, choose a uniformly distributed random number between 0 and 1
  - If the value is less than π, then the event has occurred, otherwise it has not
  - Repeat every period in sequence
- Problem
  - Each bond requires a large number of random numbers to generate the result!

ex. $\pi = 1\%$ $\quad$ =if(RAND() <= .01, 1, 0)

$[0,1]$ $\tilde{u}$ = RAND()

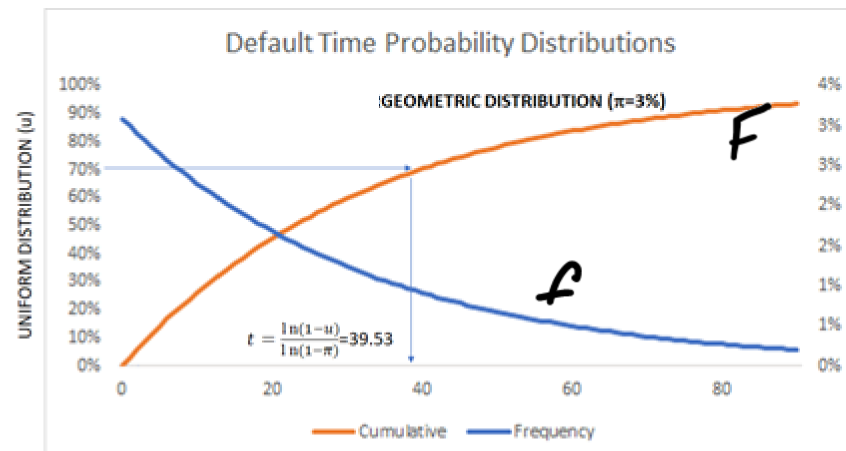


Simulating an event – The easy way

- Suppose the probability of default for a corporate's bond is π per year, e.g. 2% per year
- The time to default is modeled as a geometric distribution
  - Not available in Excel!
- Simulate default time using
  - $t = \mathrm{INT}\left(\frac{\ln(1-u)}{\ln(1-\pi)}\right)$

*u is a uniformly distributed random number

Simulate TIME to default!



The continuous equivalent: Poisson process

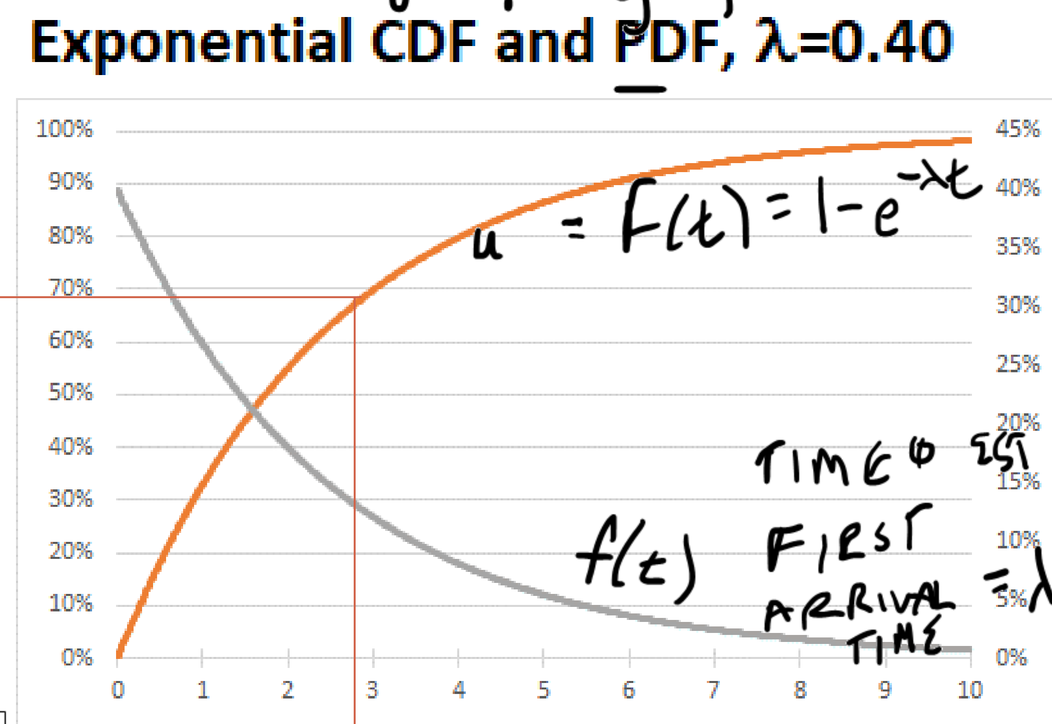
$\tilde{u} = F(\tilde{t})$

$\tilde{t} = F^{-1}(\tilde{u})$

$\tilde{u}$

u=0.69

orange gray

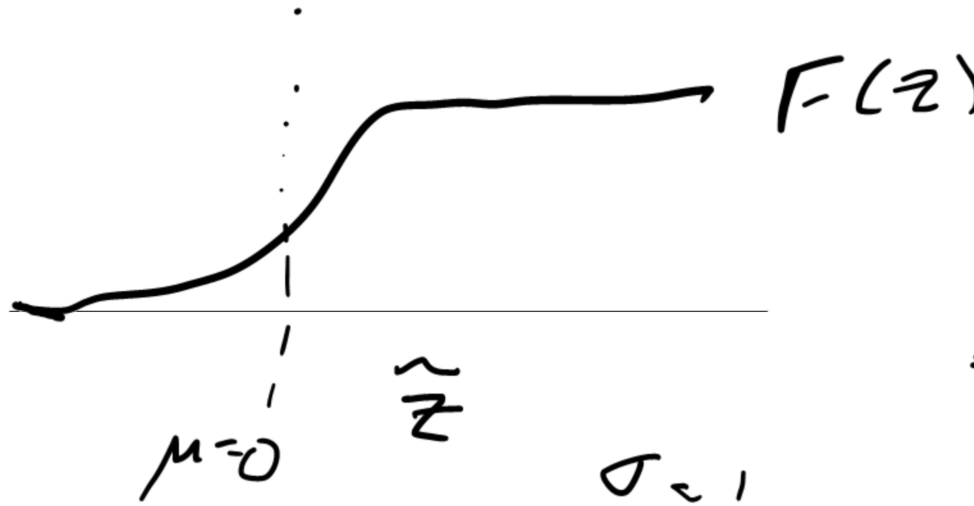


- $f(t) = \lambda e^{-\lambda t}$ with $\lambda=0.4$
- $u = F(t) = 1 - e^{-\lambda t}$
- $\boxed{t = F^{-1}(u) = -\ln(1 - u)/\lambda}$
- Find the mean using simulation

$Pr(\text{event at } t) = \lambda\, dt$

$F^{-1}(u)=2.93$

$\tilde{t}$



$$\tilde{z} = F^{-1}(\tilde{u})$$

$$\tilde{z} = \text{normsinv}(\text{rand}())$$

Part II

- Securitization as a fixed income product
- Example using Brownstone rental income
- Mortgage-backed securities and event simulation
- Valuing Collateralized Debt Obligations

Individual Borrowing: A Case Study

Assumptions

Townhouse value		1,000,000	
Annual expected income		90,000	net
Current return		9.00%	ROA

OPTION A: 60% personal loan with 6% interest

Cash out	60.00%	600,000	
Townhouse equity		400,000	
Income		90,000	
Interest	6.00%	36,000	
Net		54,000	
ROI		13.50%	

Three ways to borrow money

1. Take out a bank loan
2. Sell the cash flows to bond investors
3. Securitize the cash flows

- Is #2 feasible? Risks to bond investors:
  - Damage to property, or insufficient maintenance
  - Lack of insurance on property
  - Fraud or theft by townhouse owner
  - Defaults or delays in payments from tenants
  - Property-specific risks

What does securitization mean here?

- Assemble 100 townhouses into a pool and assign a manager to operate them.
  - What are the manager responsibilities?
- Allow people to invest in a share of the pool
- Why would investors prefer this to buying a bond from an individual owner?
  - Manager risk mitigations
  - Diversification
- What could the securitization structuring team do to reduce the risk to bondholders and therefore the interest rate paid on the bonds?
  - Subordination
  - Overcollateralization
  - Excess spread

Credit enhancement

Subordination

In any given period, investors are paid before owners, i.e. "owners subordinate their claims to those of investors"

owners take "first-loss" position

Overcollateralization

may get a bank line of credit to cover investor losses up to some point

good because(a) bank has gone through credit process (b) bank take risk on its own to support structure

Excess Spread

all income over time must be paid to investors before owners

Should the homeowner securitize?

Assumptions

Townhouse value	1,000,000
Annual expected income	90,000
Current return	9.00%

<u>OPTION A: 60% personal loan with 6% interest</u>

Cash out	60.00%	600,000
Townhouse equity		400,000
Income		90,000
Interest	6.00%	36,000
Net		54,000
ROI		13.50%

<u>OPTION B: 80% securitized, 4% interest, $5K annual fee</u>

structuring fee

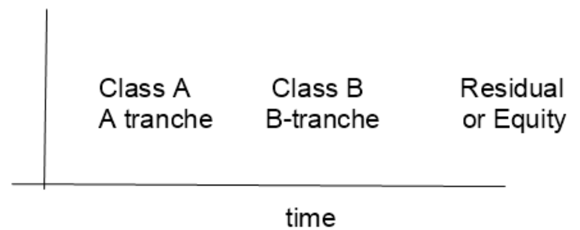
Cash out	80.00%	800,000
Townhouse equity		200,000
Income		90,000
Interest	4.00%	32,000
Fees		5,000
Net		53,000
ROI		26.50%

What is a securitization, more generally?

- The conversion of risky cash flows into investable assets
- Examples
  - Mortgages and mortgage backed securities
  - Credit card receivables
  - Subprime loans
  - Trailer park loans
  - David Bowie's future income
  - Collateralized Debt Obligations
- How does it work?
  - A *trust* owns the assets and distributes the cash flows generated by them
  - Distributions may be pro-rata or differentiated CMO, CDO
  - Differences in cash flows are often prioritized according to risk or timing of receipt

mortgages sold into pools - profit from sale, servicing, redeploying capital to new originations
ORIGINAL POOLS - pro-rata (proportionately)
MODERN POOLS- CMO -Collateralized Mortgage Obligation - cash flows flows distributed according to "waterfall" rules timing and risk

Mortgage replaced by corporate bonds



Why securitize?

- Specialization banks with MBS and CMO
  - For example, origination vs warehousing risk bank holds loans in its own portfoio
- Change risk profile
  - Lower risk or higher risk; what type of risk
- Reduce need for (equity) capital townhouse example
  - Leverage customized to the asset
- Make prices publicly observable e.g. catastrophe bond
  - Create or increase a market for future securitizations
- Increase the value of the cash flows
  - How does the pie become bigger when it is cut into slices?

The U.S. Mortgage Market

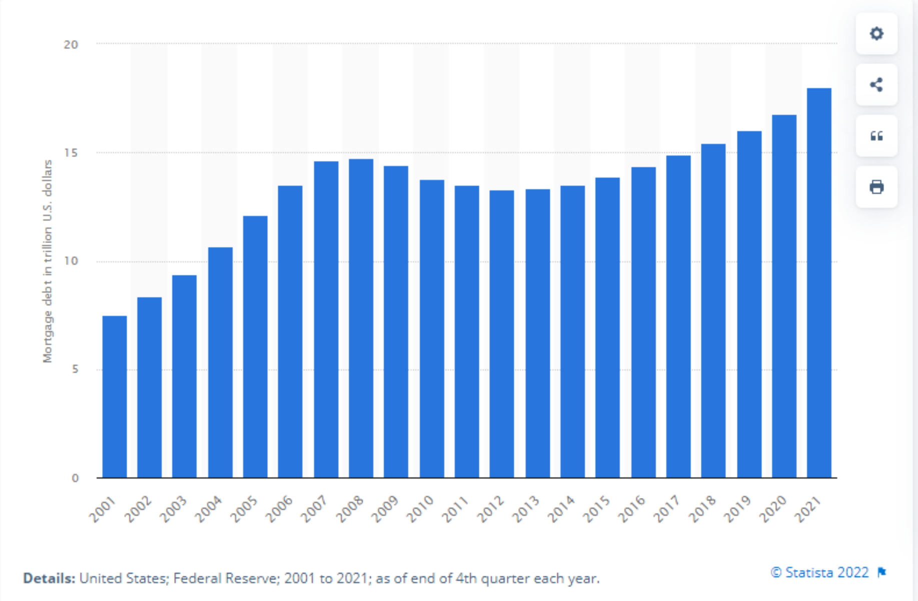
Value of mortgage debt outstanding in the U.S.

USD trillions

Real Estate › Mortgages & Financing

Value of mortgage debt outstanding in the United States from 2001 to 2021

(in trillion U.S. dollars)



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SOURCE DETAILS FAQ

Source
Federal Reserve

Survey by
Federal Reserve

Published by
Federal Reserve

Source link
Financial Accountrs of the United States, L.217

Release date
June 2022

Recent MBS Statistics

U.S. Mortgage-Related Securities Outstanding
USD Billions

sifma
Invested in America

GNMA - guarantor

ex: jumbo loans

C = commercial; R = residential

		Agency (FHLMC, FNMA, GNMA)		Non-Agency		Total		
Y	Q	Agency MBS	Agency CMO	CMBS	RMBS	Agency	Non-Agency	Total
2018	Q1	6,994.0	1,094.9	516.7	778.1	8,088.9	1,294.7	9,383.7
	Q2	7,068.8	1,102.7	526.1	786.3	8,171.4	1,312.5	9,483.9
	Q3	7,164.6	1,105.7	534.2	809.2	8,270.2	1,343.4	9,613.6
	Q4	7,268.7	1,103.2	543.1	817.3	8,371.9	1,360.4	9,732.3
2019	Q1	7,324.8	1,110.6	546.5	835.0	8,435.3	1,381.6	9,816.9

Securities Industry and Financial Markets Association

Mortgage Notes

- Issued mortgages are about the same size as the U.S. debt market
- About 2/3 of these are securitized
  - Mortgages are packaged into pools, called *Mortgage-Backed Securities*, or MBS
  - Shares in these pools are sold to investors
  - Sometimes, investors agree to receive cash flows that have been sequenced into *tranches*
  - These are called CMO's or *Collateralized Mortgage Obligations*
- The failure of the CMO market was the primary (proximate) cause of the 2008 Credit Crisis in the U.S.

Cause:
1. Banks found mortage securitization profitable, needed volume 2. Loosened credit standards (ex. Alt-A "no documentation") 3. Property values dipped 4. Defaults increase 5. But, banks went to rating agencies, getting AAA ratings!!! 6. Blame financial engineers

Questions

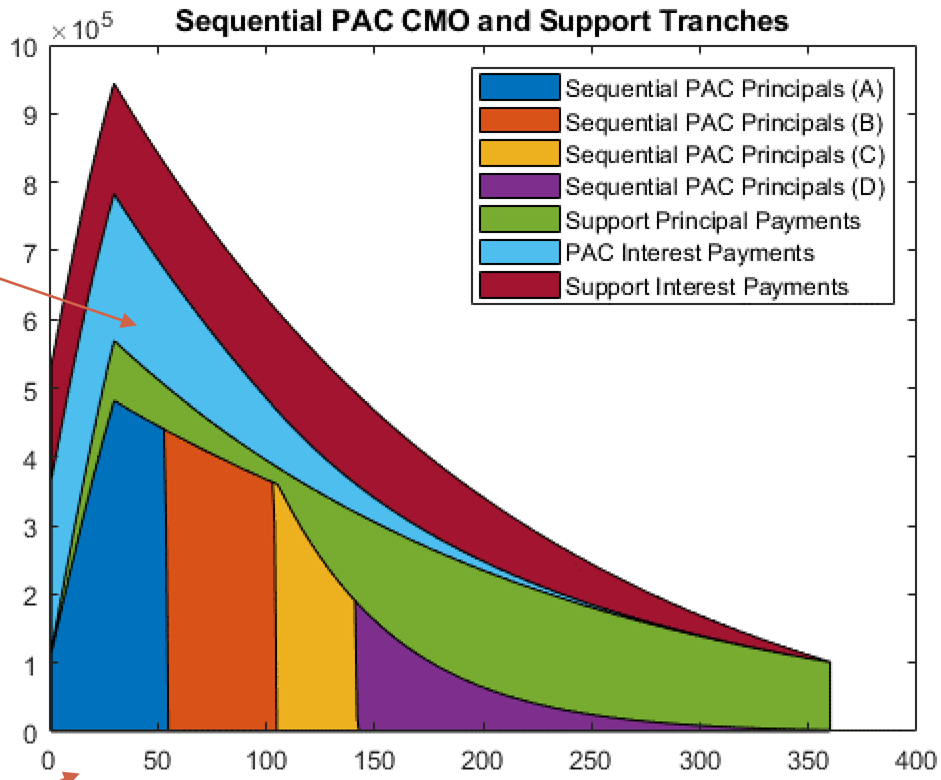
- How would you sell mortgages to investors?

- Hints
  - What do fixed income investors generally want?
  - Why don't mortgages fit this profile?
  - How can we make them fit?

- Notice, this is a *marketing* question

A sample allocation of CMO payments

Cash flow oriented
FI Investors



Shorter term
FI Investors

Longer term
FI Investors

Equity

How would you value a CMO?

How would you value a CDO?

1. SIMULATE - interest rates (risk-free), default rates, prepayment
2. CONSIDER CORRELATIONS ex. interest rates fall --> bonds refinance (prepay)
3. SIMULATE CASH FLOWS TO POOL
4. Determine from waterfall how cash flows distributed
5. Value individual tranches by finding the PV of each tranche's cash flows
6. Complete a risk assessment for each tranche

Summary of Fixed Income Valuation Models

- Value cash flows, annuities and perpetuities with different growth patterns and known discount rates
- Value assets with irregular payment and discounting patterns
- Recover risk-free rates from ZCB term structure
- Value FRNs and their components
- Value inflation-linked cash flows
- Value cash flows in different currencies
  - Compute the forward exchange rate using arbitrage
  - See appendix
- Value insurance-linked and other event-driven cash flows
- Value defaultable cash flows
- Next week: Portfolio-based equity valuation

APPENDIX: Exchange rates

RATES TABLE

1 US Dollar Rates table

Top 10 US Dollar	1.00 USD	Apr 30, 2019 14:24 UTC inv. 1.00 USD
Euro	0.891285	1.121975
British Pound	0.767611	1.302743
Indian Rupee	69.677374	0.014352
Australian Dollar	1.420660	0.703898
Canadian Dollar	1.345941	0.742975
Singapore Dollar	1.360817	0.734853
Swiss Franc	1.019249	0.981115
Malaysian Ringgit	4.137280	0.241705
Japanese Yen	111.372375	0.008979
Chinese Yuan Renminbi	6.735214	0.148473

Currency Terms

- Spot exchange rate – The price of foreign currency paid today
  - Direct quote: Units of foreign currency per USD
  - Indirect quote: USD per unit of foreign currency (e.g. GBP, EUR)
- Forward exchange rate – The price agreed today of foreign currency received and paid for in the future
- Currency swap – An agreement to exchange currency in the future
- Domestic, offshore and foreign interest rates
  - All risk-free rates are different
- Eurodollars
  - Dollar-denominated fixed income instruments traded outside the U.S.
- Purchasing Power Parity (PPP)
  - The theory that exchange rates are set so that equal value currency combinations purchase the same basket of real goods in different countries
- Interest Rate Parity (IRP) or covered interest arbitrage
  - The relationship between spot prices and forward prices of two currencies
- Arbitrage
  - Trading to make a risk-free profit from price discrepancies occurring in the market

How is the exchange rate determined?
- Markets
- Central banks/intervention
- Pegs
- Fixed exchange rates

Interest Rate Parity: Comparative forward rates

Interest rate parity illustration for direct quotation currencies

¥ 1 (X_{CNY}) $\xleftrightarrow{X_{CNY}}$ \$1

time = 0

$X_{CNY}(1+r_{CNY})^t$ $\xleftrightarrow{F(t)=?}$ $(1+r_{USD})^t$

time =t

Time	Now	In t years	In CNY
USD	\$1	$(1+r_{USD})^t$	$F(t)(1+r_{USD})^t$
CNY	¥ 1 (X_{CNY})	$X_{CNY}(1+r_{CNY})^t$	$X_{CNY}(1+r_{CNY})^t$

$$\boxed{\frac{F(t)}{X_{CNY}} = \frac{(1+r_{CNY})^t}{(1+r_{USD})^t} \equiv (1+\delta)^t}$$

Interest Rate Parity

Say that the Euro is trading at 1.30 USD per 1 EUR

If the 1 year interest rates (annual payment) are 8% and 10% for the EUR and USD respectively, what is the 1 year forward exchange rate?

Time	Now	In 1 years
USD	$1.30	1.3*(1.1)
EUR	€1	€1*(1.08)

$$F = \frac{1.3 * 1.1}{1 * 1.08} = 1.32\ USD\ per\ EUR$$

In this example, which currency is *appreciating* relative to the other?

Hint: Higher inflation results in currency depreciation