FIXED INCOME ANALYSIS

A. SPOT YIELDS & SPOT YIELD CURVES

r = YTM, a.k.a. Average Yield, a.k.a. Par Yield

r_m = Spot Yield, the rate applied to a specific cash flow in a specific year

- **Calculating Spot Rates from Yields-to-Maturity**
  - Method called ***Bootstrapping***. Try to calculate it indirectly from a series of current coupon bonds of different maturities.
  - *For example, there are a series of current coupon bonds with the maturities shown in the table below. The SPOT yields can be calculated using the following re-iterative procedure*

Maturity (yrs.)	*Coupon*	*Per.*	*Price*	*YTM*
0.5	*6%*	*1*	*100*	*6%*
1.0	*6.5%*	*2*	*100*	*6.5%*
1.5	*7.0%*	*3*	*100*	*7.0%*
2.0	*7.5%*	*4*	*99*	*8.05%*

1. *The SPOT Yield on the 6 month bond is 6.00% because it is effectively a Zero Coupon Bond*
   $P = (Coupon + Principal)/(1+r_{6\ month\ Spot})$
   $100 = (103)/(1+r_{6\ month\ spot\ yield})$
   $r_{6\ month\ spot\ yield} = .03 \rightarrow 6\%$ *annualized*
2. *SPOT on the 1 year bond is calculated a follows.*
   $P = (Coupon)/(1+r_{spon\ yield\ on\ 6\ month}) + (Principal + Coupon)/(1 + r_{spot\ yield\ on\ 1\ year})$
   $100 = (3.25)/(1+.03) + (103.25)/(1+r_{1\ year\ Spot})^2$
   $(1 + r_{1\ year\ Spot\ yield}) = (1.06614)^2$
   $r_{1\ year\ spot\ yield} = .03254 \rightarrow 6.508\%$ *Annualized*
3. *SPOT on 1.5 year bond is calculated as follows*
   $P = (Coupon)/(1 + r_{6\ month\ spot\ yield}) + (Coupon)/(1 + r_{1\ year\ spot\ yield})^2 + (Principal+Coupon)/(1 + r_{1.5\ year\ spot\ yield})^3$
   $100 = (3.5)/(1+.03) + (3.5)/(1.0325)^2 + (103.5)/(1+r_{1.5\ year\ spot\ yield})^3$
   $r_{1.5\ year\ spot\ yield} = .03512 \rightarrow 7.024\%$ *annualized*
4. *SPOT on 2 Year Bond is Calculated as follows*
   $P = (Coupon)/(1+r_{6\ mo.\ spot}) + (Coupon)/(1+r_{1\ yr.\ spot})^2 + (Coupon)/(1+r_{1.5\ yr.\ spot})^3 + (Coupon + Principal)/(1+r_{2\ year\ Spot})^4$
   $99 = (3.75)/(1.03) + (3.75)/(1.0325)^2 + (3.75)/(1.03512)^3 + (103.75)/(1+r_{2\ year\ Spot\ Yield})^4$
   $r_{2\ year\ spot\ yield} = .04066 \rightarrow 8.132\%$

- STRIPPING opposite of RECONSTRUCTION. Take Coupons, Strip them, & then resell them as strips priced with the Spot yield

B. *FORWARD RATES & SPOT RATES*

- According to the PURE EXPECTATIONS THEORY of the Term Structure of Interest Rates, SPOT Rates & FORWARD Rates are Related as follows (this is for bonds that pay interest once per year)
- For twice per year paying bonds, change the formula to periodic.

$(1 + r_{m+n})^{m+n} = (1 + r_m)^m(1+{}_mf_n)^n$

  - ${}_mf_n$ = m-year forward rate that matures in n years. Yield on n year bonds that is expected to prevail m years in the future
  - r_{m+n} = the currently observable yield on a bond that matures m+n years from now
  - r_m = currently observable yield on a bond that matures m years from now

For Example: a 1 year bond, 1 year in the future, is really a current 2 year bond. Thus, given the following table, what should be the 1 year forward rate on a 1 year bond?

Maturity	*Spot Yield*
1 year	*8.05%*
2 years	*7.90%*
5 years	*7.70%*
10 years	*7.45%*

$(1 + r_{m+n})^{m+n} = (1 + r_m)^m(1+{}_mf_n)^n$

$(1+r_2)^2 = (1 + r_1)^1(1 + {}_1f_1)^1$

$(1.079)^2 = (1.0805)^1(1 + {}_1f_1)^1$

${}_1f_1 = 7.75\%$

- **Spot Rates as Geometric Averages of Forward Rates**
  - The Observable n-year spot rate is really the geometric average of a series of future 1 year forwards rates and the observable 1 year spot rate:

$r_n = [\ (1+r_1)(1+{}_1f_1)(1+{}_2f_1)(1+{}_3f_1)..(1+{}_{n-1}f_1)]^{1/n} - 1$

C. *DURATION & CONVEXITY*

- PRINCIPAL RISKS of BOND INVESTMENT

  Credit Risk: Risk of Default

  Interest Rate Risk: Risk of Rising Interest Rates → Bond Price Decline, Higher Coupon Re-investment possibility

- HOW the PRICE of a BOND Responds to Changes in Yields

Modified Duration = $\mathbf{D}^* = (-dP/dr)/P$

Convexity = $\mathbf{C} = (d^2P/dr^2)/P$

$\%\Delta$ Bond Price = $(\Delta P/P) = - D^* \Delta r + (1/2)C \Delta r^2$

- ***Calculating Duration & Convexity for Conventional Non-callable Bonds***
  1. To Calculate the Macaulay Duration & Convexity of a Bond, 1st Calculate its YTM
  2. Set up the Following Table for Each Period (m = coupons paid per year)

Yr	Period	Cash Flow	PV of CF (r = $YTM_{periodic}$)	(n)(PV)	(n)(n+1)(PV CF)

$\text{Macaulay Duration}_{periodic} = \mathbf{D_p} = [\Sigma\ (n)(PV\ CF)]\ /\ \text{Bond Price}$

$\text{Macaulay Duration}_{annual} = \mathbf{D} = D_p / m$

Modified (adjusted) Duration = $\mathbf{D}^* = D / (1 + YTM_{periodic})$

$\text{Convexity}_{periodic} = \mathbf{C_p} = \{[\Sigma\ (n)(n+1)(PV\ CF)]\ /\ [(\text{Bond Price})(1 + YTM_{periodic})^2\}$

$\text{Convexity}_{annual} = \mathbf{C} = (C_p) / (m^2)$

Duration & Convexity as Measures of Interest Rate Risk

$(\Delta P / P) = - D^{*} \Delta r + (1/2) C \Delta r^{2}$

Since Interest Rates usually don't change much over a short period of Time, can actually eliminate the Convexity Part from the Equation. Therefore, the Volatility of a Bond's Price can simply be related to its duration through the following Equation. In this way, Modified Duration is the Measure of Interest Rate Risk.

$(\Delta P / P) = - D^{*} \Delta r$

Price Value of a Basis Point

Measurement of the absolute dollar change in the price of a bond as interest rates change. For example, when the interest rates change by one Basis Point.

$PVBP = -.0001 PD^{*}$

Also, Dollar Duration is the PVBP divided by .0001.

$\text{Dollar Duration} = -PD^{*} = (dP) / (dr)$

Also, there is Dollar Convexity, which is the dollar change in the price f a bond due to its convexity alone

$\text{Dollar Convexity} = (1/2) PC = (d^{2}P) / (dr^{2})$

Properties of Duration

1. Duration of a Portfolio is the Weighted Average of the Duration of the bonds in the Portfolio, with the weights being the percentage of the total portfolio that is invested in each bond, assuming the yields on all the bonds in the portfolio change in a parallel manner.
2. Duration is USUALLY INVERSELY related to the Coupon of the Bond: the higher the coupon, the lower the duration for a constant maturity.
3. Duration is Inversely Related to YTM: When YTM is high, Durations tend to be low
4. For ZERO Coupon bonds, the Macaulay Duration of a Bond EQUALS its YEARS to MATURITY; for Non-zero Coupons, Macauley Duration is SHORTER than the Number of Years to Maturity
5. Duration is Positively Related to the # of Years to Maturity for Bonds Selling at Par or Above. For DISCOUNT bonds, duration can rise as maturity increases up to a point: it then decreases toward the duration of a perpetual bond as maturity continues to increase.
6. Duration of a CALLABLE BOND depends on 3 Factors:
   a.) Duration of Bond, if not Callable
   b.) Ratio of the Price of an Equivalent, non-callable bond to the price of the callable bond
   c.) The Δ of the Imbedded Call Option in the Callable Bond

Uses of Duration

Duration is a measure of Interest Rate Risk (does not factor Credit Risk). Duration:Bonds = Beta:Stocks
Lower Quality Bonds have a higher return per Duration unit.

Limitations of Duration as Measures in Fixed Income Strategic Analysis

Duration is a GOOD measure of the Sensitivity of Bond Prices to changes in interest rates. BUT it is NOT a perfect measure of sensitivity because:

1. Duration measures bond price sensitivity to SMALL changes in Yields. If interest rate changes are LARGE, Convexity Must be taken into consideration
2. Duration measures the sensitivity of bond prices to instantaneous changes in interest rates. If interest rates change over a long period of time, the durations themselves change.
3. Bonds with IMBEDDED Options, such as CALLABLE Bonds, have price sensitivities that can be MUCH different from those measured by conventional modified duration. Rather than using the Macaulay Method, must use the EFFECTIVE METHOD

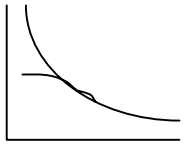
   $\text{Effective Duration} = (\Delta P / P) / (\Delta r)$

4. When yield curves shift non-parallel, 2 bonds with same duration end up with different durations after the shift.
5. Like YTM, Duration is NOT always the best way to analyze bond strategies. I.e., whether Bullet or Barbell strategy should not be adjudged by Duration Alone.

PROPERTIES of CONVEXITY

1. Convexity of a Portfolio is the Weighted Average of the Convexities of the bonds in the Portfolio with the weights being the percentage of the portfolio that is invested in each bond.
2. As yields rise, convexity falls if coupon and maturity are held constant
3. Convexity rises with the maturity of a bond if coupons & YTM are constant
4. Convexity falls as the coupon on the bond rises, if YTM and maturity are held constant. Zero Coupon bonds have high convexity.
5. Convexity of callable bonds is positive when interest rates are high and the bond is priced well below the call price. But when interest rates are low and the bond is priced close to the call price, the convexity of callable bonds become negative.

Call Price



Yield

$P_{CB} = P_{NCB} - C$

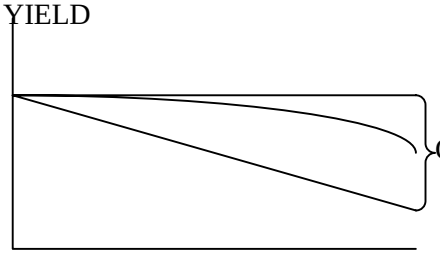
D. OVERVIEW: FORWARD RATE ANALYSIS

Overview of Forward Rate Analysis by Antti Ilmanen

Factors Affecting the Shape of the Yield Curve

1. Expectations of Future Interest Rates – If future behavior of interest rates that are implied by the current shape of the forward yield curve actually occurs, all investment strategies will produce the same result over a given time horizon. ONLY if the future behavior of interest rates is different from that already implied by the current forward yield curve will some strategies be superior to others.
2. Time Premiums – Liquidity preference suggests that investors prefer their bond investments to be as liquid as possible. Thus, long-term bond yields have to be higher than short-term bond yields in order to coax investors to place funds in longer, less liquid bond structures. But, it is difficult to estimate time/liquidity premiums because they are NOT stable nor constant across maturities and do not seem to be linearly related to duration.
3. Convexity Bias: Positive Convexity is a desirable characteristic in a bond because there is an average gain from convexity that biases the returns of such bonds upward. Negative convexity is an unfavorable characteristic of a bond.

YIELD



Current Expected Yields

Spot Rates

1 Year Forward Rates

Duration

As interest rate volatility increases, the shape of the yield curve should become more concave

Implications of Convexity

1. Analysts using the slope of the yield curve to predict interest rates must FIRST eliminate the effects of liquidity premiums and convexity bias on the shape of the yield curve before attempting to compute the forward rate that embody their forecasts. Problems with certain assumptions that are needed to actually do it.
2. Due to Convexity Bias, bonds with same rating & duration may produce different returns. (Ceteris Paribus, those with high convexity should produce lower returns)
3. If yield curve shifts in a way that is already expected by the market, no strategy will produce superior returns relative to any other strategy.
4. Bootstrapping only works in the intermediate term (2-10 years). In 0-2, time bias; 10+ convexity bias.

E. ANALYSIS - CALLABLE BONDS & OTHER BONDS w/Imbedded Options

$P_{CB} = P_{NCB} - C$

Option Adjusted Yield

For example: A 7% coupon, 5 year callable bond is priced at 102. The Value of the Imbedded call option of the bond has been calculated to be 5.00, based upon a conventional bond call option pricing model. Non-callable bonds of equal quality are currently yielding 6.00%. The option-adjusted yield spread between this bond and an equivalent straight bond is:

$P_{CB} = P_{NCB} - C$

$P_{NCB} = P_{CB} + C$

$P_{NCB} = 102 + 5$

$P_{NCB} = 107$

$OAY_{CB} = YTM_{NCB}$

OAY = 5.38%

Option Adjusted Spread = OAY_{CB} – Current $Yield_{NCB}$

OAS = 5.38 – 6.00 = (.62%)

The bond with the HIGHEST OAY is considered to be the most attractive bond, ceteris paribus.

Different Bond Structures

$P_{PB} = P_{NPB} + Put$

F. VALUATION MODELS FOR CALLABLE BONDS

Hopefully, will never need to actually price these on the test because they take too long

3 Types:

Binomial Lattice Model
Monte Carlo Method
Continuous Time Diffusion Method

G. OPTION ADJUSTED SPREAD

Bonds are often quoted in terms of their yield, rather than their price, so bonds with different coupons can be compared equally on the basis of return per dollar invested.

1. **Yield-to-Maturity**
   - $P_B = (CF_1/(1+r)) + (CF_2/(1+r)^2) + \ldots + (CF_n/(1+r)^n)$
   - Then Compare it with a Spread to Treasury
   - $P_B = (CF_1/(1+r_T+s)) + (CF_2/(1+r_T+s)^2) + \ldots + (CF_n/(1+r_T+s)^n)$

PROBLEM with this Method of Comparison

- YTM is 1 uniform Rate, applied to all cash flows produced by the bond. Ignores the true spot rates of the Cash Flows
- When use SPOT RATES to Discount a Bond, can define a target bond's spread over treasuries as representing a spread over the entire spot rate curve. This is Called the STATIC Spread

2. **Static Spread**
   - $P_B = (CF_1/(1+r_{T1} + ss)) + (CF_2/(1+r_{T2}+ss)^2) + \ldots + (CF_3/(1+r_{Tn}+ss)^n)$
   - But Problems arise with Callable Bonds and the character of cash flows from the non-treasury issues.
3. **Option Adjusted Spread**
   - Takes into account both the term structure and the volatility of interest rates. It replaces the traditional YTM spread over treasuries with an OAS spread as a way of determining the relative attractiveness of bonds.
   - OAS is the YIELD on a Bond over the Entire Yield Spectrum in excess of some benchmark yield curve after the effects of the imbedded call have been removed: IT is the yield spread over the benchmark yield curve at which the non-callable equivalent of the callable target bond would trade. Can be calculated using either binomial lattice or Monte Carlo methods. Require a computer to compute.

Value of a Target Bond's Imbedded Option (measured in Basis Points) can be estimated from the relationship:

$C_{bp} = \text{Static Spread}_{bp} - OAS_{bp}$

$\text{Static Spread} = YTM_{CB} - Y_{Treasury}$

Factors Affecting OAS & SS

1. Volatility of Interest Rates
2. Call Rule Assumption →

Using OAS to Determine the Relative Attractiveness of Bonds

As Volatility increases, the OAS over Treasuries decreases.
Thus, want to buy the bond with the highest OAS over Treasury

OAS Analysis: Going down the Wrong Path by Kopprasch

- Try using Scenario Analysis Instead

H. EFFECTIVE (option adjusted) DURATION & CONVEXITY

When have a bond with imbedded options, must use Option-adjusted analysis to re-compute the effective duration & effective convexity of the bond (using Binomial Lattice or Money Carlo Methods) since a change in Yield will affect the Cash Flow (unlike a non-callable bond where a change in yield will not affect the cash flow and therefore normal duration & convexity can be calculated)

1. Calculate the OAS of the TARGET BOND.
2. Shift the Benchmark Yield curve up a few basis points from its current level (r_0) to a slightly higher level (r_+)
3. Construct a new Binomial Interest Rate Tree (binomial lattice model) or select a new set of possible interest rate paths (Monte Carlo Method) for a bench mark
4. Add the OAS to each of the rates in the interest rate tree or along the various interest rate path
5. Based upon the new model constructs, calculate the new FMV for the target bond (P_+)
6. Starting back with the current benchmark yield curve (r_0), shift it downward a few basis points to a slightly lower level (r_-)
7. The Effective Duration and Effective Convexity of the Target Bond are then Calculated using the Following Relationships

Effective Duration = $[P_- - P_+] / [P_0(r_+ - r_-)] = [P_- - P_+] / [2P_0 (r_0 - r_-)]$

Effective Convexity = $[P_+ + P_- - 2P_0] / [P_0(1/2*(r_+-r_-))^2] = [P_+ + P_- - 2P_0] / [P_0(r_0-r_-)^2]$

I. ANALYSIS OF CONVERTIBLE SECURITIES

- These are really hybrids of Bonds & Equities

Know the Following:

Conversion Value = $\mathbf{kP_{CS}}$

Conversion Rate = **k** = # Shares Received by Converting 1 share of the Convertible

Market Price of Common Stock = $\mathbf{P_{CS}}$

Conversion Premium = (Market Price of Convertible/Conversion Value) – 1

Straight Value = $\mathbf{P_{pfd}} = (DIV_{pfd} / r_{pfd})$

Min. Value $_{pfd}$ = MAX: [P_{pfd} or kP_{CS}]

Analyzing Convertible Bonds

1. Determine the QUALITY of the Bond using the Conventional Techniques of Credit Analysis
2. Determine the GROWTH PROSPECTS of the Underlying Common Stock
3. Determine the MINIMUM VALUE of the Convertible Bond (Greater of Straight Value or Conversion Value)
4. Perform a PREMIUM ANALYSIS
   - *Investment Premium* = [1 – (Straight Value of Bond / Market Price of Convertible)]
   - *Yield Sacrifice* = $YTM_{Straight} - YTM_{Convertible}$
   - *Conversion Parity Price* = (Dollar Market Price of Convertible Bond / Conversion Ratio)
   - *Conversion Premium* = [(Market Price of Convertible/Conversion Value) – 1]
5. Determine a BREAKEVEN (Payback) TIME

Breakeven Time = $(MV_{Convertible} - Conversion\ Value) / (Dollar\ Coupon\ on\ Bond - (P_{bond})(Current\ Yield_{Stock})$

   - As a rule of Thumb, Payback time should be 3-5 years

6. May have to Value the Imbedded Options

$Dollar\ Value_{Bond\ with\ Imbedded\ Options} = Dollar\ Value_{equivelant\ straight\ bond} + Dollar\ Value_{Imbedded\ Option\ to\ convert} - Dollar\ Value_{Imbedded\ Call\ Option}$

Practical Problems with Convertibles

1. Thin Market
2. Anticipating Calls is Difficult

When to Convert a Convertible

1. When Current $Yield_{convertible}$ < Current $Yield_{Stock}$
2. ??

J. MORTGAGE BACKED SECURITIES (& their derivatives –REMICS)

- Mortgages are debt instruments that are backed by real estate collateral. Typically, mortgages generate a monthly stream of cash flows that are self-amortizing (both interest & principal)
- Often, mortgages are pre-paid (due to changing rates, property being sold, etc.)

Mortgage Passthroughs

- Mortgages can be securitized. Mortgage Passthroughs represent ownership of the Cash Flows.
- To be liquid, are generally backed by FNMA or GNMA or Fredie Mac.
- Are Subject to ***pre-payment risk***. Creates Uncertainty for Yield
- **PSA Standard Model** assumes that annual prepayments will occur at a constant percentage of the mortgage pool per month (CPR – Constant Percentage Rate). The Single Monthly Mortality Rate (SMM) of a mortgage is related to CPR as Follows

$$\mathbf{SMM = 1 - (1\text{-}CPR)^{1/12}}$$

From the SMM, it is possible to calculate the amount of pre-payments that SHOULD occur in a given month in a mortgage pool

$$Prepayment_{month} = SMM\ [\ Beginning\ Mortgage\ Balance - Scheduled\ Principal\ Payment_{month}]$$

The PSA standard benchmark (100% PSA) assumes that the CPR for a 30 year mortgage pool in the t^{th} month after the mortgages are issued (CPR_t) is as follows

$CPR_t = (.06)(t) / (30)$ if t < =30 months

CPR_t = 6% of t > 30 months

Slower or faster prepayment rates are then referred to as different percentages of Standard PSA. For example, 50% PSA means that pre-payments are at ½ the standard PSA 100% rate.

- To Calculate Yield & Cash Flows: Estimate Pre-payments using SMM & PSA model
- **Problems with PSA Convention**
  - Empirical evidence does not support the assumptions. When rates fall, prepayments accelerate more than the model predict (which assumes more of a constant stream of prepayments for reasons different than interest rates)
  - To reduce uncertainties surrounding the CASH FLOWS generated by Mortgage Passthroughs, derivative securities have been produced called **REMICS = Real Estate Mortgage Investment Conduits**
  - Most Common REMICs are **Collateralized Mortgage Obligations (CMOs)** and **Stripped Mortgage-backed Securities** (Commonly Interest Onlys or Principal Onlys). These have more steady streams of cash flows.

Collateralized Mortgage Obligations (CMOs)

- Structured as a Series of bonds (CLASSES or TRANCHES) whose cash flows were generated from the payments received from a pool of mortgages, or from a pool of mortgage passthrough securities..
- Certain Tranches have priorities.

  All Principal, including prepayments received, are first distributed to the holders of the A tranche securities until that tranche is retired

  Once A is retired, principal & prepayments received are then distributed to B Tranche, until retired; and so on.

  A TRANCHE bears the highest Pre-payment Risk.

Lockout Period: the expected time until the first principal payment is received. Investors often like this to be close to the maturity of a security, as it is with an ordinary bond
Window: the period during which repayments of principal are expected to occur. Investors like this to be as narrow as possible, as it is with an ordinary bond.
Expected Final Maturity: the date on which the last principal payment is expected to be made.
Stated Final Maturity: last possible date on which principal is to be repaid.

CMO-Tranches

1. **Planned Amortization Class (PAC) Tranche**
   - A bond which amortizes with a sinking fund schedule that is predetermined within a broad range of prepayment rates. It has a fixed principal payment schedule that must be met before other tranches receive principal payments. Thus, unless the prepayment speeds are much different than expected, PAC bonds can be expected to pay down principal, according to their stated specifications.
2. **Targeted Amortization Class (TAC) Tranche**
   - Like a PAC, a TAC has a sinking fund schedule. However, it will only be met if the prepayment rate rises up to some limit from its level at issuance, or falls down to a limit, but not both. Some Cash Flow stability, but not as much as a PAC. Will sell at higher yields than a PAC.
3. **Companion or Support Tranche**
   - Only 1 source of Cash flow for the payment of all tranches in a REMIC and that is the underlying mortgage themselves. Therefore, prepayment risk cannot be eliminated: it can only be redistributed. Companion Tranches are shock absorbers in the CMO structures. Will only be paid if excess prepayment is received. More uncertain, even higher yields.
4. **Very Accurately Defined Maturity (Stated Maturity Bond) Tranche**
   - Accretion from an accrual tranche can be used in combination with prepayments to retire sequential tranches; or the prepayments can be used to pay down one sequence of tranches, while the accretion is used to pay down a sequence of stated maturity bonds (SMB). Since accretion is highly predictable, stated maturity bonds will have no risk of having longer average lives and little risk of shorter average lives than specified.
5. **Jump Z Tranche**
   - A Z bond that moves immediately from the accretion stage to pay down upon the occurrence of some specified triggering event. [Z bonds have stated coupon rate, but the coupon is paid in more bonds rather than in cash].
6. **Principal Only (PO) Tranche**
   - A mortgage-backed security with the Coupon stripped from it. Sold at a Discount. Principal is returned in the form of scheduled principal repayments plus prepayments. Thus, the PO performance is dependent upon such prepayments. The more rapid the prepayments, the higher the yield on the bond.
7. **Interest Only (IO) Tranche**
   - Receive only the interest portion of the mortgage. IOs are sold at a discount to their notional principal amount.
8. **Floating Rate Tranche**
   - Can be backed by cash flows from fixed rate mortgages.?
9. **Inverse Floating Rate Tranche**
   - Bonds whose coupon rates move inversely with some specified market rate and usually by a leveraged amount
10. **Residual Tranche**
    - All REMICs contain a residual interest comprised of the excess CF over regular interest CF

- REMICS are held mainly by banks who prefer short & intermediate-term PACs, TACs, & Floaters
- 2nd Largest holders are insurance companies preferring short & intermediate-term Tranches that match the guaranteed investment contracts that they sell to their customers
- Money Managers & Mutual Funds are also in the REMIC market
- REMIC
- Regulated by the OFFICE of THRIFT SUPERVISION

ANALYSIS of MORTGAGE –BACKED SECURITIES
2 Ways to Analyze Mortgage-backed Securities: Static Cash Flow Analysis & Option-Adjusted Spread Analysis

Static Cash Flow Analysis
- Measure the Return on Fixed Income Securities using a Horizon Yield Calculation. Difficult to do because the reinvestment risk is high.
- Not Really done

Option Adjusted Spread Analysis
- $C_{bp} = Static_{bp} - OAS$
- Don't really understand it

K. ADJUSTABLE RATE MORTGAGES
- ARMs are Mortgages whose Coupon Interest Rates Adjust periodically, based upon changes in an underlying index interest rate.
- Main feature of ARM is the fact that its coupon is reset periodically.
- Analysis of ARM Passthrough depends on the Specific Parameters of the Security; including
  1. ***Interest Rate Index upon which Coupon is Based***
  2. ***Net Margin*** *(spread between coupon on the ARM and the interest rate index upon which it is based, usually expressed in basis points)*
  3. ***Adjustment Frequency***
  4. ***Interest Rate Cap*** → *maximum amount that the coupon rate is allowed to be under the terms of the ARM*
  5. ***Negative Amortization*** → *specify what happens in the event negative amortization occurs* → *a mismatch between the reset dates of the mortgages and the reset dates of the coupons*
  6. ***Lookback*** → *When reset, don't reset to the rate when set, but something like the rate that existed 2 months prior to the reset date*
  7. ***Teaser Rates*** → *Initial Coupon rates set on an ARM, which are usually below the normal spread over the interest rate index, and operate for a specific period of time.*
  8. ***Convertibility Options*** → *contained in some ARMs, giving the mortgagor the right to convert from an ARM to a fixed rate mortgage.*
  9. ***Stratified Resets*** → *If mortgages in the pool have different reset dates, may have some mortgages that reset every month making the pool more responsive to interest rates.*

ARM Programs
- An ARM program is a pool of Adjustable Rate Mortgages that have been securitized into ARM passthrough securities. 2 General types of programs exist:
  Conventional ARM: made up of conventional ARM pools. Most banks prefer to retain the ARM loans they make rather than securitizing them. Consequently, limited # of them.
  Agency ARM; constructed by Federal Agencies. Varying guarantees.

Analyzing ARMs

There are **3** ways of assessing the relative value of ARMS

1. **Net Effective Margin Analysis**
   - This is a Calculation that is done in 3 steps (too complex to be on exam)
     - Expected Cash Flows generated by Passthroughs are estimated assuming the interest rate index upon which the Adjustable coupon rate is based remains unchanged at current levels for the remaining life of the bond, using an assumed constant prepayment rate (CPR) underlying the mortgages in the pool
     - Trial & Error is used to determine the Bond Equivalent Discount Rate (semi-annual compounding) that will make the present value of the expected cash flows = current price of the ARM passthrough
     - Net Effective Margin is the difference (Spread) between the Discount Rate and the Current Level of the Interest rate index upon which the coupon rate of the ARM is based
2. **Option Adjusted Spread Analysis**
   - Using Large # of Scenarios (Monte Carlo Method), OAS over Treasury Yield curve that an investor in an ARM could be expected to earn can be calculated. The higher the OAS, the more attractive it is.
   - PRO- based upon a dynamic interest rate scenario (rather than assuming a static interest rate environment like Net Effective Margin) and it takes into account the value of the Embedded Option
3. **Duration Analysis**
   - Since Reset the rates periodically, the Duration Tends to be quite low.
   - Duration of an ARM is calculated using an OPTION ADJUSTED MODEL to find the Effective Duration
   - Effective Duration = $[P_- - P_+] / [P_0(r_+ - r_-)]$ = $[P_- - P_+] / [2P_0 (r_0 - r_-)]$
   - Generally, Effective Duration of ARMs range from 0.5 to 4.0 years
   - PROPERTIES
     - Longer Reset means Higher Duration
     - Lower Teaser Rate means Higher Duration
     - Higher Caps mean Lower Duration
     - Faster Prepayment mean Lower Duration
     - Falling Interest Rates mean Lower Duration

L. CREDIT ANALYSIS

Purpose: To determine the ability of a firm to make timely payment of its debt service obligations
S&P and Rating Agencies are slow to change their ratings. Thus, do an independent analysis.

CORPORATE BOND ANALYSIS

1. ***Adjust the Reported Financial Data***

Adjust Asset Values

CASH: Valued at Market
A./R: Valued at Stated amounts unless concerned about collectibility
INVENTORIES: Should be Valued at FIFO (restate from LIFO if necessary)
PPE: generally kept at stated values
Intangibles & Deferred Charges: Should be Written down to **ZERO** for credit analysis

Adjust Liability Values; Usually kept unadjusted

Short Term Debt (A/P & accruals) Usually left alone
Deferred Tax Liabilities: Often Transferred to EQUITY if not likely to reverse
LTD: Usually RESTATED to Market Value
Pension & Post-retirement Benefits: Replaced with UNFUNDED Pension Liability
Off Balance Sheet Liabilities; usually put back on to the balance sheet
Factored Receivables: Added back to assets and adding equal debt.
Operating Leases: Add PV to the Asset Side & = Liability (like capital leases)
Commitments & Contingencies; added to liabilities
Stock Options; may be treated as liabilities or equity based on MV

Adjust Shareholders Equity

Change to reflect difference between adjusted asset & liability values

Restate Revenues

To Reflect any obvious distortions created by factors such as uncollectible receivables, Long term receivables that are treated as current receivables and so forth

Adjust Expenses

Adjusted to Reflect Actual Cash Outlays as appropriate.

2. ***Analyze the Cash Flow of the Firm***

- Most important to determine the Trend and Outlook for the future for Cash from Ops – Cash from Investing.

3. ***Perform a Conventional Financial Ratio Analysis***

Financial Ratio	Investment Grade	Poor Grade
Pre-tax Interest Coverage	> 3.15x	< 1.92x
Long-term Debt to Capital	<35.9%	> 45.6%
Pretax Fixed Charge Coverage	> 2.17x	<1.55x
Pretax Funds Flow Coverage	>4.96x	< 3.01x
Operating Cash Flow/Debt	>31.6%	<18.8%
Free Operating Cash Flow /Debt	>3.4%	< (.5)%
Pretax Return on Capital	>13.0%	< 11.0%
Operating Income / Sales	>12.0%	< 9.3%

4. ***Assess the Volatility of the Firm***
   - One Measure of Risk may be the VOLATILITY of SALES, EARNINGS & CASH FLOW
   - (Cash + Expected Operating Cash Flow) / (Standard Deviation of Op. Cash Flow)
   - Forces contributing to Volatility include
     - Volatility of Unit Sales
     - Volatility of Product Prices
     - Degree of Operating Leverage (%of fixed costs that are in the operating cost structure) Hard to do, sometimes use a regression where Total Cost = a +b(sales) where a is the fixed cost and b is the variable cost. The lower b, the greater the operating leverage. May Also use FIXED Asset / TOTAL Asset as a surrogate for Operating Leverage
     - Degree of Financial Leverage (debt/equity, debt/assets, assets/equity)
     - %Δ income = Operating Leverage Effect * Financial Leverage Effect * % Δ Sales
     - %Δ income = (1 + (fixed operating cost/EBIT)) * (EBIT/EBT) * %Δ Sales
     - Measure BUSINESS & FINANCIAL Risk

5. ***Model Measures of the Probability of Bankruptcy***
   - TYPE I Error: Predict Firm won't go Bankrupt & then it does
   - TYPE II Error: Predict Firm will go Bankrupt & then it doesn't
   - Common Statistic is the **Altman Z-Score**

$Z = a[\text{Working Capital / Total Assets}] + b[\text{RE / Total Assets}] + c[\text{EBIT / Total Assets}] + d[\text{Equity}_{MV} / \text{Debt}_{BV}] + e[\text{Sales/Total Assets}]$

   - A,b,c,d,e are proprietary
   - Z Scores of a certain number indicate probability of Bankruptcy
   - Also, Calculated not from Balance Sheet, but also do may Adjustments

6. ***Examine the Protective Covenants & Bond Indenture***
   - Only marginally useful because they can be manipulated for legal reasons; or are not enforced or liberally interpreted by the courts; and it might be too expensive for bondholders to assert their claims & win in court

A Review of Credit Analysis of Corporate Bonds by Jane Tripp Howe

1. ***Analyze the Industry of the Issuing Firm***
   a.) Understand the Behavior of the Industry Relative to the General Economy
   b.) Understand the Growth Outlook for the Industry
   c.) Understand the Role Played by R&D
   d.) Understand the Competitive Structure of the Industry
   e.) Understand the Source of Supply of Raw Materials
   f.) Understand the degree and direction of Regulation
   g.) Understand the Labor environment
   h.) Understand the Accounting Methods used by an Industry
2. ***Perform a Financial Analysis***
   a.) Traditional Ration Analysis
      1. Analyze PRETAX INTEREST COVERAGE = (EBT + Interest)/ Gross Interest Expense
      2. Analyze OPERATING CASH FLOW = [NI + Non-cash Exp + Def. Tax – Non Cash Income / Total Debt]
      3. Analyze FINANCIAL LEVERAGE = (LTD) / (LTD + Equity)
      4. Analyze NET ASSETS / TOTAL DEBT
      5. Analyze WORKING CAPITAL

	Investment Grade	Medium Grade	Low Grade
Pretax Interest Coverage	> 5.35x	2.91 – 5.35x	< 2.91x
EBITDA Coverage	> 8.00x	4.82 – 8.00x	< 4.82x
Op Cash Flow / Debt	>43.8%	29.9 – 43.8%	< 29.9%
FCF_{op} / Debt	>20.2%	6.2 – 20.2%	< 6.2%
LTD / Total Cap	<33.2%	33.2 – 44.8%	>44.8%
Total Debt / Total Cap	< 39.7%	39.7 – 49.5%	> 49.5%

b.) Equity Oriented Analysis
- Look at DuPONT MODEL

ROE = (Pretax Income/Sales) * (Sales/Assets) * (Assets/Equity) * (1-t)
- Also look to Volatility of Revenue, Currency Risk, Quality of Management

3. Analyze the Bond's Indenture Provisions

A Review to GUIDE to Evaluating Sovereign Credits by Der Hovanesian

Analyzing Political Risk

1. Understand Centers of Decision Making
2. Understand ideological Beliefs of Political parties (especially future opposition)
3. Understand Political Stability
4. View Integration into International Political & Financial Arrangements
5. Stability of Racial, Ethnic, & Religious Relationships
6. Labor Relations & political influence of unions & demographic groups

Analyzing Economic Risk

1. Key National Economic Ratios
   - Debt Ratio = (External Debt / Current Account Earnings) → should be below 2.0
   - Debt Service Ratio = Debt Service / Current Account Earnings → should be below 25%
   - Net Financing Requirement = Current Account Balance / GDP → under 3%
   - Liquidity Import Cover = Reserves / Monthly Imports → want at least 3 mos.
   - Fiscal Discipline = National Budget Balance / GDP → want it close to 0 on average
2. Natural Resource Wealth
3. Industrial Diversification
4. Degree of Economic Growth or Development
5. Fiscal Policy
6. Inflation & Unemployment Rates
7. Free Floating Exchange
8. Foreign Trade & Current Account
   - Trade System, degree of Protectionism, Export Diversification, competitiveness
   - Types of Imports –Consumer, net debt with poor future; productive capacity is good
   - Sources of Foreign Exchange – (Ex –Im); (Tourism earnings) (FX sent home from abroad by citizens); (FX sent from foreign contributions)
   - Geographic diversification of Exports & Imports
   - Current Reserves of Exchange
   - Inflow of Capital & how invested
9. External Debt
   - Level of Foreign Debt as %of Current Account Income
   - Composition of External Debt

M: ASSET BACKED SECURITIES

- Asset Backed Securities are Fixed Income Notes & Bonds whose debt service is Paid from the Cash Flow that is generated from a Pool of Loans.

Automobile Loans

- Certificates for Automobile Receivables (CARs).
- Mature in < 6 years
- Collateralized by the automobiles upon which the original loans were written
- Self-amortizing notes that pay a series of equal monthly payments that represent part interest & part principal
- Prepayments can occur but they tend to be stable and independent of interest rates.
- Default rates are low (and easy to re-possess)
  - 2 main Types
  - **Grantor Trust**: allows a non-bank issuer of auto loans the ability to retain or to sell subordinated classes of debt (passthrough only)
  - **Owner Trust**: requires multiple trustees but permits credit enhanced subordinate classes of debt to be issued. Similar to CMO tranche

Credit Card Backed Notes

- Debt on cards has no true maturity date (due to revolving credit)

Home Equity Loans

- Securitized through REMICs

N: EVALUATING JUNK BONDS

Risk & Volatility

- Risk of Default is relatively quadruple that of investment bonds 4.8 – 1.7
- Higher Yields to compensate for this risk
- Industry Specific Junk Bond Default → can reduce through diversification

Analysis of High Yield Bonds

- Competitive Environment of firm
- Cash Flow Projections & Financial Flexibility
- FMV of Underlying Assets : Debts (& marketability of those assets)
- Capability of management
- Financial Leverage (Debt:Equity)MV
- Specific Provisions of Indenture