Fixed Income Review

Problem Set: fixed income review

1. LIST and DESCRIBE TWO Disadvantages of owning callable bonds.

Two disadvantages of owning callable bonds:

Reinvestment Rate Risk: If the bond is called, the bondholder will most likely have to re-invest the proceeds at a lower rate

Price Compression: If interest rates are falling, the price of a callable bond will be limited to the call price

2. EXPLAIN three limitations of yield to call as a return measure

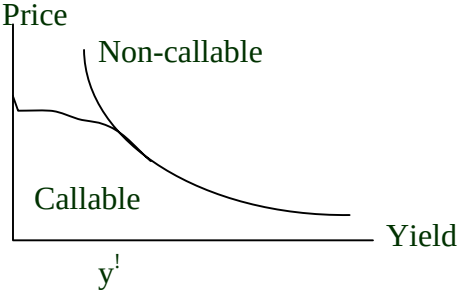
Yield to Call suffers from the following assumptions

Coupons are assumed to be reinvested at the yield to call
Investors are assumed to hold the bond until the call date
Issuers are assumed to call bonds on the call date

3. DESCRIBE the price/yield relationship of callable bonds. You may want to illustrate your argument graphically.

The price/yield relationship for a non-callable bond is downward sloping and convex. The solid line in the figure below represents this behavior.

Above a certain yield level, callable bonds behave in the same fashion as their non-callable counterparts. This is because at high yield levels, there is little chance of the bond being called. BELOW a certain yield level ($y^!$), investors begin to anticipate that the firm may call the bond. If the firm calls the bond, investors will receive the call price. Therefore, as yield levels drop further, the bond's market value is bounded from above by the call price. The dotted line in the figure below represents the price/yield relationship for a callable bond.



Note that the price behavior of the callable bond below $y^!$ exhibits PRICE COMPRESSION or Negative Convexity

4. DESCRIBE the relationship between the value of callable bonds and interest rate volatility. You may wish to argue your point graphically.

Recall from basic options pricing, that as volatility of the underlying asset increases, the value of call options increase. Since you are short the call option, the value of the callable bond should decrease as the value of the call increases.

5. CALCULATE Modified Duration for a bond with Macauley's duration of 3.511 years if the market interest rate is 7% (with interest paid semi-annually).

Modified Duration = Duration / (1+r)

$D^* = 3.511 / (1+ (0.07/2)) = 3.392$ years

6. Calculate the following for a bond maturing in 4 years, with a par value of $1,000, a coupon rate of 8% (paid semi-annually), a market rate of interest of 9%, and a duration of 3.4912 years.
a.) Calculate Modified Duration -
Modified Duration = Duration / (1+r) = 3.4912 / (1+(.09/2)) = 3.341

b.) Using the bond valuation equation, determine what the price of the bond would be if interest rates rose from 9% to 10%. What is the percent change in price?
Original Price: $967.02 (N=8, i/y = 4.5, PMT = 40, FV =1000)
New Price: $935.37 (N=8, i/y = 5, PMT = 40, FV = 1000)
Percentage Change: (935.37 - 967.02) / 967.02 = -3.2729%

c.) Using the bond valuation equation, determine what the price of the bond would be if interest rates dropped from 9% to 8%. What is the percent change in price?
New Price: $1,000 (N=8, 1/y = 4, PMT = 40, FV = 1000)
Percentage Change: (1000 - 967.02) / 967.02 = 3.4105

d.) Use the duration equation to determine the predicted price change with a yield change of 1% in either direction.
$dP / P = (-)(MD)(dr) = -3.341(.01) = -.03341 = -3.341\%$ for a one percent increase in YTM
$dP / P = (-)(MD)(dr) = (-3.341)(-.01) = .03341 = 3.341\%$ for a one percent decrease in YTM

e.) Give that convexity is equal to 13.72, reconcile the differences between what the bond valuation equation produces and what the duration equation produces as an answer for both a one percent increase and decrease in yield to maturity.
$dP / P = (-)(MD)(dr) + (1/2)(Convexity)(dr)^2 = -3.341(.01) + (1/2)(13.72)(.01)^2 = -3.2724$
$dP / P = -3.341(-.01) + (1/2)13.72)(.01)^2 = 3.4096$

7. DISCUSS difference in construction between a bullet and barbell strategy.
A BULLET strategy is composed of one or more bonds with IDENTICAL Durations. a BARBELL strategy is composed of a bond or set of bonds with Short Durations combined with a Bond or set of bonds with Long Durations, such that the average duration is equal to the bullet portfolio.

8. DISCUSS four types of asset backed securities.
Credit Cards - The underlying assets in the pool are credit card receivables
Home Equity - The underlying assets in the pool are secondary mortgages or balances on home equity lines of credit
Automobiles - The underlying assets in the pool are automobile loans
Student Loans - The underlying assets in the pool are student loans
Manufactured Housing - The underlying assets in the pool are installment credits issued to the buyers of factory built homes

9. DESCRIBE the cash flow characteristics of mortgage-pass through securities.

Mortgage pass-through securities have the following cash flow characteristics

- Mortgages have a monthly amortization schedule (monthly payment)
- Cash Flow = Monthly Cash flow of the underlying mortgages MINUS Servicing and Guarantee Fees
- There is a delay from the time of mortgage payment to the receipt of cash flow by the investor
- Each monthly payment (unless segregated) is composed of *Principal & Interest*
- In the US, homeowners have the right to pre-pay their mortgages at any time without penalty. The result is that mortgage pass-through cash flows are not known with certainty. Investors face *Principal Pre-payment Risk*

10. DEFINE IO and PO securities and DESCRIBE the cash flow characteristics of each.

(IOs & POs) securities slice the mortgage pool horizontally. POs receive only the principal payment portion of each mortgage payment while the IO receives the interest payment portions.

The PO Cash flow stream starts out slow and gets bigger over time while the IO cash flow stream starts out big and gets smaller over time. IOs have shorter effective lives than POs because of this payoff pattern.

The financial performance of a PO is extremely sensitive to pre-payment rates. Higher pre-payment rates cause a faster than expected return of principal and a higher yield. Because faster pre-payments are usually associated with lower market interest rates, PO prices are enhanced by falling interest rates. Ultimately, the entire face amount of a PO is repaid to the investor. The question of pre-payment is one of sooner or later.

Since IOs only receive the interest payment, it is possible that an investor could receive less cash flow over the life of the mortgage pool than was initially invested. If market interest rates fall the mortgage pool will be paid off sooner than expected leaving investors with no interest cash flow.

11. You have a 1-year 12% coupon bond with a price of $1,050. If the 6-month T-bill rate is 4%, what is the 1-year BEY spot rate?

YTM of bond = 6.667%

12. Given the following spot rate curve:

SPOT RATE	CASH FLOW	PV of CF
1-yr. zero = 7%	$80 @ 7, n=1	$ 74.77
2-yr. zero = 7.25%	$80 @7.25, n=2	$ 69.55
3-yr. zero = 7.50%	$80 @7.5, n=3	$ 64.40
4-yr. zero = 7.75%	$80 @7.75, n=4	$ 59.35
5-yr. zero = 7.75%	$1080 @7.75, n=5	$743.60
	PV of Cash Flows	$1011.67

a.) COMPUTE the Market Price of a five-year 8% annual coupon rate bond. (see cash flow table above)

b.) If the bond is selling for $1,025, what should you do?

Buy Zero Strips that match the bond's cash flow pattern for $1,011.67
Reconstitute the bond and sell it in the market place for $1,025. Net Profit of $13.33 per bond

c.) If the bond is selling for $1,005, what should you do?

Buy the whole bond for $1,005, strip off the coupons and sell them individually for $1,011.67. Net Profit of $6.67 per bond.

13. Given the following spot rate curve:

SPOT RATE	CASH FLOW	PV of CF
1-yr. zero = 9.50%	$90 @ 9.50%, n = 1	$ 82.19
2-yr. zero = 8.25%	$90 @ 8.25%, n = 2	$ 76.80
3-yr. zero = 8.00%	$90 @ 8.00%, n = 3	$ 71.44
4-yr. zero = 7.75%	$90 @ 7.75%, n = 4	$ 66.77
5-yr. zero = 7.75%	$1090 @ 7.75%, n = 5	$750.48
	PV of Cash Flows	$1047.68

a.) COMPUTE the market price of a five-year 9% annual coupon rate bond. (see cash flow table above).

b.) If the bond is selling for $1,075, what should you do?

Buy the strips for $1,047.68. Reconstitute them into a 5-year 9.0% coupon bond and sell it for $1,075. Your net profit is $27.32 per bond

c.) If the bond is selling for $1,025, what should you do?

Buy the bond for $1,025, strip the coupons and sell the pieces for $1,047.68. Your net profit is $22.68 per bond

14. You observe the following spot rate yield curve:

MATURITY	RATE	PRICE
1-yr. zeros	8.00%	$925.93
2-yr. zeros	8.50%	$849.46
3-yr. zeros	8.75%	$777.52

You have a 1-year holding period. What should you do?

Holding Period Return $\rightarrow$ HPR = [Cash Income + (P_{end} - P_{start})] / P_{start}

(a) Buy a 1 year bill? HPR on a 1-year bill is 8.0%

(b) Buy a 2-year note selling it after one-year? HPR on buying the 2 year note and selling it one-year later is (925.93 - 849.46) / 849.46 = 9.0%

or (c) Buy a 3 year note and sell it after one year? HPR on buying the 3-year note and selling it one year later is (849.46 - 777.52) / 777.52 = 9.25%

Note: The risk is the yield curve will shift upward or the short end of the curve will twist clockwise

15. You know the 1-year theoretical BEY spot rate is 8.3% (4.15% semi-annually) and you also know the 1.5 year spot rate is 8.93% (4.465% semi-annually). What is the implied six-month (1 period) rate one year (2 periods) from now?
$_2f_1 = [(1+.04465)^3 / (1+.0415)^2] - 1 = 0.051$ or 5.1%

16. You know the 5-year spot rate is 10% and you also know 4-year spot rate is 10.5%. What is the implied 1-year rate four years from now?
$_4f_1 = [(1+.1)^5 / (1+.105)^4] - 1 = 0.08$ or 8%

17. You know the 10-year spot rate is 10% and you also know the 11-year spot rate is 10%. What is the market telling you the one-year rate will be 10 years from now?
$_{10}f_1 = [(1+.1)^{11} / (1+.1)^{10}] - 1 = .1$ or 10%

18. Given the following spot rate curve (assume annual rates): 1 = 0.083; 2 = 0.09247; 3 = 0.09787; 4 = 0.10592. What is the implied 2-year rate 2 years from now? Note you must annualize this rate since it is a 2-year rate. Use the effective annual yield method (take the square root).
$_2f_2 = [(1+.10592)^4 / (1+.09247)^2] - 1 = .25366$ over 2 years or $(1.25336)^{1/2}-1=.12$ or 12% annually

19. Given the following spot rate curve (work this problem on an annual basis): 1 = 0.083; 2 = 0.09247; 3 = 0.09787; 4 = 0.10592; 5 = 0.11021. What is the implied 2-year rate 3 years from now?
$_3f_2 = [(1+.11021)^5/(1+.09787)^3 - 1 = .2746$ over 2 years or $(1.2746)^{1/2} - 1 = .129$ or 12.9% annually

Active Bond Portfolio Management Strategies

flashcard concepts

- Active Bond Management strategies attempt to capitalize on differences between your opinion of market direction and the market consensus. Passive strategies simply attempt to replicate the performance of a market index.
- Rate anticipation swaps are typically designed to take advantage of a contrary interest rate forecast. If you expect rates to fall, lengthen duration to capture larger capital gains
- The performance of yield curve strategies (bullets v. barbells) depend on (a) the MAGNITUDE of the change in yields and (b) the TYPE of yield curve shift (flattening or steepening)
- FLATTENING yield curves favor BARBELLS while STEEPENING yield curves favor BULLETS
- Barbells tend to have MORE convexity. Hence, if you think that interest rates will change a lot, a barbell with greater convexity may be preferred over a bullet
- Yield Spreads between callable and non-callable bonds depend on (a) the direction of interest rate moves, and (b) interest rate volatility. As volatility increases, the yield spread widens. As interest rates fall, the spread widens

- When making a yield spread swap, be sure that the dollar duration of both positions are equal so that you don't unknowingly make a yield Level bet at the same time
- Credit Spreads widen and narrow depending on the level of economic activity. A flight-from-quality typically occurs as the economy is improving (the credit spread narrows) and a flight-to-quality occurs when the economy falters (the spread widens)
- In a substitution swap, you simply swap one bond for another with similar qualities except for a higher yield
- A study by Teovs on OAS strategies shows that over the past ten years, mis-pricing of mortgage-backed pre-payment options has declined significantly

Problem Set: active bond portfolio management strategies by fabozzi

1. LIST and DESCRIBE the FIVE Steps of the Investment Management Process as outlined by Fabozzi

The investment management process is composed of five steps

Setting Investment Objectives: The liability structure of the institution will be a determining factor in the investment objective. An example is a bank. A Bank's investment objective is to earn a positive spread between funds paid to maintain liabilities (deposits) and funds received from its assets (loans and other investments)

Establishing Investment Policy: The investment policy considers the objectives and constrains of the client. Legal/Regulatory and Tax considerations must be taken into account. The result of the investment policy is the appropriate asset allocation

Selecting a Portfolio Strategy: The portfolio strategy must be consistent with client objectives and investment policy statements. Types of strategies include:

Active Strategies: Form expectations for each asset class and shift the asset allocation to take full advantages of expectations

Passive Strategies: Invest in the market index

Structured Portfolio Strategies: Immunization, Contingent Immunization, Cash Flow Matching, and Horizon Matching are examples

Selecting Assets: Consider maturity, credit quality, and embedded options when examining individual assets

Measuring and Evaluating Performance: Evaluation should take place against a "benchmark" portfolio or a "normal" portfolio. Benchmarks are typically market indexes. Performance should be measured against both the benchmark and the investment objective

2. LIST and DESCRIBE THREE types of Yield Curve Shifts. Be sure to discuss any correlation between the types of shifts

There are three types of observed Yield Curve Shifts:

a.) Parallel Shifts

b.) Twists (Flattening or Steepening)

c.) Humps (Butterfly Shifts)

Upward shifts are positively correlated with flattening twists. Upward, flattening shifts are postively correlated with less humpedness and downward steepening shifts are positively correlated with more humpedness

3. DEFINE an inter-market spread swap. When would you use this type of swap?

Inter-market spread swaps attempt to capitalize on the yield spread between two bonds that appears to be out of alignment with historical yield spreads. A good example is the spread between high and low quality corporate bonds (quality spread).

4. DEFINE a Substitution Swap. When would you use this type of swap?
In a substitution swap, a portfolio manager swaps bonds that are similar in all aspects except one has a higher yield.

5. DEFINE a Rate Anticipation Swap. When would you use this type of swap?
If you believe interest rates will rise, you will decrease the duration of your portfolio and if interest rates are going to fall, you will increase your portfolio's duration. Shifts in portfolio duration are typically achieved via RATE ANTICIPATION SWAPS. Hence, existing bonds are swapped for bonds with the appropriate duration in an attempt to capitalize on the expected shift in yields.

Indexing

flashcard concepts

- There are several advantages of Bond Indexing:
  - Low Risk of Under-performing the index
  - No dependence on active management's ability to forecast interest rates
  - Reduced investment advisory fees and custodial fees
  - Greater Control over the activities of investment managers
- There are several potential drawbacks to an indexing strategy:
  - Active Bond Management MAY be able to produce superior results
  - The index return may not satisfy the client's return or income objectives
  - Indexing typically limits the manager's flexibility
  - Many indexes exclude certain market sectors that may be attractive
- Adequate portfolio diversification can be achieved with fewer than 40 Bonds in a portfolio. However, diversification effects depend on the bond quality rating. It takes fewer bonds (4-8) to diversify a high quality (Aaa) bond portfolio than the number of bonds (20-40) it takes to diversify a lower quality (Baa) portfolio
- *Tracking Error* represents any differences between the index fund's actual return and the return to the benchmark portfolio. The sources of tracking error are:
  - Transaction Costs
  - Differences in portfolio composition
  - Differences between prices used to calculate the return to the index and the market price paid by the portfolio manager
- The Three Indexing Methodologies are
  - *Stratified Sampling*
  - *Optimization*
  - *Variance Minimization*
- Enhanced Indexing is a combination of active portfolio management strategies and the indexing strategy. The objective is to earn the index return at a minimum in order to offset the additional costs associated with added active management strategies

Problem Set: indexing by fabozzi

fixed income

1. COMMENT on the relationship between bond diversification and bond credit rating

Diversification effects depend on the bond quality rating. It takes fewer bonds (4-8) to diversify a high quality (Aaa) bond portfolio than the number of bonds (20-40) it takes to diversify a lower quality (Baa) portfolio

2. LIST and DESCRIBE THREE Advantages and THREE Disadvantages to using an indexing strategy

Advantages:

- Active Bond Management has historically produced poor results
- Reduced Advisory Fees
- Reduced Custodial Fees
- Greater control over the activities of investment managers

Disadvantages:

- Active Bond Management MAY be able to produce superior results
- The index return may not satisfy the client's return or income objectives
- Indexing typically limits the manager's flexibility
- Many indexes exclude certain market sectors that may be attractive

3. DESCRIBE THREE Factors to consider when deciding whether or not to employ an indexing portfolio strategy

There are Three factors to consider when selecting an indexing strategy:

- *Investor's Risk Tolerance*: Some indexes contain exposures to market sectors which may be relatively risky
- *Investor's Objective*: The index must be chosen to best suit the investor's total return objective
- *Regulatory Constraints*: Certain investor's are restricted as to the sectors of the market they can be exposed to

4. LIST THREE sources of tracking error between a bond index fund and its underlying benchmark portfolio. LIST TWO Additional logistical problems with employing an indexed portfolio strategy

Sources of Tracking Error:

- Transaction Costs
- Differences in Portfolio Composition
- Differences between prices used to calculate the return to the index and the market price paid by the portfolio manager

Logistical Problems

- Prices used to calculate the value of the index are most likely not the prices at which portfolio managers can execute transactions
- Reported prices for index calculation are bid prices. However mangers can only purchase at the ask price. Hence there will be bid-ask spread bias
- In the corporate sector, some issues may be highly illiquid. Therefore, the prices will be unreliable
- There may be considerable difficulty in determining the values of some mortgage-backed issues

- Total Return depends on the assumed reinvestment rate used in index calculation. The fund's actual reinvestment rate may be different than the rate assumed

5. LIST and DESCRIBE THREE approaches to building an indexed portfolio

a.) *Stratified Sampling or Cell Approach* - Here a market index is divided into cells representing different portfolio characteristics such as duration, coupon, maturity, market sector, credit ratings, call features, and sinking-fund features. The goal of the cell approach is to choose securities from the index which are used to represent an entire cell. The portfolio manager must be careful to make sure that the market value weights of each component are adequately represented in each cell.

b.) *Optimization Approach* - The optimization approach builds on the cell approach by including several constraints and objectives to the analysis. Mathematical programming is used to optimize the portfolio, subject to the stated return objectives and investment constraints

c.) *Variance Minimization Approach*: The variance minimization approach uses historical data to estimate the variance of the tracking error. Quadratic programming techniques are used to minimize the variance of tracking error. This approach is quite complex.

Liability Funding Strategies

flashcard concepts

- The SURPLUS of a financial institution represents assets - liabilities
- The ECONOMIC SURPLUS of a financial institution is defined as the Market Value of Assets - Market Value of Liabilities. Management of the economic surplus depends on the interest rate sensitivity of assets relative to liabilities
- The ACCOUNTING SURPLUS deals with how assets and liabilities are treated on the firm's financial statements. SFAS 115 is the new accounting standard that applies to the financial statement treatment of assets
- A HELD-TO-MATURITY security is an asset that the institution plans to hold to final or stated maturity. Accounting surplus will NOT be affected by valuation changes in these securities because the are not marked-to-market
- TRADING SECURITIES (short-term) and AVAILABLE for SALE (longer-term) securities are assets that the institution cannot hold until maturity or intends to sell prior to maturity. Unrealized gains or losses are recognized on the balance sheet and the accounting surplus will be affected by valuation changes due to the marking-to-market of these assets
- Interest rate risk is composed of 2 components: *Price Risk* and *Reinvestment Rate Risk*. These two components move in opposite direction for a given change in interest rates
- The goal of immunization is to equate the interest rate risk for liabilities with the interest rate risk of assets. If we do this, then assets and liabilities will move the same amount for a one-time shock to interest rates and the firm's surplus will not be adversely affected.
- You can immunize a single liability payment by (a) setting Macaulay duration equal to the investment horizon, and (b) setting the present value of the bond equal to the present value of the liability
- A single liability will cease to be immunized if (a) interest rates change MORE than once and (b) time passes. Therefore, your portfolio will need rebalancing to equate duration and investment horizon
- The portfolio that has the lowest re-investment rate risk is the portfolio that will do the best job of immunization

- Contingent Immunization is the combination of active management strategies and immunization techniques. As long as the rate of return on the portfolio exceeds some safety net return, the portfolio is managed actively. If the portfolio return hits the safety net return, then an immunization-strategy is implemented to "lock in" the safety net return
- If there are multiple liability payment dates, the conditions necessary to immunize the stream of liabilities are (a) portfolio duration must equal the duration of the liabilities, (b) the present value of the assets must equal the present value of the liabilities, and (c) the distribution of the durations of the individual bonds in the bond portfolio must be more widely dispersed than the distribution of the liability payment dates
- A dedicated portfolio is one in which each portfolio cash inflow is used to fund a portion of a future liability

Problem Set: liability funding strategies by fabozzi

1. LIST and DESCRIBE TWO Components of Interest Rate Risk. DESCRIBE a situation in which interest rate risk can be eliminated. What are some of the potential problems with your argument above?

Interest rate risk is made up of 2 components: *Price Risk & Re-investment Rate Risk*. If interest rates risk, the price of the bonds will fall. But at the same time, the amount received from re-invested coupons will rise. The net result is that the two components of interest rate risk move in opposite directions.

Immunization can be used to eliminate Interest Rate Risk. You can IMMUNIZE a SINGLE Liability Payment by:

- set Macaulay Duration = Investment Horizon
- set Present Value of Bond = Present Value of Liability

The potential problems with this strategy are:

a.) *Rebalancing an Immunized Portfolio* - A single liability will cease to be immunized if:
- Interest Rates Change MORE than once
- Time Passes

Thus, your portfolio will need rebalancing to equate duration and investment horizon. The rebalancing decision is a cost-benefit trade-off. There may be substantial transaction costs involved in rebalancing

b.) *Immunization Risk* - Additional considerations in the immunization problem are that the yield curve is assumed to be FLAT and any changes in the Yield Curve are PARALLEL. If shifts in the yield curve are non-parallel, then immunization is not assured

c.) *Credit Risk* - If individual issues within the portfolio default, you may not be able to achieve your target yield. Therefore, accepting increased credit risk will increase the potential target yield, but it also increases the risk that the target yield will not be achieved.

d.) *Call Risk* - The same story holds as in the credit risk example above. If bonds are called, you may not realize your target yield.

2. DESCRIBE TWO Necessary Conditions to immunize a Single Liability Payment. List TWO situations in which your immunized portfolio would need rebalancing

You can immunize a single liability payment by:

- Set Macaulay duration equal to the Investment Horizon
- Set the Present Value of the Bond = Present Value of the Liability

Rebalancing an Immunized Portfolio: A single liability will cease to be immunized if:

Interest Rates change MORE THAN ONCE

Time Passes

3. You wish to immunize a single liability payment that will occur 6 years from today. You are considering two portfolios to immunize this liability: (1) A coupon bond with duration of 6 years and (2) 50% in a 3-year zero-coupon bond and 50% in a 9-year zero-coupon bond. COMMENT on the effectiveness of each of these two portfolios in immunizing your liability

There are many bond portfolios that can be constructed to immunize a given liability

A bullet Portfolio (i.e., the individual securities in the portfolio all have about the same duration) will outperform a Barbell Portfolio with the same duration

IN general, the portfolio that has the LOWEST REINVESTMENT RISK is the portfolio that will do the best job of immunization

- If there is a high dispersion of cash flows about the horizon date (as in a barbell) reinvestment risk will be high
- If cash flows are more concentrated around the horizon, (as in a bullet) reinvestment risk will be low

4. You have $100 Million and would like to institute a Contingent Immunization strategy. Current rates of return for Immunization strategies are 10% and you are willing to accept an 8 1/2% safety net rate of return. Your Active strategy is to purchase an 8%, 25 year, semi-annual bond selling to yield 10%. You have a 6 year investment horizon.

a.) COMPUTE the minimum target portfolio value at the end of the investment horizon

Minimum Target Portfolio Value: $(100 \text{ Million})(1.0425)^{12} = \$164{,}783{,}136$

Note that you can purchase 122,333 bonds with your initial allocation of $100 Million since each bond sells for $817.44 (N=50, i/y=5, PMT=40, FV=1000)

b.) Compute today's dollar safety margin

$\$164{,}783136 / (1.05)^{12} = \$91{,}757{,}416$ equals the present value of the minimum target

So the safety dollar margin is $100,000,000 - $91,757,416 = $8,242,584

c.) If interest rates fall to 8% immediately after the purchase of the bond, is immunization necessary? Re-compute the dollar safety margin

In this situation, the bond price rises to $1,000. Since you own 122,333 bonds, your portfolio is worth $122,333,000.

Given the new interest rate, it would take:

$\$102{,}923{,}061 = \$164{,}783{,}136 / (1.04)^{12}$ to fund the minimum target value

Since your portfolio is currently worth more than the present value of the minimum target DON'T IMMUNIZE

5. COMPARE and CONTRAST multi-period immunization techniques and cash matching techniques. Be sure to Comment on the relative cost of these procedures

Multi-period Immunization

The conditions necessary to immunize a stream of liabilities are:

- Portfolio duration must equal the duration of the liabilities
- The Present Value of the Assets must equal the Present Value of the Liabilities
- The distribution of the durations of the individual bonds in the bond portfolio must be more widely dispersed than the distribution of the liability payment dates

In actual application, you must consider the immunization risk of non-parallel shifts in the yield curve. Therefore, in addition to the above constraints, you also want to choose the portfolio with the least immunization risk

Cash Flow Matching

A *Dedicated* Portfolio is one in which each portfolio cash inflow is used to fund a portion of a future liability. The procedure to build a dedicated portfolio is:

- Select the bond with a maturity date equal to that of the last liability payment date
- Buy enough in par value of this bond to fully fund the final liability payment
- Using a recursive procedure (working backwards) choose another bond that fully funds the second to last liability payment and so on

Differences between cash flow matching and multi-period immunization are:

- Cash Flow Matching has No duration requirements
- No rebalancing needed in a cash flow match
- With a Cash Flow Match, there is no risk of not being able to fund liabilities
- The COST of a cash match strategy is typically 3-7% higher than a multi-period immunization strategy

