

# APM Complete Illustrative Solutions

## Spring 2011

### 1. Learning Objectives:

2. The candidate will understand the variety of financial instruments available to managed portfolios.

### Learning Outcomes:

- (2a) Compare and select specialized financial instruments that can be used in the construction of an asset portfolio supporting financial institutions and pension plan liabilities.

### Sources:

Fabozzi, Handbook of Fixed Income Securities, 7<sup>th</sup> edition, 2005

- Chapter 10, U.S. Treasury and Agency Securities (pgs. 229-231, 241-245)
- Chapter 13, Corporate Bonds (pgs 305-327, 331-335)
- Chapter 14, Medium-Term Notes (pgs 339-340, 344-350)

### Commentary on Question:

This is a recall and synthesis question asking candidates to (a) evaluate the risks inherent in a given investment strategy for a given insurance liability structure, (b) apply their knowledge of corporate callable bonds and evaluate their appropriateness in backing an interest-sensitive liability structure, and (c) formulate an appropriate investment strategy for a specific product line and explain why the strategy is appropriate for that product line.

### Solution:

- (a) Evaluate the current investment strategy for the universal life product with respect to interest rate risk.

Wonka Life has a severe duration mismatch between assets and liabilities of 5.3 years, and a dollar duration mismatch of over \$2 million which exceeds the guideline of \$0.4 million. This exposes the company to significant interest rate risk.

The current investment strategy subjects Wonka Life to risks in rising interest rate environments, because securities may have to be liquidated at a capital loss to cover cash surrender value.

Wonka Life is also subject to reinvestment risk due to the current low interest rate environment. The strategy does not provide a sufficient hedge on interest rate risk due to the minimum product guarantee.

## 1. Continued

- (b) Describe the advantages and disadvantages of using callable corporate bonds to back this block of business.

**Advantage:**

Callable corporate bonds generally have a higher yield than comparable government bonds so as to compensate for the call risk. These bonds also have a shorter duration which better aligns to the company's liability duration.

**Disadvantage:**

Bonds can be called prior to the maturity or termination of the insurance contract. This may introduce uncertainty of asset cash flows and provide insufficient cash flows to fund those required by surrenders and terminations.

Moreover, bonds are more likely to be called as interest rates decline, which exposes Wonka Life to reinvestment risk. It would be difficult to find a bond yielding more than the minimum crediting interest guarantee. Unlike Treasury securities, corporate callable bonds may have higher degrees of default risks.

- (c) Recommend an investment strategy to better manage Wonka's exposure to interest rate risk for the universal life product and justify your recommendation.

The strategy must address the growing duration mismatch between assets and liabilities. Wonka Life can consider rebalancing the portfolio by investing in shorter maturity assets, or entering into an interest rate swap or other types of financial instruments such as interest rate floors and floaters.

## 2. Learning Objectives:

3. The candidate will understand the importance of the techniques and theory behind portfolio asset allocation.
6. The candidate will understand and apply portfolio management Quantitative Techniques.

### Learning Outcomes:

- (3c) Evaluate the significance of liabilities in the determination of the asset allocation.
- (6d) Calculate effective duration and effective key-rate durations of a portfolio.
- (6e) Contrast modified duration and effective duration measures.

### Sources:

Babbel, D. and Fabozzi, F. J., 199, Investment Management for Insurers, Chapter 17, "Effective and Ineffective Duration Measures for Life Insurers."

Tilman, Asset/Liability Management, Chapter 14, Asset/Liability Management for Life Insurers: Lessons Learned and Future Directions

### Commentary on Question:

This question was testing the candidates' understanding of the duration concept as applied to non-callable corporate bonds, as well as various insurance liabilities and surplus.

### Solution:

- (a) Describe considerations when calculating the effective duration for a portfolio of non-callable corporate bonds.

The effective duration assumes a parallel shift of the underlying yield curve, which may not be realistic. The common yield curve changes include shifts, twisting and steepening.

The changes in interest rates may change the bond's credit standing, which impacts the bonds price.

The default risk, liquidity risk, as well as currency and tax considerations may be important as well.

- (b) Describe how the effective duration of Wonka's Universal Life product will be affected by a decrease in interest rates.

The effective duration will be increased because policyholders may choose to stay, put in more premiums, or take out less policy loans, given the 4% minimum crediting rate guarantee. This extends out the cash flows as well as the effective duration.

## 2. Continued

- (c) Describe the risks of investing in agency mortgage pass-throughs to back Wonka Life's UL products.

Agency mortgage pass-throughs have prepayment risk, where prepayments increase with lower interest rates. The effective duration therefore decreases with lower interest rates.

The asset duration therefore moves in opposite directions with the liability duration when interest rates decrease, presenting a significant asset liability mismatch.

- (d) Calculate the effect of issuing \$2 billion in new insurance liabilities on Wonka Life's surplus duration.

$$D_s = (D_a - D_l) * A/S + D_l$$

$$D_a = 6. \quad D_l = 5.3$$

With new debt:

$$PV \text{ Assets} = 6,031,012 + 2,000,000 = 8,031,012$$

$$PV \text{ Liabilities} = 5,220,000 + 2,000,000 = 7,220,000$$

Surplus is unchanged at 807,912

$$\text{New Leverage } A/S = 8,031,012 / 807,912 = 9.94$$

$$\text{"New Surplus Duration} = 12.26$$

Surplus duration has increased. Existing duration was 10.6

- (e) Recommend a method for managing the surplus duration back to within guidelines.

The current surplus duration is larger than the guidelines. In order to reduce gap, a number of actions can be taken:

- Rebalance into shorter duration assets (e.g. shorter maturity corporate bonds, floating rate securities)
- Use derivatives to reduce the asset duration
- The leverage could be decreased by divesting blocks of businesses
- The liability duration can be modified by changing product characteristics of inforce products, or more likely, for new business

- (f) Explain whether it is possible to manage the asset duration to achieve a zero surplus duration.

This is theoretically possible, though practically difficult. From the formula we see that:

$$D_s = (D_a - D_l) * A/S + D_l$$

$$0 = (D_a - D_l) * A/S + D_l$$

$$D_a = D_l(A/S - 1) * S/A$$

So we need to set the asset duration equal to the above amount. This is effectively matching the dollar duration of assets with dollar duration of liabilities

### 3. Learning Objectives:

4. The candidate will understand the specific considerations relative to managing an equity and/or alternative asset portfolio within an asset allocation framework.

#### Learning Outcomes:

- 4b Assess a portfolio position against portfolio management objectives using qualitative and quantitative techniques.

#### Sources:

Maggin & Tuttle, "Alternative Investments Portfolio Management," Chapter 8

#### Commentary on Question:

This is a recall and analysis question testing the candidates' knowledge of private equity investments and their potential application to life insurance investment portfolios.

#### Solution:

- (a) Describe vintage year considerations and why they might be important with respect to evaluating performance of this type of investment.

Vintage year information reflects similar market opportunities and economic conditions in the year of investment. Private Equity performance should be evaluated against other funds of the same vintage year to reflect their similar opportunity set.

In addition, vintage year conveys information about funds life cycle. It can indicate whether the fund is near harvesting profits or still in the early stages. Vintage year also indicates the economic environment in which the fund began. If the fund originated at the end of a down economic cycle and had positive returns those positive returns could be due to the better economy and not the private equity investment.

- (b) Describe the general characteristics of this type of investment with regards to each of the following criteria:

- (i) Time horizon
- (ii) Liquidity
- (iii) Leverage

Time horizon for private equities is long and generally uncertain. The funds are expected to be locked in and future capital commitments are possible.

Private Equity investments are illiquid because of the lack of secondary market. High due diligence costs and low transparency create additional barriers for transactions. Some companies in later stages of development could be more liquid, for example, if they are close to an IPO.

### 3. Continued

Private equity investments generally would utilize leverage for Leveraged Buyouts. The use of leverage increases the return as well as the overall risk. Venture capital investments have low or no leverage.

- (c) Evaluate the suitability of a private equity investment for Wonka's surplus account.

To evaluate a private equity investments in the context of a surplus account, PE properties will have to be compared to the surplus account' stated objectives and constraints.

PE offers high expected returns, which fits with the surplus account objective of maximizing returns. While it is highly volatile, it offers some diversification benefit to the surplus account investments because of its low correlation to the rest of the portfolio.

PE investments are illiquid, while in general surplus account investments have to be more liquid. Surplus account needs a mix of short term funding but can permit some long term investments if the allocation to them is not overly high.

Legal, regulatory and operational concerns could make PE investment unsuitable for Wonka's surplus account, as well as lack of managerial expertise in house.

#### **4. Learning Objectives:**

8. The candidate will understand the behavior characteristics of individual and firms and be able to identify and apply concepts of behavioral finance.

#### **Learning Outcomes:**

- (8a) Explain how behavioral characteristics of individuals or firms affect the investment or capital management process.
- (8c) Identify and apply the concepts of behavioral finance with respect to investors, option holders and policyholders, including optimal behavior, real behavior, model behavior and empirical studies.

#### **Sources:**

*Behavioural Finance and Investment Committee Decision Making*, Arnold Wood, pp. 32-34

*Behavioral Finance: Theories and Evidence*, Alistair Byrne

#### **Commentary on Question:**

Commentary provided below each question component.

#### **Solution:**

- (a) Identify behavioral biases and factors that may lead Wonka's committees to less than fully rational financial decisions.

#### **Commentary on Question:**

Many candidates listed behavioral biases without identifying how the committees at Wonka Life would be influenced by them.

Board Not Diversified

- Mostly homogenous background (mostly current/former employees)

Pressure to Conform

- Dissenting views were not encouraged

Board Audit Committee only met once and Board Investment Committee did not meet at all.

Committees lacked focus/ Board Audit and Risk committee overlap.

When they did meet board committees typically followed task oriented reviews rather than process planning agendas.

Common Knowledge Syndrome

## 4. Continued

- (b) Identify potential fiduciary liability issues.

**Commentary on Question:**

Many candidates listed the fiduciary responsibilities without identifying how Wonka Life could be liable.

Duty of Care

- Meeting only once (audit) or not at all (investment) likely insufficient to meet duty threshold

Duty of impartiality

- Board has many ties, current and past, to Wonka management
- May be difficult to show that “due regard” for the interests of others

Duty to Delegate

- Investment committee has delegated authority but not responsibility
- Board should retain investment expertise to help establish investment and audit guidelines

- (c) Recommend appropriate changes for 2010.

Diversify board composition and ensure proper skill level.

- Add outside/independent directors

Board Audit and Investment Committees should meet more frequently.

Areas of responsibilities need to be made clear.

Chairmen of each committee should take steps to be an effective chair.

- Focus, diplomacy, communication

ERM report directly to the board.

CEO cannot determine own compensation.

## 5. Learning Objectives:

1. Candidate will understand and be able to follow the investment management process for insurance companies, pension funds and other financial intermediaries.

### Learning Outcomes:

- (1c) Determine how a client's objectives, needs and constraints affect the selection of an investment strategy or the construction of a portfolio. Considerations include:
  - Funding objective
  - Risk-return trade-off
  - Regulatory and rating agency requirements
  - Risk appetite
  - Liquidity constraints
  - Capital, tax and accounting considerations
- (1d) Identify and describe the impact on investment policy of financial and non-financial risks including but not limited to: Currency risk, credit risk, spread risk, liquidity risk, interest rate risk, equity risk, product risk, operational risk, legal risk and political risk.

### Sources:

"Liquidity risk Measurement," CIA Educational Note

### Commentary on Question:

This question focuses on issues related to liquidity management in the context of a life insurance company.

### Solution:

- (a) The Byrd Ratings & Analysis report has defined the Liquidity Ratio to be liquid assets / projected demand liability.

- (i) Define demand liabilities.

Demand liabilities are cash values that the customer can contractually withdraw on demand within the time horizon tested.

- (ii) Describe how the demand liability will be measured for the following Wonka lines of business:

#### Term Certain Annuity

These are payout annuities that have no cash surrender value. Therefore, there is no demand liability.

#### Universal Life

The demand liability is the account value, net of any surrender charges and outstanding loans.

## 5. Continued

### Group Life & Health

There is cash-flow unpredictability. Therefore, amounts on deposits and surplus positions should be considered as demand liabilities. Special considerations must be taken into account in a worst-case scenario.

(b) Critique Roach's assertion based on the information in their Quarterly Product Report.

- Roach is wrong.
- Most of the business is available for withdrawn at book value.
- Surrender charges decline to 0% over a 5-7 year period.
- Next year, annuities with 5% minimum guarantee will reach the end of the surrender charge period.
- There is a \$250 Million Market Value Adjusted annuities.
- When surrender charges decline, policy holder may increase surrender activity.

(c) Critique the former CFO's proposed liquidity management framework.

### Responsibility

- The company's management is responsible for setting guidelines, monitoring the position relative to those guidelines and taking action to manage the overall balance sheet to prevent a liquidity shortfall.
- Collaboration between ALM, product development, customer service, investment and senior management.

### Methodology

- Study over multiple time horizons.
- Liquidity Ratio is liquidity assets / projected demand liabilities.
- There are other assets considered to be liquid, such as high quality bonds, MBS, etc.

### Scenarios

- A Stress Scenario should be tested.
- Normal Scenario should reflect normal business but with somewhat more conservative assumptions.
- A Stress Scenario could be triggered by internal or external factors. For example, ratings downgrade of the industry, the loss of a large client or distribution channel, or a significant change in the market that causes a product to lose its attractiveness and the existing inforce block to leave.

## **6. Learning Objectives:**

1. Candidate will understand and be able to follow the investment management process for insurance companies, pension funds and other financial intermediaries.
2. The candidate will understand the variety of financial instruments available to managed portfolios.
4. The candidate will understand the specific considerations relative to managing an equity and/or alternative asset portfolio within an asset allocation framework.

## **Learning Outcomes:**

- (1a) Explain how an investment policy and an investment strategy can help manage risk and create value.
- (1c) Determine how a client's objectives, needs and constraints affect the selection of an investment strategy or the construction of a portfolio. Considerations include:
  - Funding objective
  - Risk-return trade-off
  - Regulatory and rating agency requirements
  - Risk appetite
  - Liquidity constraints
  - Capital, tax and accounting considerations
- (1d) Identify and describe the impact on investment policy of financial and non-financial risks including but not limited to: Currency risk, credit risk, spread risk, liquidity risk, interest rate risk, equity risk, product risk, operational risk, legal risk and political risk.
- (2a) Compare and select specialized financial instruments that can be used in the construction of an asset portfolio supporting financial institutions and pension plan liabilities.
- (4a) Explain how an investment policy affects the selection of an investment strategy or the selection of an optimal portfolio.

## **Sources:**

Liability-Relative Strategic Asset Allocation Policies. Pages 57 to 59

“Living with Mortality: Longevity Bonds and Other Mortality-Linked Securities”, by Blake, Cairns and Dowd, Institute of Actuaries, 2006 (Sections 3-5)

Balancing the opportunities in real return investments by Robert Bertram page 45-45-47

Liquidity Risk Measurement - CIA Educational Note

## 6. Continued

Derivatives: Practices and Principles. Page 37

Liability-Relative Strategic Asset Allocation Policies. Pages 44 and 56

### **Commentary on Question:**

The candidates were expected to provide recommendations on strategies that could be used to mitigate various risks facing pension plans.

### **Solution:**

Recommend risk reduction strategies that would help Wonka Life in managing the following risks of their Employees' Pension Plan, and justify your recommendations.

**Longevity Risk:** They can diversify their longevity risks. Balance their portfolio by seeking to exploit possible natural hedges involved running a mixed business of term assurance and annuity business. They can enter into a variety of forms of reinsurance with a reinsurance company. They can manage the risk using mortality-linked securities. These securities might be traded contracts (longevity bonds, annuity future, options, etc.) or over-the-counter contracts (mortality swaps or forwards).

**Inflation Risk:** Invest in TIPS or real return bonds. Invest in commodities. Commodities have the lowest correlation with stock market activity, so they are a good diversifier that provides a hedge against unexpected inflation. Invest in real estate portfolio. Real estate offers long term average returns of the CPI plus 5% and it also offers good long term protection against inflation. Invest in infrastructure portfolio. Infrastructure assets offer stable returns and pass through unanticipated inflation. Invest in timberland. Timberland is a good hedge against unexpected inflation. Returns are largely depending on organic growth. Increase exposure to equities. Inflation factors are best modeled as equity-like exposures. To properly hedge those exposures, plan needs some portion of the fund in equities.

**Liquidity Risk:** Invest in cash or other short-term assets (do not involve significant credit risk). Increase exposure to fixed income (e.g. bonds). Public bonds are more liquid than non-investment grade. Invest in marketable instruments where there is an active secondary market. Increase contribution.

**Currency Risk:** Enter into currency swaps and futures/forwards and other derivatives can be used to eliminate currency risk. Reduce allocation to foreign equities and fixed income.

## **6. Continued**

**Pension Funding Risk:** Pension funding risk is controlling the net of the assets and the liabilities (the deficit and surplus). The pension Plan is actually underfunded (Assets less than Liabilities). Investment policy, contribution policy and benefit policy are all very important and should be reviewed in a holistic manner in order to control pension funding risks. Plan sponsor should focus on liability-relative investment policies and approaches (liability matching portfolios). Plan sponsor should consider controlling volatility of surplus and contribution and expense through liability-relative investment policies such as interest rate hedging using swaps or other derivative instruments. Plan sponsor needs to review the allocation to risky assets to find an appropriate balance between the growth of the plan surplus and the risk to the funded status. A consideration might be given to reducing the allocation to risky assets.

## 7. **Learning Objectives:**

7. The candidate will understand the purposes and methods of portfolio performance measurement.

### **Learning Outcomes:**

- (7a) Describe and assess performance measurement methodologies for investment portfolios.
- (7b) Describe and assess techniques that can be used to select or build a benchmark for a given portfolio or portfolio management style.
- (7c) Recommend a benchmark for a given portfolio or portfolio management style.
- (7d) Recommend a performance measurement methodology.

### **Sources:**

Fabozzi HFIS Chapter 44 – Quantitative Management of Benchmarked Portfolios

### **Commentary on Question:**

This question focuses on managing issuer-specific risk in fixed income portfolios.

### **Solution:**

- (a) Explain how the manager of Portfolio C can use credit default swaps (CDS) to manage single issuer risk, while providing a similar cash flow pattern and achieving the original target total return.

The manager can use Credit Default Swaps to remove the existing exposures in the portfolio and to create new exposure that is suitable for benchmark matching without violating the single-name policy.

They can enter into CDS as the protection buyer, use CDS to hedge the part of over-exposure to specific single issuer.

For the exposures that are not over the exposure limit, they can consider selling some CDS protection to generate some income to cover the CDS spread they need to pay for the CDS protection.

- (b) Recommend approaches to manage issuer-specific risk other than using CDS to the managers of Portfolio A and B.

#### **For Portfolio A:**

I suggest the manager to reduce the issuer –specific risk by using diversification in its credit portfolio.

Relatively larger portfolio size and efficient transaction cost management will mitigate the higher transaction cost due to the frequent rebalancing requirement.

## 7. Continued

Portfolio A does not have a dedicated credit research resource. Managers will be forced to extend to issuers that are not highly rated by their credit analysts and therefore dilute the value of the credit research.

**For Portfolio B:**

I recommend using swaps as a total-return investment.

It does not require cash up front, so it is suitable for smaller funds with transaction cost constraints.

## 8. Learning Objectives:

2. The candidate will understand the variety of financial instruments available to managed portfolios.

### Learning Outcomes:

- (2a) Compare and select specialized financial instruments that can be used in the construction of an asset portfolio supporting financial institutions and pension plan liabilities.

### Sources:

V-C146-09 – “The role of Commodities in Investment Portfolios”

### Commentary on Question:

This is a recall and application question that requires candidates to (a) evaluate market conditions for commodity investing and (b) formulate a strategy using futures that will generate a profit if the investor’s view is realized.

### Solution:

- (a) Describe the economic drivers of return for long-only commodity indexation.
  1. T-Bill Return  
Return earned on the collateral  
Published indices assume T-Bills are used as collateral  
 $T\text{-Bills} = \text{real rate of return} + \text{inflation}$   
Expected inflation inherent in the return comes not from the commodities but from collateral
  2. Risk Premium  
Investor assumes price risk, need a risk premium  
Commodity producer has greater need for price protection  
The commodity producer has high fixed cost (large inventory)  
Buyer of the commodity is less exposed to change in prices  
Buyer of the commodity has a lower inventory  
Long-only investor extracts an insurance premium from the producer  
Risk premium is less important now than in the past
  3. Rebalancing  
Returns in commodities are not correlated with each other  
Assign a strategic percentage to each of the commodities  
Periodically rebalance to sell high and buy low  
Produce an incremental return

## 8. Continued

4. Convenience Yield
  - Product of low inventory relative to market demand
  - Premium that the buyer of the commodity is ready to pay to ensure supply
  - Known as “Backwardation”
  - Long-only investor sells the higher-priced nearby contract to buy the lower-priced distant contract
  - When inventories are at normal levels, return from convenience yield is not available

5. Expectational Variance
  - Market surprises
  - Unusual and unexpected occurrences
  - Not a source of return
  - Affects the patterns of returns

- (b) Describe the market conditions in which futures for Brent crude oil and copper are currently trading.

1. Brent Crude Oil
  - “Contango”
  - Upward-sloping forward curve
  - Cost of carry reflected
  - High or normal inventory
2. Copper
  - “Backwardation”
  - Markets think the cash price of the commodity will be lower in the future
  - Inventories are low
  - Tight supply (asset not currently available for purchase)

- (c) Describe a strategy that would yield a profit for a long-only investor if this price were realized.

Investor benefits from selling the contract with an earlier expiration at a higher price and rolling into a lower-priced contract that matures later.  
The Investor can roll up the cure as the more distant futures contract approaches maturity and the price increases.  
The long-only investor makes money even though the spot price does not change.  
Sell the July 2011 contract and buy January 2014 contract.

## 9. Learning Objectives:

5. The candidate will understand the specific considerations relative to managing affixed income portfolio within an asset allocation framework.

### Learning Outcomes:

- (5b) Assess a portfolio position against portfolio management objectives using qualitative and quantitative techniques.
- (5f) Demonstrate how to apply funding and portfolio management strategies to control interest rate and credit risk, including key rate risks.

### Sources:

Managing Investment Portfolios, Chapter 6, Section 4.1, 5.3

### Commentary on Question:

This is a recall and application question that requires candidates to (a) provide information about the definition and types of spread duration and (b) determine the asset allocation that will satisfy stipulated criteria.

### Solution:

- (a)
  - (i) Define spread duration.

Measure of how the market value of a risky portfolio changes with a parallel 1% shift in spread above the benchmark portfolio.

- (ii) Describe the major types of spread duration.

#### Nominal Spread

Spread of a bond or portfolio above the yield of a certain maturity Treasury

#### Static Spread or Zero-Volatility Spread

Defined as the constant spread above the Treasury spot curve that equates the calculated price of the security to the market price

#### OAS – Option Adjusted Spread

Current spread over the benchmark yield minus that component of the spread that is attributable to any embedded optionality in the instrument

- (b) The CFO has expressed concern that the current portfolio yield is too low, but Culebra's investment policy restricts spread duration to be no more than 3.0 years.
  - (i) Calculate the maximum allowable allocation to Corporate Bonds under the investment policy while keeping the allocations to Mortgages at the current level.

## 9. Continued

Spread Duration for a portfolio is the market weighted average of the spread durations of the component securities.

In order to keep the allocations to Mortgages the same, we must use cash and/or sell Treasury bonds to purchase more Corporate Bonds

Let  $b$  be the market value of total Corporate bonds (in Millions) in the resultant portfolio. Then,

$$\{(1015 - b) * 0 + b * 5.9 + 475 * 1.3\} / 1490 = 3$$
$$b = 653$$

The maximum allocation to Corporate bonds is 653 million.

- (ii) Recommend an asset allocation that rebalances the portfolio so that the asset dollar duration matches the liability while being sensitive to the CFO's concerns.

Dollar Duration of portfolio is:

$$(0 * 240 \text{ Million} + 11 * 275 \text{ Million} + 6.2 * 500 \text{ Million} + 2.2 * 475 \text{ Million}) / 100 = 71.7 \text{ million}$$

To increase the Dollar Duration to  $850,000 * 100 = 85$  million one would increase the allocation to Treasury Bonds while reducing cash.

This will increase dollar duration while limiting the spread duration to the desired target.

This addresses the CFO's concerns and manages spread duration restriction within Culebra's investment policy.

## 10. Learning Objectives:

2. The candidate will understand the variety of financial instruments available to managed portfolios.
5. The candidate will understand the specific considerations relative to managing affixed income portfolio within an asset allocation framework.

### Learning Outcomes:

- (2a) Compare and select specialized financial instruments that can be used in the construction of an asset portfolio supporting financial institutions and pension plan liabilities.
- (5h) Describe and critique the role of rating agencies in evaluating credit risk.

### Sources:

Crouhy, Galai and Mark, Risk Management, 2001, Chapter 12

V-C179-10: J. Coval, et al. the Economics of Structured Finance

V-c165-09: IMF, global Financial Stability Report, April 2008

### Commentary on Question:

This is a recall and synthesis question that requires candidates to demonstrate their understanding of the structure of Collateralized Debt Obligations (CDOs), the difficulty in rating them and the resulting deficiencies in how rating agencies evaluate them as well as the deficiencies in the existing disclosure requirements for them. Further, the question requires candidates evaluate the risks and rewards of a particular CDO tranche.

### Solution:

- (a) Describe the differences between collateralized loan obligations and collateralized high-yield bond obligations in terms of their default risk.

Collateralized loan obligation's default risk is lower than that of the collateralized high yield bond obligation because of the underlying collateral – loans are amortized and tend to have shorter duration and have higher recovery rates.

- (b) Calculate the maximum return available on the equity tranche assuming no arbitrage and ignoring CDO manager fees.

$$220 * 100 = 20 * 82 + 120 * 8 + 10 * s$$
$$S = 19.40\%$$

- (c) Analyze the risk/reward trade-offs of the equity tranche.

The equity tranche has the highest risk and the highest spread; however it is the first tranche to absorb default/losses.

## 10. Continued

- (d) Describe the challenges of rating CDO tranches.
- There is a narrow range in historical defaults and a paucity of historical data
  - Estimating default probability is difficult
  - Estimating correlation of defaults is difficult
  - A small change in parameter input can have material impact on the rating
- (e) Describe the deficiencies in solely using rating agency credit ratings to assess the default risk of a CDO.
- Rating models do not measure either the likelihood or intensity of downgrade
  - Rating models do not capture the underlying correlation appropriately
  - Rating agencies are slow to react to changes in market condition
- (f) Describe any limitations in the disclosure requirements for structured finance products.
- Lack of disclosure on the underlying instruments
  - Neither disclosure nor its frequency is mandated
  - Disclosure only focuses on the total balance
  - Disclosure is left to the discretion of the issuer

## 11. Learning Objectives:

1. Learning Objective: Candidate will understand and be able to follow the investment management process for insurance companies, pension funds and other financial intermediaries
4. The candidate will understand the specific considerations relative to managing an equity and /or alternative asset portfolio within an asset allocation framework

### Learning Outcomes:

- (1c) Determine how a client's objectives, needs and constraints affect the selection of an investment strategy or the construction of a portfolio.
- (4b) Assess a portfolio position against portfolio management objectives using qualitative and quantitative techniques

### Sources:

Chapter 26, The Use of Derivatives in managing Equity Portfolio

V-C127-09: Liabilities Relative Strategic Asset Allocation Policies

### Commentary on Question:

This question is testing the candidates' understanding of using equity index futures in managing an equity portfolio. It is also asking the candidates to review the rationale for a pension plan of investing in equities.

### Solution:

- (a) Calculate the hedge ratio and the number of S&P 500 Index futures contracts needed to replicate the equity exposure of this portfolio.

Hedge Ratio =  $B_s/B_f$

Future Beta = 1;  $B_s = 1.06$ . So the hedge ratio is  $h = 1.06$ .

Contract Size =  $500 \times 800 = 400,000$

Equity Exposure =  $500M \times 20\% = 100M$

Number of Futures needed =  $(h \times \text{equity exposure})/\text{contract size} = 1.06 \times 100M / 400,000$   
 $= 265$ .

So in order to hedge we need to long 265 index futures.

- (b) Analyze the pros and cons of using equity index futures in managing an equity portfolio.

Pros:

- Equity index futures creates equity exposure without needing to buy equity
- Index futures are a hedge for equity

## 11. Continued

- Can be used for excess cash by putting cash on margin
- Index has diversification
- No need to constantly buy and sell stocks – Less transaction fees
  
- Less resources than a managed account
- Transaction is quick
- Index has been shown to outperform managed funds on occasion
- Margin means you don't have to put up all the cash immediately to fund the equity (Liquidity)
- Standardized futures are more liquid than the managed portfolio

### Cons:

- Basis Risk – Changing factors make the index an inappropriate hedge in the future
- Pension plan equity investment may not align with the index
- Active management may bring higher returns
- Exposure to equity risk
- Tax implications
- Need to put up a margin
- May result in immediate excess cash that needs to be invested for the expiration date
- Large shift in the market still an issue

- (c) Describe the reasons for and against investing in equities for a pension plan like Hatfield's.

### For investing in equities:

- Hedge – Not all liabilities are bond-like, some are equity liked
- Pension liabilities have future accruals and the plan needs to have some component of equities to model the market-related risks in those future values
- Examples of market related risks: Inflation, salary wages, etc.
- Equity can have higher returns than fixed income
- Leverage – increase asset beta if under-funded in order to increase returns to make up the shortfall

### Against investing in Equities

- Equity risk – Volatility in equity returns
- More expertise is needed in managing equity
- Cost in rebalancing for equity futures
- Increase the allocation to equities to obtain a higher expected return on assets, which implies a higher discount rate and therefore a lower liability value and expected contributions

## 12. Learning Objectives:

3. The candidate will understand the importance of the techniques and theory behind portfolio asset allocation.

### Learning Outcomes:

- (3d) Demonstrate how to include risk management principles in the establishment of investment policy and strategy including asset allocation.

### Sources:

V-C148-09: Pgs. 61-64

V-C150-09: Pgs. 61-74

### Commentary on Question:

This is a recall and calculation question testing candidates' understanding of equity risk premium and Sharpe ratio.

### Solution:

- (a) Define equity risk premium.

Equity risk premium is the difference between the expected returns on stocks and on risk-free assets.

- (b) List the biases that exist in estimating the equity risk premium.

Potential biases include:

- International Survivorship Bias
- Historical biases in bond returns
- Failure to consider transaction costs and diversification benefits
- Failure to account for tax implications with pension plans
- Investor ignorance of risks, returns, and mean-reversion.

- (c) Critique the statement that the equity risk premium should be measured against the short term rate.

With CAPM, the risk-free rate is calculated against the rate on short-term risk-free assets, such as T-bills.

With intertemporal CAPM short term rate is not appropriate.

Investors will hedge against changes in investment opportunities, thereby changing the real risk free interest rate.

In intertemporal CAPM, we should use a long-term inflation indexed bond to obtain the risk-free rate.

## 12. Continued

Short-term rate may also not be applicable because:

- T-bills carry a liquidity premium
- T-bills are subject to inflation risk
- There is reinvestment risk for longer time horizons

(d) Calculate.

Equity risk premium =  $R_e - R_f = 8\% - 2.5\% = 5.5\%$ .

Sharpe ratio 1yr =  $(R_e - R_f) / \sigma = 5.5 / 20 = 0.275$

$$\begin{aligned} \text{Sharpe ratio for 5 years} &= \frac{(1 + R_1)^n - (1 + R_f)^n}{((\sigma_1^2 + (1 + R_1)^2)^n - (1 + R_1)^{2n})^{0.5}} \\ &= ((1 + 0.08)^5 - (1 + 0.025)^5) / (((0.2^2 + (1 + 0.08)^2)^5 - (1 + 0.08)^{10})^{0.5}) \\ &= 0.54 \end{aligned}$$

### 13. Learning Objectives:

4. The candidate will understand the specific considerations relative to managing an equity and/or alternative asset portfolio within an asset allocation framework.

#### Learning Outcomes:

- (4b) Assess a portfolio position against portfolio management objectives using qualitative and quantitative techniques.

#### Sources:

Maginn & Tuttle, Managing Investment Portfolios 3<sup>rd</sup> Ed. Equity Portfolio Management, Pgs. 353 and 357

#### Commentary on Question:

This is a recall and calculation question testing candidates' understanding of equity index construction methodology.

#### Solution:

- (a) Describe the characteristics of four common index weighting methods for this equity market segment.

##### **Price-Weighted Index**

Each stock is weighted according to its absolute value.

Sum of the shares prices divided by the adjusted number by shares in the index.

Represents the performance of a portfolio that simply bought and held one share of each index component.

##### **Value-Weighted Index (or Market Capitalization)**

Each stock in the index is weighted according to its market cap.

Share price multiplied by the number of shares outstanding.

Represents the performance of a portfolio that owns all the outstanding shares in each index component.

Self corrects for stock splits, reverse stock splits, and dividends because such actions are directly reflected in the number of shares outstanding and price per share for the company affected.

Biased to the shares of companies with the largest market capitalization.

##### **Float-Weighted Index**

Each stock in the index is weighted according to the number of shares outstanding that are actually available to investors.

Represents the performance of a portfolio that bought and held all the shares of each index components that are available for trading.

The weight of a stock in a float-weighted index equals its market-cap weight multiplied by a free-float adjustment factor.

### 13. Continued

#### Equal-Weighted Index

Each stock is weighted equally.

Represents the performance of a portfolio in which the same amount of money is invested in the shares of each index component.

Must be rebalanced periodically to reestablish the equal weighting.

- (b) Calculate the return of this market segment for each of the four index weighting methods identified in part (a).

#### Price-Weighted Index

Average of share Price December 31, 2010 / 453 / 4 = 13.25

Average of Share Price December 31, 2011 / 461 / 4 = 15.25

#### Value-Weighted Index (or Market Capitalization)

Market Value December 31, 2010 217,055

Market Value December 31, 2011 264,573

Value-Weighted Index return =  $264,573 / 217,055 - 1$   
2189%

#### Float-Weighted Index

Sum(Market Value December 31, 2010 x Free Float Factor) = 176,967

Sum(Market Value December 31, 2011 x Free Float Factor) = 217,904

Float-Weighted index return =  $217,904 / 176,967$   
23.13%

#### Equal-Weighted Index

Step 1: Calculate Price Change of each Share

YourWay Airways -42.86%

Snack International 66.67%

RugWorth Retail 10.00%

Import International 21.43%

Step 2: Equally weigh each price change or take the average

Equal-Weighted Index Return = Average (-42.86%, 66.67%, 10.00%, 21.43%)  
13.81%

- (c) Recommend a benchmark that is consistent with a passive management strategy of investing in this market segment and justify your recommendation.

A float-weighted index of the six shares is the recommended benchmark index. It reflects the supply of shares actually available to the public.

## 14. Learning Objectives:

6. The candidate will understand and apply portfolio management Quantitative Techniques.

### Learning Outcomes:

- (6d) Calculate effective duration and effective key-rate durations of a portfolio.

### Sources:

Tuckman B., Fixed Income Securities, Chapter 7, Key Rate and Bucket Exposures: Hedging with Key Rate Exposures, Pgs. 136-148

### Commentary on Question:

This question deals with developing a strategy to hedge interest rate risk exposure under a non-parallel shift in the yield curve.

### Solution:

- (a) Calculate X, Y, Z<sub>1</sub>, and Z<sub>2</sub>.

$$X = \text{Initial Value} - \text{Value of Liability (10 year shift)}$$

$$X = 109$$

$$Y = \text{Key Rate 01} / \text{Initial Value} * \text{Normalizing Factor}$$

$$Y = 170/237069 * 10,000$$

$$Y = 7.2$$

For Z<sub>1</sub>, and Z<sub>2</sub> the Key Rate Duration requires to be summed up.

2	0.3	0.024793
10	4.6	0.380165
30	7.2	0.595041
Total	12.1	

Or Sum up DVO1' = 286

With this information Z<sub>1</sub>, and Z<sub>2</sub>

$$Z_1 = \text{Key Rat Duration (2)} / 12.1$$

$$Z_1 = 2.5\%$$

$$Z_2 = \text{Key Rat Duration (30)} / 12.1$$

$$Z_2 = 59.5\%$$

- (b) Briefly describe the factors that affect the pattern of key rate sensitivities across key rates.

1. The pattern reflects the distribution of cash flows.

## 14. Continued

2. The sensitivity to short term key rates is likely to be relatively low since the duration (or DV01) of short-term cash flows is relatively low.
3. The sensitivity to longer term key rates is depressed by the fact that longer term cash flows are worth less than shorter-term cash flows.
4. The pattern of key rate exposures is affected by the choice of key rates.

(c) Estimate (ignoring convexity):

- (i) The change in the liability value.

$$\text{Structure: } \Delta P = \text{KR01}(2 \text{ Yr}) * R1 + \text{KR02}(30 \text{ Yr}) * R2$$

Liability

$$\Delta P = 20 * -.50 + 35 * .50$$

$$\text{Change in Liability} = 7.5$$

- (ii) The change in value of the hedge instruments.

Asset

$$\Delta P = 40 * -.50 + 20 * .50$$

$$\text{Change in Hedge Instrument Value} = -10$$

(d) Describe a strategy using any of instruments A, B, and C to limit the 10 year and 30 year Key Rate DV01 of the surplus portfolio to 5 and -5 respectively, based on Table 2 without changing the current portfolio mix.

- Candidate is required to set up simultaneous equations such that the surplus key Rates sum to the required amount by structuring the equations as follows:

	Eq 1(10yr)	Eq 2(30 Yr)
Inst A	a * 0	a * 0
Inst B	b * 10	b * 20
Inst C	c * 5	c * 15
+Asset	40	20
-Liability	-20	-35
Total	5	-5

## 14. Continued

Out of which the Candidate should recognize that no instrument a is required.

Eq 1 (multiplied 2) becomes

$$20b + 10c = -30$$

Eq 2 is

$$20b + 15c = 10$$

Eq 1 - Eq 2

$$-5c = -40$$

$$c = 8$$

$$b = -5.5$$

The strategy would be to hold -5.5 units of Instrument B and 8 units of instrument C.

## 15. Learning Objectives:

6. The candidate will understand and apply portfolio management Quantitative Techniques.

### Learning Outcomes:

- (6a) Define and evaluate credit risk as related to fixed income securities and derivatives counter parties.
- (6c) Describe, contrast and assess credit risk measurement techniques and models.

### Sources:

Crouhy, Galai and Mark, Risk Management, 2001

- Chapter 8 Credit Migration Approach to Measuring Credit Risk
- Chapter 9 The Contingent Claim approach to Measuring Credit Risk
- Chapter 10 Other Approaches: The Actuarial and Reduced-Form Approaches to Measuring Credit Risk
- Chapter 11: Comparison of Industry-Sponsored Credit Models and Associated Back-Testing Issues

### Commentary on Question:

This question is testing the candidates' understanding of credit risk measurement techniques and models.

### Solution:

- (a) Describe the two flawed critical assumptions underlying the CreditMetrics framework for modeling credit risk and the implications of these assumptions in determining a company's bond credit rating.

CreditMetrics assumes credit rating equals to credit risk, but it is not always the case.

It uses historical default rates which is not specific to company.

Distribution is skewed to right, i.e. mean is greater than median, which overestimates default risk for most companies.

Default risk changes continuously based on underlying company's risk factors, but the credit rating only changes discretely.

It assumes the same default risk and recovery rates for all companies with the same rating category, which is not always true.

- (b)
- (i) Describe the principal driving factors behind the KMV framework for modeling credit risk.

The principal driving factors for KMV are asset value, asset volatilities, capital structure, and correlation in the loan portfolio.

## 15. Continued

The KMV uses Merton's asset model with the implementation of default distance. Defaults process is modeled through the asset value. In Merton's model, when the asset value drops below the loan face amount at maturity, the firm will default.

The asset value volatility, therefore, plays a great role in determining the default time. Also, KMV uses the term structure of EDF, which is estimated by the default distance. Therefore, default depends on capital structure, asset value, volatility, and correlation.

- (ii) Describe how these address the flaws in the CreditMetrics model.

Now even two firms with the same credit rating, will have different default probabilities based on their own capital structure and firm asset value, which are firm specific to determine default.

Asset volatility returns and correlations are taken from market instead of from historical data. Therefore it captures better the relationship between risk factor and the default risk.

The EDF is used in this process which captures the current market assumption.

- (c) List the advantages and limitations of the CreditRisk+ model.

### Advantage of CFE

Can compute marginal risk contribution

Few inputs such as exposure and default rate

Easy to implement and has a closed form solution

### Limitations

Assumes credit risk has no relationship with market risk

Ignore migration risk

Does not work well with non-linear products like options

Only accounts for default credit event

Does not account for down-grade risk

- (d) Calculate the forward prices for each of the possible states at the end of one year for the BBB bond.

Forward curve with spread for AAA

Year 1 = 0.60% + 0.50% = 1.10%

Year 2 = 0.70% + 0.60% = 1.30%

Year 3 = 0.85% + 0.70% = 1.55%

## 15. Continued

Forward curve with spread for BBB

$$\text{Year 1} = 0.60\% + 1.00\% = 1.60\%$$

$$\text{Year 2} = 0.70\% + 1.10\% = 1.80\%$$

$$\text{Year 3} = 0.85\% + 1.20\% = 2.05\%$$

Forward curve with spread for CCC

$$\text{Year 1} = 0.60\% + 5.00\% = 5.60\%$$

$$\text{Year 2} = 0.70\% + 5.10\% = 5.80\%$$

$$\text{Year 3} = 0.85\% + 5.20\% = 6.05\%$$

$$V_{AAA} = 6 + 6/(1+0.011)^1 + 6/(1+0.013)^2 + 106/(1.0155)^3$$

$$V_{AAA} = 119.00$$

$$V_{BBB} = 6 + 6/(1+0.016)^1 + 6/(1+0.018)^2 + 106/(1.0205)^3$$

$$V_{BBB} = 117.43$$

$$V_{CCC} = 6 + 6/(1+0.056)^1 + 6/(1+0.058)^2 + 106/(1.0605)^3$$

$$V_{CCC} = 105.92$$

Year Ending Rating	Probability	Forward Price	Change in Value
<b>AAA</b>	6.30%	119.00	1.567022874
<b>BBB</b>	92.60%	117.43	0
<b>CCC</b>	0.92%	105.92	-11.52
<b>Default</b>	0.18%	40.00	-77.4346269

- (e) Calculate the 99% Credit VaR for this bond using the CreditMetrics framework for a one-year time horizon.

$$99\% \text{ VaR} = 40 - 117.43 = -77.43$$

- (f) Describe how the Credit VaR metric will be affected by the following situations:

- (i) Default recovery rate increases.

As default recovery rate increases, forward price of bond will be higher. Therefore the potential loss will decrease. Credit VaR will be lower.

- (ii) Credit spreads increase from current levels.

As credit spread increases, forward price would reduce in general. If the credit spread increases consistently by the same magnitude for all bonds for any rating, the forward price of each bond will decrease by the same amount. Therefore, credit VaR will not change.

## 15. Continued

- (g) Your supervisor suggests that since your portfolio losses exceeded the 99% VaR level last year, you are safe for the next 90+ years.  
Critique this suggestion.

The statement is not correct.

99% Var means 99% chance the credit portfolio will not drop below the 99% Var Level.

The credit portfolio may still deteriorate even it already hits the 99% Var level. It doesn't mean the portfolio is safe. Each year is generally independent of the next year. If exposure is left unchanged, we are in a similar position to last year with similar risk, hence may exceed VaR again this year.

Models are usually wrong in extreme tail scenarios.

- (h) Your CEO has lost faith in these models and suggests eliminating the credit risk modeling function.  
Outline your response.

Credit risk modeling function cannot be eliminated

Historically these models have been pretty consistent.

Credit risk is a major risk that should not be ignored. Further testing can be done on the models. However, credit models are hard to validate as default is a rare event.

For instance, can test them by validating the model input, testing against the cumulative credit gains/losses, stress-testing in scenarios when the model is likely to fail, explaining the current term structure of spread rates.

Need to know the weakness and strength of each of them, than we will have a better insight into how to interpret them. Models still can be useful to gain insights into possible future scenarios.

During volatile market, they will blow up and fail. But if you are aware of that, you can deal with it.

Need specialists to understand modeling and its limitations.

Models are evolving and continue to improve as we get more creditability.

The current state of the art of risk modeling does not allow for the full integration of market and credit risk.

Regulators need to be convinced that banks trust their models enough to use them to manage their loan portfolio before there is a real chance their internal models will be approved for regulatory capital calculations.

## 16. Learning Objectives:

3. The candidate will understand the importance of the techniques and theory behind portfolio asset allocation.

### Learning Outcomes:

- (3c) Evaluate the significance of liabilities in the determination of the asset allocation.

### Sources:

Litterman, Modern Investment management: An Equilibrium Approach, 2003

- Chapter 10, Strategic Asset Allocation in the Presence of Uncertain Liabilities

Maginn & Tuttle, Managing Investment Portfolios, 3<sup>rd</sup> Ed. 2008

- Chapter 5, Asset Allocation

### Commentary on Question:

This question is asking the candidates to demonstrate their knowledge of methods that can be used in the determination of the asset allocation for a pension plan.

### Solution:

- (a) Explain the differences between the Asset/Liability Management (ALM) approach and the asset-only approach to the strategic asset allocation process.

The ALM approach involves explicitly modeling liabilities and adopting the optimized asset allocation in relationship to funding liabilities.

The Asset-only approach does not explicitly involve modeling liabilities.

The ALM approach typically results in a higher allocation to the fixed-income instruments than an Asset-only approach.

Fixed-income instruments have pre-specified interest/principal payments that typically represent legal obligations of the issuer. Because of the nature of their cashflows, fixed-income instruments are well suited to offsetting future liability obligations.

- (b) Describe situations where an investor would favor the ALM approach.

The investor has below-average risk tolerance.

The penalties for not meeting the liabilities are very high.

The market value of liabilities is interest rate sensitive.

Risk taken in the investment portfolio limits the investor's ability to profitably take risk in other activities.

Tax incentives favor holding fixed-income securities.

- (c) Compare the appropriateness of the traditional Sharpe Ratio measure and the Risk Adjusted Change in Surplus (RACS) when managing the assets of this pension plan.

## 16. Continued

The traditional Sharpe Ratio measure considers only the risk and return of assets, ignoring the presence of any liability stream.

Some investment structures are better suited to hedge against the value of liabilities than others. This hedging ability should be taken into account when evaluating an investment, but is ignored when the Sharpe Ratio is used as an evaluation measure.

In contrast, the RACS recognizes liabilities by considering the expected change (mean) in surplus and the uncertainty (standard deviation) in the change in surplus.

The RACS measures the dollar return on surplus that is in excess of the risk-free rate of return against the risk taken relative to the risk-free strategy.

Hence RACS is more suitable when managing the assets of this pension plan.

(d)

- (i) Calculate the RACS for each of Portfolio A and Portfolio B.

$$\text{RACS}(t) = E_t[S_{t+1} - S_t (1+R_f)] / \sigma_t[S_{t+1}]$$

Where

$$\sigma_t[S_{t+1}] = \sigma_t[S_{t+1} - S_t (1+R_f)]$$

- (ii) Recommend which of Portfolios A or B should be selected, based only on the RACS.

<b>Portfolio A:</b>	
$S_t = A - L = 110 - 100$	10
$E(S_{t+1}) = 110 * 1.06 - 100 * 1.04$	12.6
$E_t[S_{t+1} - S_t (1+R_f)] = 12.6 - 10 * 1.03$	2.3
$\sigma_t[A] = 110 * 12\%$	13.2
$\sigma_t[L] = 100 * 10\%$	10.0
$\sigma_t^2[S_{t+1}] = 13.2^2 + 10^2 - 2 * 13.2 * 10 * 0.2$	221.44
$\sigma_t[S_{t+1}] = 221.44^{0.5}$	14.88
$\text{RACS}(t) = 2.3 / 14.88$	15.46%
<b>Portfolio B:</b>	
$S_t = A - L = 110 - 100$	10
$E(S_{t+1}) = 110 * 1.05 - 100 * 1.04$	11.5
$E_t[S_{t+1} - S_t (1+R_f)] = 11.5 - 10 * 1.03$	1.2
$\sigma_t[A] = 110 * 11\%$	12.1
$\sigma_t^2[S_{t+1}] = 12.1^2 + 10^2 - 2 * 12.1 * 10 * 0.9$	28.61
$\sigma_t[S_{t+1}] = 28.61^{0.5}$	5.35
$\text{RACS}(t) = 1.2 / 5.35$	22.43%

Since  $\text{RACS}(t)$  for Portfolio B >  $\text{RACS}(t)$  for Portfolio A, the manager would choose Portfolio B.

## 16. Continued

- (e) In addition to the information provided in (d), assume that the Pennywise Pension Plan has a payout rate of 8% per year.

- (i) Calculate the funded ratio for the Pension Plan at year-end 2009.

$$\begin{aligned} \text{Funded Ratio, } F_t &= A_t/L_t \\ \text{Portfolio B value in 2010} &= 110 \\ \text{Pension Liabilities in 2010} &= 100 \\ F_t &= 110/100 = 1.1 \end{aligned}$$

- (ii) Calculate the minimum excess return over liabilities that the fund must achieve in order to maintain the same funded ratio throughout 2010.

$$E_t[F_{t+1}] = F_t E_t[(1+R_{A,t+1}) / (1+R_{L,t+1})]^* [1/(1-p)] - p/(1-p)$$

To maintain the funded ratio, assume  $F_{t+1} = F_t$

$$E_t[(1+R_{A,t+1}) / (1+R_{L,t+1})] = [E_t[F_{t+1}] (1-p) + p] / F_t$$

$$\text{Define } R_{x,t+1} = (1+R_{A,t+1}) / (1+R_{L,t+1})$$

$$\begin{aligned} E_t[R_{x,t+1}] &= [E_t[F_{t+1}] (1-p) + p] / F_t \\ &= [1.1 * (1 - 0.08) + 0.08] / 1.1 \\ &= 0.9927 \end{aligned}$$

The minimum excess return over liabilities that the fund must achieve to maintain a funded ratio of 1.39 over a one-year period is then  $0.9927 - 1 = -0.73\%$

- (iii) Recommend a strategic asset allocation strategy, given that the Pension Plan is overfunded, and justify your recommendation.

- The Pension Plan is overfunded with a funded ratio of 1.1.
- Since the Pension Plan is overfunded, the funded ratio of 1.1 can be maintained even with a net negative asset over liabilities return.
- Overfunded pension plans can actually increase the probability of losing surplus by allocating more to equities (since equities are typically riskier).
- Recommend that the pension plan adopt a more conservative investing strategy, for example by allocating more to fixed income type assets in order to avoid the danger of falling below its target funded ratio.
- Other considerations that need to be taken into account:
  - Expected future growth of pension liabilities
- Type of pension plan formula (consider salary growth, inflation, expenses etc)

## **17. Learning Objectives:**

1. Candidate will understand and be able to follow the investment management process for insurance companies, pension funds and other financial intermediaries.
2. The candidate will understand the variety of financial instruments available to managed portfolios.
8. The candidate will understand the behavior characteristics of individual and firms and be able to identify and apply concepts of behavioral finance.

### **Learning Outcomes:**

- (1a) Explain how an investment policy and an investment strategy can help manage risk and create value.
- (1b) Identify the obligations of a fiduciary in managing investment portfolios and explain how they apply in a given situation.
- (1c) Determine how a client's objectives, needs and constraints affect the selection of an investment strategy or the construction of a portfolio. Considerations include:
  - Funding objective
  - Risk-return trade-off
  - Regulatory and rating agency requirements
  - Risk appetite
  - Liquidity constraints
  - Capital, tax and accounting considerations
- (2a) Compare and select specialized financial instruments that can be used in the construction of an asset portfolio supporting financial institutions and pension plan liabilities.
- (8c) Identify and apply the concepts of behavioral finance with respect to investors, option holders and policyholders, including optimal behavior, real behavior, model behavior and empirical studies.

### **Sources:**

Maginn & Tuttle, Chapter 3, Managing Institutional Investor Portfolios, pgs 65, 81-83

Fiduciary Liability Issues for Selection of Investments pgs 4-9

V-C146-09: The Role of Commodities in Investment Portfolios, pg 35

Byrne & Brools, Behavioral Finance: theory and Evidence, pgs 7-8

## 17. Continued

### **Commentary on Question:**

This is a recall and evaluation question that is asking the candidates to (a) describe purposes of establishing a SIP, (b) identify sponsor's fiduciary responsibilities and (c) identify and apply the concepts of behavioral finance, all in the context of a DC pension plan.

### **Solution:**

- (a) Describe the purpose of establishing a Statement of Investment Policy in the context of a DC pension plan.

The establishment of an IPS may be legally mandated.

The IPS documents the manner in which the plan sponsor is meeting the fiduciary responsibility to have an adequate process for selecting the investment options offered to plan participants as well as for periodically evaluating those options. A DC investment policy statement establishes procedures and governing principles to ensure that a myriad of individual investor objectives and constraints can be properly addressed.

In a DC plan, the plan sponsor does not establish objectives and constraints; rather, the plan participants set their own risk and returns objectives and constraints. The plan sponsor provides educational resources, but the participant is responsible for choosing a risk and return objective reflecting his or her own personal financial circumstances, and attitudes toward risk.

The primary focuses of an investment policy statement for a DC plan are as follows:

- Clearly distinguish among the responsibilities of the committee, the plan members, the fund managers, and plan trustee recordkeeper selected by the committee.
- Provide descriptions of the investment alternatives available to plan participants.
- Provide criteria for monitoring and evaluating the performance of investment managers and investment funds relative to appropriate investment benchmarks.
- Provide criteria for manager and fund selection, termination and replacement.
- Establish effective communication procedures for the fund managers, the trustee recordkeeper, the committee, and the plan participants.

## 17. Continued

- (b) Identify the responsibilities of ABC Company in developing the list of investment options for a DC pension plan.

Duties of the trustee

1. Loyalty
2. Care
3. Diversify Plan Assets
4. Impartiality
5. Delegate
6. Follow Statutory Constraints
7. Make the Property Productive
8. Regarding Co-Trustees
9. Act in Accordance with the Trust Agreement

Diversification: The sponsor must offer a menu of investment options that allows participants to construct suitable portfolios. Role is to provide participants with an array of investment choices with various investment objectives and asset classes with different risk and return characteristics that should enable participants to invest according to their varying investment needs.

ERISA establishes a safe harbor for DC plan sponsors against claims of insufficient or imprudent investment choice if the plan has at least 3 investment choices diversified versus each other, and a provision for the participant to move freely among options.

Other responsibilities include:

- Monitoring the funds' investment performance relative to their objectives.
- Monitoring fees and ensuring they are reasonable
- Terminating and replacing funds when appropriate.
- Assuring ongoing communication with participants and appropriate education resources.

- (c) Describe the behavioral biases facing DC plan members.

Individual investors are overconfident.

Individual investors fail to behave rationally.

Individual investors use the 1/n diversification strategy.

Enthusiasm of participants to invest in the stock of their employer.

Naïve extrapolation of strong past performance.

Participant sticks with default option.

Investors are reluctant to realize losses and tend to sell winners and hold losers.

Investors react to short-term performance records.

Investors tend to reallocate their cash to funds that own stocks with low future returns.

## 17. Continued

- (d) Assess the appropriateness of each of the investment options suggested by the committee member.

Money Market Fund has high liquidity, short-term, low return and risk with sufficient diversification properties.

Large Cap Fund has high liquidity, higher return and risk compared to Money Market Fund with sufficient diversification properties.

Venture Capital Fund seeks to earn a return in excess of public stock market. There is business risk, liquidity risk and lack of diversification. Venture Capital should expect large standard deviation of return. Low correlation with traditional asset classes bonds and equities, effective diversifying asset class.

Commodity Fund provides diversification but with volatility higher than equities. It may provide a good hedge on inflation.

Money Market Fund and Large Cap Fund are generally appropriate. Venture Capital Fund and Commodity Fund may not be appropriate given their higher risk, especially if only a limited number of options is offered.

- (e) Recommend changes to the above list of investment options and justify your recommendation.

The investment choices offered should represent asset classes with different risk and return characteristics and with sufficient diversification properties.  
Diversification: The sponsor must offer a menu of investment options that allows participants to construct suitable portfolios.  
Venture Capital Fund and Commodity Fund should be removed if only 4 funds are offered.  
Money Market could also be replaced.

Funds that could be considered:

- Balanced Fund
- Target Risk Fund
- Target Date Fund
- Life-Cycle Funds
- Fixed Income Fund
- Inflation-Indexed Fund
- Small Cap Equity Fund
- Foreign Equity Fund

## 17. Continued

- (f) Recommend a default investment option for members who refrain from selecting any options and justify your recommendation.

A product with a mix of investments that takes into account the individual's age, life expectancy, or target retirement date. An example of such a fund or portfolio may be a "life-cycle" or "target-retirement date" fund.

A product with a mix of investments that takes into account the characteristics of the employee group as a whole, rather than each individual (an example of such a fund or portfolio may be a "balanced" fund).

A capital preservation product (such as a money market account) based on the suggested options by the committee members, the Money Market Fund would be the most appropriate default investment option.

## **18. Learning Objectives:**

8. The candidate will understand the behavior characteristics of individual and firms and be able to identify and apply concepts of behavioral finance.

### **Learning Outcomes:**

- (8a) Explain how behavioral characteristics of individuals or firms affect the investment or capital management process.
- (8b) Describe how behavioral finance explains the existence of some market anomalies.
- (8c) Identify and apply the concepts of behavioral finance with respect to investors, option holders and policyholders, including optimal behavior, real behavior, model behavior and empirical studies.

### **Sources:**

V-C119-07: "From Efficient Markets Theory to Behavioral Finance," by R. Shiller, Journal of Economic Perspectives, Winter 2003, Pgs 84-96

V-C120-07: "The Efficient Market Hypothesis and Its Critics," by Malkiel, Journal of Economic Perspectives, Winter 2003, Pg. 75

### **Commentary on Question:**

The candidates are expected to demonstrate their understanding of feedback models.

### **Solution:**

- (a) Describe feedback models and explain how they relate to market inefficiency.

When asset prices go up, creating success for some investors, this may attract the attention of the public, leading more people to want to buy the asset hoping the recent price increases will be repeated. The increased demand causes further price increases.

Eventually, the bubble bursts, and prices fall as the expectations of further price increases disappear.

Prices are not sustainable because the prices are only high due to the expectation that they will rise further.

The same feedback can also produce a negative bubble as downward movements propel further downward movements, promoting word of mouth pessimism.

The downward price movements eventually result in prices that are unsustainably low.

## 18. Continued

- (b) Critique her strategy from the perspective of behavioral finance.

The company will have no guarantee that irrational investors will not continue to buy into the rising market for plantains, pushing their price even higher.

This potential for irrational investors to buy into rising markets limits the extent to which one should expect arbitrage to bring prices back to rational levels.

Since the short plantain futures position can lose an unlimited amount – plantain prices can increase indefinitely – the company will face unlimited risk.

Due to the limited length of the futures contracts (only 3 months), there is a significant chance that plantain prices will continue to rise relative to banana prices during the next three months, potentially resulting in large losses for the company.

The company should also determine if there is a reason other than irrational behavior that explains the divergence from the traditional plantain to banana price relationship.

- For example: reduced plantain production caused by a disease that affects plantains but not bananas.

## 19. Learning Objectives:

7. The candidate will understand the purposes and methods of portfolio performance measurement.

### Learning Outcomes:

- (7a) Describe and assess performance measurement methodologies for investment portfolios.
- (7b) Describe and assess techniques that can be used to select or build a benchmark for a given portfolio or portfolio management style.
- (7c) Recommend a benchmark for a given portfolio or portfolio management style.
- (7d) Recommend a performance measurement methodology.

### Sources:

Babbel & Fabozzi, Investment Management for Insurers, 1999

- Chapter 3, “A Performance Measurement System for Insurers,” by Babbel, Stricker & Vanderhoof

Fabozzi, Handbook of Fixed Income Securities, 7<sup>th</sup> Edition, 2005

- Chapter 44, “Quantitative management of Benchmarked Portfolios,” by F. Fabozzi

Maginn & Tuttle, managing Investment Portfolios: A Dynamic Process, 3<sup>rd</sup> Edition

- Chapter 12, “Evaluating Portfolio Performance,” by Bailey, Richards & Tierney

V-C168-09: Muirira, B. and H. Sierra, “Fixed Income Attribution: A Unified Framework – Part 1,” Journal of Performance Measurement, Fall 2006, pgs 23-35

V-C169-09: Muirira B. and H. Sierra, “Fixed Income Attribution: A Unified Framework – Part 2,” Journal of Performance Measurement, Winter 2006-2007, pgs 8-21

### Commentary on Question:

This question focuses on the evaluation of an investment manager’s performance. In particular, the candidates are expected to demonstrate their ability to explain in narrative form four key risk-adjusted performance measures.

### Solution:

- (a) Describe properties of a valid benchmark.
  1. Unambiguous – The identities and weights of the securities used in the benchmark are clearly defined
  2. Investible – It is possible to forgo active management and simply buy the benchmark

## 19. Continued

3. Measureable – The benchmark’s return is calculable on a frequent basis
4. Appropriate – The benchmark is consistent with the investment manager’s style and area of expertise
5. Reflective of current investment opinions – The manager has current knowledge of the securities within the benchmark
6. Specified in advance – Benchmark is specified prior to the start of an evaluation period and known to all interested parties
7. Owned – The investment manager should be aware of and accept accountability for the performance of the benchmark

(b) Explain in narrative form what these four Risk-Adjusted Performance Measures are used for and interpret the performance of the investment manager based on these measures.

1. Ex Post Alpha

Ex Post Alpha represents the excess return generated by the investment manager over the return required to compensate of the amount of systematic risk taken. The measure is based off of the CAPM model and uses the ex post SML as a benchmark.

The manager outperformed the benchmark indicating that the investment manager was skillful.

2. Sharpe Ratio

The Sharpe Ratio measures the excess return compared to the benchmark rate over the total risk (systematic and nonsystematic) of the portfolio. The benchmark is based on the ex post CML. A skillful manager will produce more average return relative to the risk free rate per unit of volatility than a passive investment.

The manager’s ratio was below that of the benchmark indicating that the manager was not skillful.

3. Treynor Ratio

The Treynor Ratio measures the excess return generated by the investment manager of the benchmark return per unit of systematic risk. The Treynor Ratio uses the ex post SML to form the benchmark. A skillful manager will produce returns that result in a slope greater than the slope of the ex post SML. This measure will always give the same results as Ex Post Alpha.

## 19. Continued

The manager's ratio was above that of the benchmark indicating that the manager was skillful.

### 4. $M^2$

$M^2$  measures what the rate of return for the account would have been if the investment manager would have taken on the same amount of total risk as the market index. This measure is closely related to the Sharpe Ratio and will always produce the same results. A skillful manager will generate value that exceeds the return of the market index.

The manager's return was below that of the benchmark indicating that the manager is not skillful.

Analysis:

In this instance, the Ex Post Alpha and Treynor measures indicated that the manager was skillful while the Sharpe Ratio and  $M^2$  indicated that the manager was not skillful. This can occur when the manager takes on large amount of nonsystematic risk relative to the amount of systematic risk. In this case the manager underperformed against the amount of unsystematic risk taken.

- (c) Describe other criteria the governors should consider when assessing the Investment Manager.

In addition to past performance, investment manager should be evaluated on the following qualitative criteria:

1. Physical – Organization structure, size, experience
2. People – Investment professionals, compensation
3. Process – Investment philosophy, style, strategy
4. Procedures – Benchmarks, trading, quality controls
5. Price – Investment management fees