

QFI PM Model Solutions

Spring 2020

1. Learning Objectives:

3. The candidate will understand the variety and assess the role of equities in investment portfolios. The candidate will demonstrate an understanding of the distinguishing investment characteristics and potential contributions to investment portfolios of the following major asset groups:
 - Real Estate
 - Public Equity
 - Private Equity
 - Infrastructure
 - Commodities
 - Hedge Funds

Learning Outcomes:

- (3a) Understand how the behavioral characteristics of individuals and firms influence the dynamics of equity markets.

Sources:

Addressing built in biases in Real Estate Investment, Cable, Neil

Commentary on Question:

This question tested knowledge of commonly observed bias amongst real estate investors and how a real estate investor can use that bias to his/her advantage. Overall, candidates performed as expected on this question. Answers were mostly correct, but were often incomplete and didn't always answer the question asked.

Solution:

- (a) Describe three key behavioral biases in real estate investing.

Commentary on Question:

Candidates performed as expected on this part. For full grading, a correct and satisfactory description of each bias listed was necessary. This question asked to describe 3 bias, 5 were present in the textbook and 5 are shown in this model solution.

-Framing bias

Investors are influenced by how an investment is labeled and presented. They'd rather make their investment decisions based on label than perform a comprehensive analysis of those investments.

1. Continued

- Anchoring bias
Relying too much on metrics with which one is comfortable, but may be outdated and/or irrelevant.
- Loss aversion bias
People care more about losing a dollar than gaining a dollar. They will do anything possible to avoid a loss.
- Home bias
Preference for what is close to one region and for what the investor is familiar with (familiarity bias).
- Herding bias
When individuals stop thinking independently and start to blindly follow the consensus instead. When people follow the actions of others in an attempt to reflect the 'correct' behavior for a given situation.

- (b) For each of the behavioral bias you described in (a) above:
- (i) Describe an experiment confirming the bias.
 - (ii) Recommend workarounds that would improve the investment decision process.

Commentary on Question:

Candidates performed below expectations on this question. Especially for part (i). They were asked to describe an experiment confirming the bias, but many candidates provided examples of the bias essentially repeating what was given in part (a). Only partial points were awarded for answering with an example. The solutions below are only one of many possible solutions.

Answers were better for part (ii), although unfortunately often too short to deserve full credit.

- (i) Experiments:
- Framing bias
2 tests group are asked to taste different strawberry jams and indicate their preference. In both cases, jams are labeled as "Elite", "Premium", "Regular" and "Economic". For the first group, there are no differences among jams except for the label. For the second group, the jams are different, but distributed randomly regardless of the label. A preference for "Elite" or "Premium" would indicate that they were influenced by the labels.

1. Continued

-Anchoring bias

In a test, an imaginary hockey pool is created in which participants are asked to create their fantasy team based on statistics provided. Participants are given past average goal and pass per game, age of players, prospect of their teams for next season and prospect for the different players. Relying too much on past average goal and pass per game would overweight the selection toward older players and neglect rookies, which prospect may be good.

-Loss aversion bias

In an experiment, propose 2 investments:

-The first with a 50% probability of a 50% gain and a 50% probability of 10% loss.

-The second with a sure 5% gain.

Although the expectation for the 1st is a 20% gain, 4 times the expectations for the second. Loss averse investors will select the second.

-Home bias

Volunteers in an experiment are shown exactly identical pastries, but those pastries are given different names for the experiment. Some are English sounding name; others have names from foreign languages. If a majority of volunteers opt for the pastries with English names, this demonstrate a home bias.

-Herding bias

A group of people is submitted a list of choices to make. They first make their choices without influence. Then, they are told that a majority made different choices than theirs and are asked if they want to rethink their decisions. Updating their choices would clearly demonstrate a herding bias.

(ii) Workarounds:

-Framing bias

Instead of focusing on labels such as “core” or “core+”, look at tenant risk and lease risk.

Diversify on the basis of tenant risk and lease structure.

-Anchoring bias

Focus on income returns over capital returns.

Place more emphasis on a property’s yield than its price. Yield gives a better indication of relative value.

Do not anchor on past growth rate or performance. There is no guarantee that such performance will continue.

1. Continued

-Loss aversion bias

Adopt a consistent investment process with a disciplined buy and sell strategy.

Don't hold on poor investments just to avoid crystallizing a loss.

Look at your real estate investment portfolio as if you don't own them.

Would you buy them today? If not than its time to sell.

-Home bias

Diversify across geography.

Diversify income streams. Income returns is less volatile than capital return.

Look abroad for more attractive valuations.

-Herding bias

Acknowledge that you are vulnerable to your emotions during a downturn.

Resist the urge to act impulsively.

Take a long-term view.

Be opportunistic. Investors who have enough resources can take advantage of others' forced selling during a downturn.

Be contrarian.

- (c) Explain why behavioral finance could be an important tool in shaping investment decision-making, particularly in the real estate investment area.

Commentary on Question:

Candidates performed as expected on this question. Quality and completeness of explanation provided made the difference between earning full credit or not.

Why real estate is a ripe area for behavioral biases:

-Physical assets may inspire irrational emotions to investors.

-Real estate market show a higher level of market inefficiency.

-There is no central exchange, thus there is a lack of transparency and delayed price discovery.

-Market is less liquid, inability to short.

Why behavioral finance can be an important tool:

-Investors and markets are not always rationale.

-Knowing other market participants inherent bias may allow an investor to gain a valuable advantage.

2. Learning Objectives:

1. The candidate will understand how to work with the variety of fixed income instruments available for portfolio construction.

Learning Outcomes:

- (1c) Demonstrate an understanding of cash flow patterns and underlying drivers and risks of non-agency mortgage-backed securities and commercial mortgage-backed securities.
- (1g) Demonstrate an understanding of commercial mortgage backed securities.

Sources:

Chapter 20 CMBS - Geltner Miller Commercial Real Estate Analysis and Investments

Commentary on Question:

This question tests the candidates' knowledge of commercial mortgage backed securities (CMBS), including understanding how different tranches are constructed and how the cash flows are distributed. Overall, the candidates performed as expected on this question.

Solution:

- (a) Describe four reasons the value of the underlying mortgages prior to tranching and securitization could be worth less than the total value of all the issued tranches.

Commentary on Question:

The candidates performed below average on this section. Most candidates successfully identified that CMBS provide greater variety of tranches with different risk and reward profiles and are more useful to investors. Only a few candidates identified increased liquidity, efficiency gains, and cost reduction due to tranching and securitization. Points were given to other reasonable answers.

- Greater variety of the CMBS tranches are more useful to the greater variety of investors;
- Senior tranches attract relatively passive or distant investors, who do not have specialized real estate expertise;
- Increased liquidity, at least for some tranches, as compared to the underlying whole loans; and
- Efficiency gains and cost reduction due to the specialization by participants and standardization of the components of the securitization process.

2. Continued

- (b) Explain why the A tranche deserves a higher credit rating, including a supporting calculation.

Commentary on Question:

The candidates performed above average on this section. Most candidates successfully explained that Tranche A deserves a higher credit rating since Tranche B is subordinate to A and will absorb loss first; however, some candidates were not able to show appropriate calculations to support this explanation. Some candidates calculated a support level of 25% of Tranche A but mis-identified 75% as the LTV of Tranche A. Partial points were given to those candidates.

Tranche A deserves a better credit rating since Tranche B is subordinate to A and will absorb loss first. Specifically, Tranche A will not be impacted until the loss is more than 25%.

Support level of tranche A = (Outstanding par value of tranches junior to tranche A) / (CMBS total outstanding par value) = \$50/\$200 = 25%.

Alternative answer (full points were given to the following answer):

Tranche A deserves a better credit rating since it has a lower implied LTV ratio. Below is the calculation of LTV ratio for Tranche A. The LTV ratio calculated for tranche A = (1-Support Level of Tranche A) * (LTV ratio of underlying mortgage pool) = (1-25%) * 80% = 60%.

- (c) Calculate the market value of the X tranche at issue if the yield to maturity at issue is 4%.

Commentary on Question:

The candidates performed above average on this section. Most calculated the market value correctly. A few candidates were not able to calculate the coupon payment in year 2 and only received partial points.

Tranche X coupon payment (Year 1) = pool coupon payment – tranche A coupon – tranche B coupon = \$200M * 5% - \$150M * 4% - \$50M * 5% = \$10M – \$6M – \$2.5M = \$1.5M

Tranche X coupon payment (Year 2) = pool coupon payment – tranche A coupon – tranche B coupon = \$100M * 5% - \$50M * 4% - \$50M * 5% = \$5M – \$2M – \$2.5M = \$0.5M

Market Value = (\$1.5M)/1.04 + (\$0.5M)/1.04² = \$1.901M

2. Continued

- (d) Show the cash flows received by each tranche at the end of year 2.

Commentary on Question:

The candidates performed below average on this section. Only a few candidates received full points. The key of this question is to understand that Tranche A gets \$3.75 from 'Recovered' to 'Interest' to make it whole, with 'Principal' receiving the rest. Most candidates who did not recognize the above did not calculate tranche A cash flows correctly.

Mortgage pool CFs (year 2)

- Interest = $\$25M * 5\% = \$1.25M$
- Principal = $\$25M$
- Recovered = $\$15M$
- Interest shortfall = $\$100M * 5\% - \$25M * 5\% = \$3.75M$
- Add $\$3.75M$ from recovered to Interest to make it whole: Interest = $\$1.25M + \$3.75M = \$5.0M$
- Principal gets the rest: Principal = $\$1.25M + \$25M + \$15M - \$5M = \$36.25M$

Tranche A CF (year 2)

- Interest = $\$50M * 4\% = \$2M$
- Principal = $\$36.25M$

Tranche B CF (year 2)

- Interest = $\$50M * 5\% = \$2.5M$
- Principal = $\$0.00$

Tranche X CFs (year 2)

- Interest = $\$5M - \$2M - \$2.5M = \$0.5M$
- IO tranche, so principal = $\$0.00$

3. Learning Objectives:

4. The candidate will understand the nature, measurement and management of liquidity risk in financial institutions.

Learning Outcomes:

- (4b) Measure and monitor liquidity risk, using various liquidity measurement tools and ratios.

Sources:

Quantitative Credit Portfolio Management, Ben-Dor, et.al., Ch 5 & 6.

Commentary on Question:

This question tests the concept of liquidity with respect to bonds, and the measurement of liquidity through liquidity cost scores (LCS) and option adjusted spread decomposition.

Solution:

- (a) Provide two alternative explanations for the widened option adjusted spreads.

Commentary on Question:

Candidates performed above average on this section. This question tested candidates understanding of the sources of option adjusted spread: market risk premium, credit risk, and liquidity risk. Most candidates successfully identified market risk premium and liquidity as alternative drivers of OAS. Some candidates lost points by suggesting a redundant alternative, such as two very similar liquidity related statements. Other candidates suggested a tenuous alternative explanation, such as general changes in interest rates.

- Market liquidity may have dried up causing investors to demand a greater OAS to compensate for enhanced liquidity risk.
- The market risk premium may have increased. The general level of risk aversion may be heightened due to market turmoil, causing investors to demand greater OAS.

(b)

- (i) Attribute bond B's OAS to the following sources: market-level risk premium, credit risk, liquidity risk, and unexplained.
- (ii) Identify which bonds (if any) should be liquidated so that the portfolio is compliant with the investment policy.
- (iii) Estimate the transaction cost (in dollars) associated with liquidating bond B.

3. Continued

Commentary on Question:

Candidates performed above average on parts (i) and (ii) and below average on part (iii). Parts (i) and (ii) tested candidates understanding of how credit and liquidity risk measures can be used to decompose a bond's option adjusted spread, as well as the calculation of liquidity cost scores from bid-ask spreads. Part (iii) tested candidates understanding of the definition of liquidity cost scores (LCS).

On part (i), most candidates were successful in calculating the LCS. Some candidates mistook the risk measures (CDS spread and LCS) as the contributions of credit risk and liquidity risk to OAS. To calculate the contributions of credit risk and liquidity risk, candidates needed to multiply the risk measures by the regression coefficients. Some candidates forgot to apply the non-benchmark adjustment to bond B.

On part (ii), most candidates recognized the need to evaluate the contribution of credit risk to OAS against the investment policy. Similar to part (i), some candidates mistook the CDS spread as the contribution of credit risk to OAS and did not apply the regression coefficients to the CDS spread. Some candidates used the model estimated OAS in evaluating whether the bonds were compliant with investment policy. To receive full credit, candidates must have evaluated all three bonds and recommended liquidating bond C.

On part (iii), most candidates recognized the need to calculate transaction costs from either bid-ask spreads or from LCS. The most common mistake was to provide an estimate of the round-trip transaction cost, as opposed to the one-way transaction cost. Some of the candidates who chose to calculate the transaction costs from the bid-ask spreads made errors such as not applying the OASD or the non-benchmark adjustment.

Part (i)

$$\begin{aligned} LCS &= Bid - Ask Spread \times OASD \times Non - Benchmark Adjustment \\ &= 5 \times 60 \times 1.1 = 330bps \end{aligned}$$

$$\text{Market Risk Premium} = \alpha = 80bps$$

$$\text{OAS from Credit Risk} = \beta \times CDS Spread = 1.3 \times 250 = 325bps$$

$$\text{OAS from Liquidity Risk} = \gamma \times LCS = 0.9 \times 330 = 297bps$$

$$\begin{aligned} \text{Unexplained} = \eta &= OAS - \alpha - \beta \times CDS Spread - \gamma \times LCS \\ &= 700 - 80 - 325 - 297 = -2bps \end{aligned}$$

3. Continued

Part (ii)

The % of OAS attributable to credit risk for each bond is equal to

$$\frac{\beta \times CDS}{OAS}$$

$$\text{Bond A: } 1.3 \times \frac{150}{450} = 43.3\%$$

$$\text{Bond B: } 1.3 \times \frac{250}{700} = 46.4\%$$

$$\text{Bond C: } 1.3 \times \frac{200}{400} = 65\%$$

Liquidate bond C since more than 50% of its OAS is attributable to credit risk.

Part (iii)

The LCS is an estimate of round-trip transaction costs expressed as a percentage of market value. To estimate the transaction costs in dollars for a one-way trip, we divide by 2 and multiply by the market value. We have the LCS from part (i)

$$LCS \times \frac{MV}{2} = 330 \text{ bps} \times \frac{400}{2} = \$6.6M$$

- (c) Describe three bond attributes other than OAS and Benchmark that can be used to identify bonds with high liquidity cost scores.

Commentary on Question:

Candidates performed brilliantly on this section. Part (c) tests candidates understanding of the characteristics of liquid or illiquid bonds. Most candidates were able to identify three characteristics and demonstrate an understanding of the directional relationship with liquidity. The most common error was to suggest using large bid-ask spreads to identify bonds with high LCS. LCS is defined on bid-ask spreads, so filtering on bid-ask spreads is akin to filtering on LCS.

- Age – Older bonds tend to have lower liquidity and higher liquidity cost scores.
- Amount Outstanding – Bonds with smaller issue sizes/amounts outstanding tend to have lower liquidity and higher liquidity cost scores.
- Trading volume – Bonds with lower trading volumes tend to have lower liquidity and higher liquidity cost scores.

3. Continued

- (d) Explain how you can estimate the LCS for bond Z using the database of quoted bond attributes.

Commentary on Question:

Candidates performed above average on this section. Part (d) tests candidates understanding of how the LCS of non-quoted bonds can be estimated using the universe of quoted bonds. Some candidates provided suggestions that were too simplistic or vague, such as choosing a single bond with similar characteristics. To receive full credit, candidates needed to suggest fitting a regression model to the observed bond LCS and using the regression model to extrapolate to non-quoted bonds. Candidates also needed to suggest non-quoted adjustment.

The LCS for non-quoted bonds can be estimated by regressing the LCS of quoted bonds against certain bond attributes, such as volume, age, time to maturity, DTS/OAS, and others. The resulting model can be used to estimate the non-quoted bond LCSs. There should be an additional upward adjustment to account for the fact that non-quoted bonds are inherently less liquid than quoted bonds.

4. Learning Objectives:

3. The candidate will understand the variety and assess the role of equities in investment portfolios. The candidate will demonstrate an understanding of the distinguishing investment characteristics and potential contributions to investment portfolios of the following major asset groups:
- Real Estate
 - Public Equity
 - Private Equity
 - Infrastructure
 - Commodities
 - Hedge Funds

Learning Outcomes:

- (3b) Demonstrate an understanding of the types of equity investments available for an investor's growth allocation and their most important differences.
- (3c) Demonstrate an understanding of the investment strategies and portfolio roles that are characteristic of each equity investment.

Sources:

QFIA-126-16

Commentary on Question:

This question tested candidates' understanding of infrastructure as an asset class and some of the challenges and changes facing this asset. Candidates performed well on parts (a) and (c), but struggled elsewhere. Many candidates lost points for not completely answering a question, i.e. listing an answer when the question asks for a description.

Solution:

- (a) List four benefits of infrastructure as an asset class.

Commentary on Question:

Candidates performed above average on this question. Most candidates earned all or most credits. Some candidates listed one or more stylized economic characteristics instead of benefits, which were awarded partial credit.

Benefits of investing in infrastructure as an asset class include:

- Attractive Returns
- Low sensitivity to swings in the economy and markets
- Low correlation of returns with other asset classes
- Good inflation hedge

4. Continued

- (b) Describe two types of infrastructure investment vehicles.

Commentary on Question:

Candidates performed below average on this question. Many candidates only listed two types of infrastructure investment vehicles without providing any description. Because this question was only worth 1/2 of a point, even a brief description was enough to earn full credit. Some candidates confused this question with public infrastructure projects such as utilities, which was awarded no credit.

- Private equity type investments, predominantly via unlisted funds. Investors invest in private equity funds who then invest in infrastructure projects.
- Direct or co-investments in (unlisted) infrastructure companies, which includes direct ownership of equity or bonds.

- (c) Evaluate the appropriateness of using primarily infrastructure investments supporting the following liabilities:
- (i) 3-year Guaranteed Investment Contract (GIC)
 - (ii) Whole life insurance contracts with high surrender charge
 - (iii) Defined benefit pension liabilities with a portability option

Commentary on Question:

Candidates performed brilliantly on this question. Nearly every candidate received full credit on this question. A small number of candidates made poor evaluations or recommendations without explanation and lost credit. Part (iii) could either be appropriate or inappropriate so long as the candidate provided justification.

- (i) Using primarily infrastructure investments to support 3-year GIC's is not appropriate. GIC's are short-term liabilities and supporting these with long-term assets like infrastructure creates a maturity mismatch and considerable liquidity risk.
- (ii) Using primarily infrastructure investments to support whole life insurance contracts with high surrender charges may be appropriate. Whole life contracts are long duration liabilities that match well with infrastructure, and the high surrender charges further reduce the likelihood of needing immediate liquidity.

4. Continued

- (iii) Using primarily infrastructure investments to support DB pension liabilities is not appropriate. While pension liabilities are long duration liabilities, the portability option introduces significant liquidity risk that is inappropriate to be matched with long-term, illiquid assets like infrastructure.
- (d) Describe four potential issues associated with infrastructure asset allocation data in this study.

Commentary on Question:

Candidates performed poorly on this question. Most candidates received only partial credit, and some candidates skipped this question entirely. Because this question asked for four descriptions and was worth only 1 point, even a brief description of each potential issue would potentially have achieved credit.

Four potential issues associated with infrastructure asset allocation data include:

- Generous definitions of investor, pension funds, and infrastructure
- A relatively small sample of investors
- A bias towards more vocal or advanced investors
- Allocation can refer to capital allocated, committed, drawn down, or invested in private equity-type funds.

- (e) Explain why the total exposure to infrastructure could be significantly higher than the data suggests.

Commentary on Question:

Candidates performed as expected on this question. Candidates either understood this question and received full credit, or misunderstood the question and received none.

Total exposure to infrastructure could be significantly higher than reported because investments in listed infrastructure stocks and bonds are classified as traditional equity or fixed income investments rather than as a separate asset class.

- (f) Identify the trend in the above graph and explain why such a trend exists.

Commentary on Question:

Candidates performed as expected on this question. Candidates who recognized that older vintages have higher IRR's than more recent vintages, explained why, and discussed a J-curve typically received all or most credit. Some candidates appeared to not understand the graph and/or misunderstood vintage year.

4. Continued

This graph indicates that that more recent infrastructure funds have lower returns than intermediate and mature funds, both in mean and median internal rates of return. One possible explanation to this is the J-curve effect. The J-curve effect refers to private equity-type infrastructure funds delivering low or negative returns in early years and then delivering larger gains in later years as the portfolio of companies matures. Funds from vintage years 3-5 years ago are likely to be in the early stage of a J-curve effect and are delivering lower returns than mature funds.

5. Learning Objectives:

2. The candidate will understand:
 - The credit risk of fixed income portfolios, securities, and sectors and be able to apply a variety of credit risk theories and models.
 - How rating agencies rate corporate and sovereign bonds and securitized credit.

Learning Outcomes:

- (2a) Demonstrate an understanding of the basic concepts of credit risk modeling such as probability of default, loss given default, exposure at default, and expected loss.
- (2d) Demonstrate an understanding of Merton (structural) asset valuation models in the context of credit risk.

Sources:

Bluhm, An Introduction to Credit Risk Modeling, 2nd Ed, Ch3, Ch 6

Commentary on Question:

This question tests candidates' understanding of the basic concepts of credit risk modeling such as probability of default, loss given default, exposure at default, and expected loss. It also tests candidates' understanding of Merton (structural) asset valuation models in the context of credit risk.

Special note: There are multiple correct answers to part (c) and (d) of this question due to the given information of "The market value of the zero-coupon bond = \$63.89 million" and "The loss-given-default of this zero coupon bond is 24.01% of the face value". Had the parameters of (63.89, 24.01%) been replaced by (63.41, 25.35%), there would have been a unique answer to part (c) and (d). Candidates are encouraged to apply the parameters of (63.41, 25.35%) in studying this question.

Solution:

- (a) Calculate the continuously compounded credit spread of the zero-coupon bond

Commentary on Question:

The candidates performed brilliantly on this section. Partial credit was given for those who solved for the annual compounded credit spread, rather than the continuously compounded credit spread that was asked by the question.

5. Continued

$$B = F * e^{-(r+s)T}$$

$$s = -\left(\frac{1}{T}\right) \ln\left(\frac{B}{F}\right) - r$$

$$s = -\left(\frac{1}{16}\right) \ln\left(\frac{63.89}{100}\right) - 2\% = 0.80\%$$

Note: $s = 0.85\%$ if $B = 63.41$

- (b) Show that the risk-neutral probability of default of this zero-coupon bond is 50%.

Commentary on Question:

The candidates performed above average on this section. While the probability of default could be solved for directly, some candidates set the probability of default to 50% directly, solved for the resulting bond price and verified that it agreed with the given value in the question. Full credit was given as long as the candidates correctly demonstrated that the probability of default = 50%.

$$B = (1 - PD^{rn} * LGD) * F * e^{-rT}$$

$$PD^{rn} = \left(\frac{1}{LGD}\right) \left(1 - \frac{B}{F} e^{rT}\right)$$

$$PD^{rn} = \left(\frac{1}{24.01\%}\right) \left(1 - \frac{63.89}{100} e^{2\% * 16}\right) = 50\%$$

Note: $PD^{rn} = 50\%$ if $B = 63.41$ and $LGD = 25.35\%$

- (c) Calculate the implied total asset value of EcL.

Commentary on Question:

The candidates performed above average on this section. There are multiple methods to solve for the implied total asset value, each leading to a different, but correct, answer due to the given bond price of \$63.89. Had the bond price been \$63.41, all methods would yield the same asset value of \$78.66. Full credit is given if the candidate's answer is consistent with the method used.

5. Continued

Method 1

$PD^{rn} = N(-d_2) = 50\%$ from (b), which leads to $d_2 = 0$

$$d_2 = \frac{\ln \frac{A}{F} + \left(r - \frac{\sigma_A^2}{2}\right)T}{\sigma_A \sqrt{T}}$$

$$A = F e^{d_2 \sigma_A \sqrt{T} - \left(r - \frac{\sigma_A^2}{2}\right)T}$$

$$A = 100 e^{0 - \left(2\% - \frac{10\%^2}{2}\right)16} = 78.66 \text{ (million)}$$

Method 2

$A = B + E$ where $E = \text{EcL's equity value}$

$$E = AN(d_1) - Fe^{-rT}N(d_2) = (B + E)N(d_1) - Fe^{-rT}N(d_2)$$

$$E = \frac{BN(d_1) - Fe^{-rT}N(d_2)}{1 - N(d_1)}$$

$$d_1 = d_2 + \sigma_A \sqrt{T} = 0 + 10\% * \sqrt{16} = 0.4$$

$$N(d_1) = 0.6554$$

$$E = \frac{63.89 * 0.6554 - 100e^{-2\%*16}0.5}{1 - 0.6554} = 16.15$$

$$A = B + E = 63.89 + 16.15 = 80.04 \text{ (million)}$$

- (d) Calculate the instantaneous volatility of EcL's equity value (σ_E).

Commentary on Question:

The candidates performed above average on this section. There are multiple correct answers due to the given bond price of \$63.89. Had the bond price been \$63.41, the uniquely correct answer of asset volatility would have been 33.81%. Full credit is given if the candidate's answer is consistent with the method used.

5. Continued

$$\sigma_E = \sigma_A \frac{A}{E} \left(\frac{\partial E}{\partial A} \right) = \sigma_A \frac{A}{E} N(d_1)$$

$$d_1 = d_2 + \sigma_A \sqrt{T} = 0 + 10\% \sqrt{16} = 0.4$$

$$N(d_1) = 0.6554$$

If candidate used $A = 78.66$ from Method 1 of part (c) and solved for E by
 $E = A - B = 78.66 - 63.89 = 14.77$

$$\sigma_E = 10\% \frac{78.66}{14.77} 0.6554 = 34.90\%$$

If candidate used $A = 78.66$ from Method 1 of part (c) and solved for E by the call option formula

$$E = AN(d_1) - Fe^{-rT}N(d_2) = 78.66 * 0.6554 - 100e^{-2\%*16}0.5 = 15.25$$

$$\sigma_E = 10\% \frac{78.66}{15.25} 0.6554 = 33.81\%$$

If candidates used $E = 16.15$ and $A = 80.04$ from Method 2 of part (c)

$$\sigma_E = 10\% \frac{80.04}{16.15} 0.6554 = 32.48\%$$

6. Learning Objectives:

4. The candidate will understand the nature, measurement and management of liquidity risk in financial institutions.

Learning Outcomes:

- (4a) Demonstrate an understanding of the concept of liquidity risk and the threat it represents to financial intermediaries and markets.
- (4b) Measure and monitor liquidity risk, using various liquidity measurement tools and ratios.
- (4c) Demonstrate an understanding of the levels of liquidity available with various asset types and the impact on a company's overall liquidity risk.
- (4f) Apply liquidity scenario analysis with various time horizons.
- (4h) Create liquidity risk management plans and procedures, including addressing appropriate product design, investment guidelines, and reporting given a desired liquidity risk level.

Sources:

QFIP-105-13: Report of the Life Liquidity Work Group of the American Academy of Actuaries to the Life Liquidity Risk Working Group of the NAIC (final)

QFIP-106-13: Liquidity Risk: Measurement and Management - A Practitioner's Guide to Global Best Practices, Matz, Leonard & Neu, Peter, 2006, Ch. 3

QFIP-134-19: Quantitative Credit Portfolio Management, Ben-Dor, et. al., 2012, Ch. 5

Commentary on Question:

This question tests the understanding of liquidity risks in different scenarios, how to improve the liquidity risk profile, and how to calculate a liquidity reserve in a given stress scenario.

Solution:

- (a) Critique the CRO's statements.

Commentary on Question:

The candidates performed as expected on this section. Many candidates provided accurate critiques of statements 1 and 3. Many candidates wrongly concluded that statement 2 was incorrect. In most of those cases, candidates stated that ABC would have to reinvest at lower yields after receiving prepayments from both the callable bonds and MBS. While that is true, in the short-term, those prepayments would generate more cash (i.e. greater liquidity) for ABC, thus not causing a liquidity stress event.

6. Continued

- Statement 1: This statement is correct.
 - As interest rates increase, more SPDA policyholders will lapse and look for another product offering higher rates, increasing liquidity needs for ABC
 - FA holders would very likely request a return of premium and seek a higher rate elsewhere, increasing liquidity needs for ABC
 - BBB rated MBS will generate less cash, as there will be less prepayment when rates rise
 - The value of ABC's assets will decrease as rates rise and would generate less cash if they needed to be sold to fund liability outflows

 - Statement 2: This statement is correct.
 - ABC's assets generate more cash when rates decrease. This is due to more prepayments from mortgage refinancing and bonds being called (i.e. principal being paid in full early) since borrowers can borrow at lower rates.
 - Since ABC's liabilities have a fixed crediting rate, policyholders are less likely to lapse when rates decrease sharply. Cash needs for ABC's liabilities are likely to be less than before.

 - Statement 3: This statement is incorrect. There is likely an adverse impact to ABC's liquidity position.
 - When a major competitor becomes insolvent, people are likely to lose faith in the industry, which could cause a run-on-the-bank. Policyholders will be concerned that ABC may be next to fail.
 - FA holders will likely use their 7-day put provision, increasing liquidity needs for ABC
 - There will be an increase in SPDA lapses, especially for policyholders near/past the end of the 7-year surrender charge period, which again increases liquidity needs for ABC
 - ABC may have to sell assets at a loss in order to generate cash to pay the increased liability outflows
- (b) Recommend changes to the asset and/or liability profile to reduce ABC's stress liquidity risk.

Commentary on Question:

The candidates performed above average on this section. Many candidates provided at least 3 acceptable recommendations. Candidates who received full credit provided four acceptable recommendations.

6. Continued

- Remove the 7-day put provision from FAs to avoid having to make large repayments on such short notice
 - Embed a market value adjustment in the FAs to discourage FA holders from exercising the put when rates increase
 - Increase the surrender charge % assessed for the SPDAs to make lapsing more costly to policyholders
 - Adjust the interest rate credited to float with market interest rates in order to reduce lapses when rates rise
 - Ladder asset maturities to match projected liability cash flows
 - Purchase interest rate derivatives such as swaps or swaptions that generate positive cash flows when rates rise
 - Diversify the asset portfolio by investing in more liquid assets such as Treasuries or higher rated Corporate Bonds
 - Use repos to mitigate short-term cash needs
 - Obtain a LOC from a parent company or reliable counterparty that can be used in a stress scenario
- (c) Calculate the minimum liquidity reserve that needs to be established in order to comply with the liquidity risk policy.

Commentary on Question:

The candidates performed above average on this section. A common mistake made by candidates was not rolling over the end of month cash when calculating the reserve needed for the next month. Some candidates directly calculated a total minimum liquidity reserve instead of calculating each of the monthly reserves and summing them up to get the total minimum liquidity reserve and received partial credit.

Under the stress scenario, the new cash flows are:

Projected Cash Flows (millions)	Month 1	Month 2	Month 3
Corporate Bonds	400	400	400
MBS Bonds	40	60	40
SPDA	-360	-480	-600
FA	-200	-250	-300

6. Continued

Month 1:

$$\text{Cash Sources} = 400 + 40 = 440$$

$$\text{Cash Needs} = 360 + 200 = 560$$

$$\text{Cash Flow Cushion} = \text{Sources/Needs} = 440/560 < 1.05 \text{ Fail (reserve needed)}$$

$$\text{Month 1 Reserve Need} = 560 * 1.05 - 440 = 148$$

$$\text{End of Month Cash} = 440 + 148 - 560 = 28$$

Month 2:

$$\text{Cash Sources} = 28 \text{ (rolled over)} + 400 + 60 = 488$$

$$\text{Cash Needs} = 480 + 250 = 730$$

$$\text{Cash Flow Cushion} = 488/730 < 1.05 \text{ Fail (reserve needed)}$$

$$\text{Month 2 Reserve Need} = 730 * (105\%) - 488 = 278.5$$

$$\text{End of Month Cash} = (488 + 278.5) - 730 = 36.5$$

Month 3:

$$\text{Cash Sources} = 36.5 \text{ (rolled over)} + 400 + 40 = 476.5$$

$$\text{Cash Needs} = 600 + 300 = 900$$

$$\text{Cash Flow Cushion} = 476.5/900 < 1.05 - \text{Fail (reserve needed)}$$

$$\text{Month 3 Reserve Need} = 900 * (105\%) - 476.5 = 468.5$$

$$\text{Minimum Liquidity Reserve} = \text{Month 1 Reserve} + \text{Month 2 Reserve} + \text{Month 3 Reserve} = 148 + 278.5 + 468.5 = 895$$

- (d) Calculate the amount (in millions) of the bond that would need to be sold to provide the 3-month cash flows in the liquidity stress scenario.

Commentary on Question:

The candidates performed below average on this section. Most candidates stated that ABC needed to generate cash equal to the amount of the liquidity reserve they calculated in part (c). Most candidates provided the correct formula for LCS but did not adjust for the sale being a one-way trip when calculating the unit transaction cost.

ABC will sell the corporate bond to generate cash. The total cash needed during the 3 months is $(360+480+600+200+250+300) - (400+400+400+40+60+40) = 850\text{M}$.

LCS is an estimate of round-trip transaction costs expressed as a percentage of market value.

$$\text{LCS} = \text{Bid-Ask Spread} * \text{OASD} * \text{Non-Benchmark Adjustment Factor}$$

6. Continued

To estimate the transaction costs in dollars for a one-way trip, we multiply the LCS by 0.5 and get a unit transaction cost of:

$$\text{Unit Transaction Cost} = 0.5 * \text{LCS} * \text{Market Value} = 0.5 * (40\text{bps} * 5 * 1.15) = 0.0115$$

To generate 850M of cash, ABC needs to sell $850\text{M} / (1 - 0.0115) = 859.89\text{M}$

7. Learning Objectives:

1. The candidate will understand how to work with the variety of fixed income instruments available for portfolio construction.

Learning Outcomes:

- (1a) Describe the cash flow of various corporate and sovereign bonds considering underlying risks such as interest rate, credit and event risks.
- (1c) Demonstrate an understanding of cash flow patterns and underlying drivers and risks of non-agency mortgage-backed securities and commercial mortgage-backed securities.
- (1g) Demonstrate an understanding of commercial mortgage backed securities.

Sources:

Handbook of Fixed Income Securities, Chapters 18 & 31

Commentary on Question:

This question tested the candidates' knowledge of Treasury Inflation-Protected Securities (TIPS) bonds and nonagency residential mortgage-backed securities.

Solution:

- (a) Calculate the real duration and an estimate of the effective duration of this TIPS bond.

Commentary on Question:

The candidates performed below average on this section. Most candidates correctly stated the "75% yield beta" approximation needed to estimate effective duration from real duration. Several candidates calculated the classical Macauley duration instead of real duration, while other candidates used incorrect yields in the real duration calculations.

$$Duration_{Real} = -\frac{1}{P} * \frac{dP}{di} = \frac{MV(Yield_{Real}-0.5\%) - MV(Yield_{Real}+0.5\%)}{1\% * MV(Yield_{Real})}$$

Since the TIPS real yield = 0.5%, the terms in the numerator are very convenient to calculate. The first term in the numerator is the bond value with its 9 remaining cash flows discounted at 0% → $MV(0\%) = 8 \times 10 + 1010 = 1090$. The last term in the numerator is the value of a bond paying 1% interest and valued using a 1% discount → $MV(1\%) = 1000$ (yield rate = coupon rate).

$$MV(0.5\%) = \sum_{j=1}^8 \frac{10}{(1 + 0.5\%)^j} + \frac{1010}{(1 + 0.5\%)^9} = 1,043.89$$

7. Continued

$$\Rightarrow Dur_{Real} = \frac{1090 - 1000}{0.01 * 1043.89} = 8.62$$

To approximate effective duration from real duration, one can apply the “75% yield beta” relationship:

$$Dur_{Eff} \approx 75\% * Dur_{Real} \Rightarrow Dur_{Eff} = 75\% * 8.62 = 6.47$$

For the numerical calculations underlying real duration, some candidates used a smaller value of delta to evaluate marginal change in bond price and received full marks for a correct alternate solution:

$$Duration_{Real} = \frac{MV(Yield_{Real}-\Delta y) - MV(Yield_{Real}+\Delta y)}{(2\Delta y) * MV(Yield_{Real})}$$

- (b) Assess whether you should invest in this TIPS bond instead of the conventional bond taking into consideration the break-even inflation rate.

Commentary on Question:

The candidates performed below average on this section. Most candidates correctly obtained the break-even inflation rate from the conventional nominal and TIPS real yields. However, many candidates did not explain how to use break-even inflation rate to evaluate whether to invest in the TIPS bond as an alternative to the conventional Treasury note.

The break-even inflation rate can be approximated as the difference between nominal & real yields (2.5% - 0.5% = 2.0% approximate break-even), or calculated exactly as follows:

$$Breakeven = \frac{1 + ConventionalNominalYield}{1 + TIPSRealYield} = \frac{1.025}{1.005} - 1 = 1.99\%$$

Because TIPS pay in real dollars, exhibit low volatility, and have low correlation with other assets, at least part of the inflation risk premium should not be included in TIPS yields. Therefore, the TIPS risk-adjusted break-even inflation rate would equal the calculated break-even inflation rate minus some inflation risk premium. Hence, because the expected inflation rate equals the calculated break-even inflation rate, the investor can still advantageously use TIPS over the conventional bond. Another consideration supporting TIPS investment is a desire to lock in some real yields as part of the portfolio.

7. Continued

Alternatively, one could argue that TIPS is not preferable over the conventional Treasury note because the nominal 2.5% yield exceeds the 1.99% break-even inflation rate and if hedging inflation is not a concern for the asset portfolio strategy.

- (c) Describe Nonagency RMBS.

Commentary on Question:

The candidates performed below average on this section. Most candidates correctly gave the primary defining characteristic of nonagency RMBS as not being backed by government-sponsored entities (GSEs) or government agencies. Many candidates did not provide supporting details of these instruments that would be important characteristics needed to evaluate their appropriateness for the given investment context.

Nonagency RMBS are residential mortgage-backed securities that are not guaranteed by GSEs or government agencies. Typical collateral in nonagency RMBS pools come from loans that do not conform to agency/GSE standards for size and/or underwriting (for example, jumbo loans, alt-A loans, subprime loans, second liens, adjustable rate mortgages, & manufactured housing mortgage loans). Unlike agency RMBS, nonagency RMBS have higher prepayment & credit risks based on the composition of its collateral pool. Nonagency RMBS often include credit enhancements to mitigate credit risk.

- (d) Describe the key measurements of collateral performance for Nonagency RMBS.

Commentary on Question:

The candidates performed as expected on this section. Most candidates were able to identify at least one key measurement for collateral performance for nonagency RMBS; however, many candidates listed metrics that would be used for individual mortgage underwriting at point of loan origination, rather than considering the collateral pool underlying the nonagency RMBS.

Key measurements for nonagency RMBS collateral performance include:

- Delinquency – the 2 standards for measuring contractual delinquency status are the Mortgage Bankers Association (MBA) standard and the Office for Thrift Supervision (OTS) standard;
- Default – commonly defined by liquidation (via short sale, foreclosure sale, or REO sale) and the remaining default balance;
- Voluntary prepayments; and
- Loss severity

7. Continued

- (e) Compare the two credit enhancement strategies for Nonagency RMBS.

Commentary on Question:

The candidates performed poorly on this question. Most candidates gave correct high-level summaries of the basic design for the 2 credit enhancement strategies. Unsuccessful candidates failed to provide valid comparisons between the 2 structures or evaluate their relative utilities in the given context.

The senior/subordination shifting interest (Senior/Sub) structure typically consists of a AAA-rated senior class/tranche followed by 6 subordinated classes/tranches with lower credit ratings. The Senior/Sub structure is commonly used for mortgage pools with lesser credit concerns, such as prime jumbo loans. The subordination mechanism that secures the senior class/tranche's higher credit rating works by allocating principal prepayments first to the senior class and then as a waterfall descending through the various subordinate classes/tranches, while default losses are assigned in reverse order from the most junior class/tranche first and then ascending through the various classes/tranches to the most senior class/tranche last.

Like the Senior/Sub structure, the Overcollateralization and Excess Spread (OC/XS) structure includes a subordination mechanism with various classes/tranches of different credit ratings. But the OC/XS structure also includes overcollateralization and excess spread credit buffers. Overcollateralization involves adding more collateral to the mortgage pool than the notional amounts of securities issued, and excess spread is the difference between the interest paid on assets in underlying mortgage pool and interest paid on the issued securities. In the OC/XS structure, default losses are recovered first out of excess spread, followed by the overcollateralization, and finally work their way up the subordination structure from the most junior class/tranche up to the most senior class/tranche. OC/XS deals are typically used for mortgage pools with more significant credit concerns, such as subprime mortgages.

During the lock-out period, subordinate bonds are not allowed to receive unscheduled principal payments in Senior/Sub deals; after the lock-out, junior bonds receive unscheduled principal allocated on a pro-rata basis so long as performance triggers are passed. In OC/XS deals, junior bonds are not allowed to receive any principal until the step-down date and performance triggers are passed. In a Senior/Sub structure, class/tranche sizes are relatively stable over time, while OC/XS class/tranche sizes are much more volatile due to having more trigger events and small changes in performance can trigger large swings in the cash-flow waterfall which can have major impact on bond valuation.

8. Learning Objectives:

5. The candidate will:
- Demonstrate an understanding of regulatory and accounting frameworks around investment governance.
 - Understand how to develop an investment policy including governance for institutional investors and financial intermediaries within regulatory and accounting constraints.
 - Understand how rating agency frameworks affect portfolio construction and management.

Learning Outcomes:

- (5a) Describe the regulatory and rating agency contexts in which various institutions operate and how those contexts affect portfolio strategy
- (5b) Explain how investment policies and strategies can manage risk and create value
- (5c) Identify a fiduciary's obligations and explain how they apply in managing portfolios
- (5d) Determine how a client's objectives, needs and constraints affect investment strategy and portfolio construction. Considerations and constraints include:
- Capital and expected return on allocated capital
 - Risk appetite and risk-return trade-off
 - Tax
 - Accounting
 - Regulators
 - Rating agencies
 - Liquidity

Sources:

Maginn & Tuttle, 3rd Edition, 2007 Ch.3

Commentary on Question:

This question focuses on understanding of considerations and constraints to consider in an IPS with the transfer of risk from one institution to another.

Solution:

- (a) Explain why segmentation of the asset portfolios is important for ABC.

Commentary on Question:

Candidates performed above average on this part. Candidates were successful at identifying segmentation as being important to determine the multiple return objectives and recognizing the specific characteristics of UL and immediate annuities. Most candidates did not identify the segmentation as an attribute for crediting competitive return.

8. Continued

Asset segmentation makes it possible to:

Determine the return objective specific to each product;

Allows crediting competitive interest rates to each product;

Recognize specific characteristics of each product. For example, with UL the return of the fund and for immediate annuities the payment period.

- (b) Describe valuation concern with an example of how rising interest rates could adversely affect ABC's UL products.

Commentary on Question:

Candidates performed as expected in this section. The majority of candidates explained the risk of ABC associated with the policy surrender but a few didn't identify the limited market value as contributing risk. Some candidates identified the surplus erosion due to the asset and liability cash flow mismatch. A key area missed by most candidates is the problem associated with asset duration exceeding liability duration.

For ABC the mismatch of asset and liability cash flows can lead to erosion of surplus.

For example, in the event that interest rates rise and the UL contract provides only a limited adjustment to the market value in the event of surrender, the risk of disintermediation is present. The policyholders may seek to reinvest at a higher rate where the cash surrender value exceeds the market value of the fund.

- (c) Describe reinvestment risk with an example of how lower interest rates could adversely affect ABC's annuity business.

Commentary on Question:

Candidates performed as expected on this section. Almost all candidates mentioned risk to reinvest the asset, only a few mentioned the pricing referral rate. Also, most candidates missed addressing that not matching the asset and liability duration can cause profitability to drop. Some candidates mentioned redemption of immediate annuities although such action is not possible.

In the event of an unexpected drop in interest rates, the risk is that the assets supporting the liabilities of the annuities cash flow might be invested at a rate lower than the rate used at the time of pricing.

For example, for long-term annuity business, if asset and liability duration is not matched, then a decline in interest rates will negatively impact the profitability.

8. Continued

- (d) Discuss any potential adverse impacts of these regulatory requirements to ABC.

Commentary on Question:

Candidates performed below average in this section. Candidates did not distinguish the reserve and the surplus requirements and the relationship with the risk exposure of the company. A few candidates specified the impacts on the possible reserve inadequacy or vulnerability of the surplus.

With the new formulaic approach, we need to consider its implication with the market-based valuation perspective of the company risk exposure for assets and liabilities.

With growing portfolio, the asset valuation reserve may be inadequate and surplus is vulnerable.

On the other side, a market valuation increases the volatility of the balance sheet.

- (e) Explain how the following factors may impact the risk tolerance of a traditional defined benefit pension plan:
- (i) Plan funded status
 - (ii) Sponsor financial status
 - (iii) Sponsor profitability
 - (iv) Workforce characteristics

Commentary on Question:

Candidates performed above average in this section. Almost all candidates who provide an explanation identified the relationship between each factor and the risk tolerance. A few candidates provided the justification associated with the debt ratio and only those candidates were awarded full credit for this part.

- (i) Plan funded status is measured by the ratio of assets to liabilities. The higher the ratio the greater the risk tolerance.
- (ii) Sponsor financial status: Lower the debt ratio (Debt / Asset) of the plan sponsor, higher the risk tolerance. The plan sponsor has the capacity to support the pension plan in the event of an adverse situation.
- (iii) Sponsor profitability: Higher the current or expected profitability, higher the capacity of the plan sponsor to contribute to the pension plan. Then higher the risk tolerance.

8. Continued

- (iv) Workforce characteristics: Younger the workforce and greater proportion active lives imply greater duration of liabilities and then greater risk tolerance.
- (f) Discuss how the transaction will impact the following elements of the IPS for XYZ:
 - (i) Risk and return objectives
 - (ii) Liquidity
 - (iii) Time horizon
 - (iv) Legal and regulatory factors

Commentary on Question:

Candidates performed below average in this section.

Unsuccessful candidates generally did not assess the longevity risk transfer for the retirees and its impact on the IPS considering a longer duration associate with the liabilities of the active participants. This led to wrong answers in (i) (ii) and (iv). In part (i), some candidates related the return objective to the risk premium paying to ABC and such answers were not awarded credit. In part (ii), many candidates mentioned the liquidity need to pay the ABC risk premium, but this explanation received no credit. For part (iv), the majority of candidates did not identify that the IPS must respect the regulated framework of a pension plan even if the risk has been transferred to ABC.

- (i) Risk and return: Since the transaction will transfer associated risk of retirees to ABC Company, the age of the workforce will be younger and the duration of remaining liability will be longer. The risk tolerance will be higher, and the return objective may be more aggressive.
- (ii) Liquidity: Because the plan has no risk for retirees after the transaction, there is little need for immediate liquidity.
- (iii) Time horizon: Without retirees' risk in the plan, the time horizon is longer with younger participants.
- (iv) Legal and regulatory: XYZ remains as the sponsor of the pension plan after the transaction and must meet the regulatory framework of the jurisdiction in making investment decisions.

9. Learning Objectives:

2. The candidate will understand:
 - The credit risk of fixed income portfolios, securities, and sectors and be able to apply a variety of credit risk theories and models.
 - How rating agencies rate corporate and sovereign bonds and securitized credit.

Learning Outcomes:

- (2e) Demonstrate an understanding of the term structure of default probability.
- (2f) Demonstrate an understanding of and be able to apply the concept of Duration Times Spread (DTS)
- (2g) Demonstrate an understanding of credit default swaps (CDS), including the use of CDS in a portfolio context
- (2i) Understand and apply various approaches for managing credit risk in a portfolio setting

Sources:

Handbook of Fixed Income Securities, Ch. 55, 66, 67, Fabozzi, F.J., 8th Edition, 2012

Introduction To Credit Risk Modeling, Bluhm, Christian, 2nd Edition, Ch 6
QFIP-19: Default Risk and the Effective Duration of Bonds

Commentary on Question:

This question tests the candidate's understanding of credit risk modelling. Candidates were asked to retrieve their knowledge of credit risk and apply the knowledge to explaining the DTS model and CDS formula. Candidates performed as expected on this question.

Solution:

- (a) Critique the following statements included in the report:
 - A. Empirical studies show that the ratio of corporate bond durations to synthetic Treasury bond durations is constant as a function of synthetic Treasury duration.
 - B. Effective durations should not be calculated based on changes in a single reference yield for all bonds in a portfolio; these should instead be linked to changes in yields for bonds with similar characteristics.
 - C. Real-world default probabilities are often lower than risk-neutral default probabilities as they reflect the efficiency of the market.

9. Continued

D. The spread DV01 of a long protection position is calculated to be \$3,042, meaning that a 100bp increase in the LIBOR curve while keeping the spread curve fixed would cause the value of the CDS position to increase by this amount.

Commentary on Question:

Candidates performed well on this question. Most candidates correctly identified that all statements are false. Successful candidates provided explanations into why the statements are false.

A: False. The ratio declines because riskier bonds have lower durations relative to Treasuries with the same maturity date.

B: False. Effective durations based on changes in the same reference yield is desirable because it allows for better comparison of interest rate sensitivities between two bonds, makes it easier to isolate the impact of credit risk and easier to compute portfolio durations for multiple bonds.

C: False. Risk-neutral default probabilities reflect a risk premium for market participants.

D: False. The spread DV01 of \$3,042 implies that a 1 bp (not 100 bp) increase in the CDS spread curve (not LIBOR curve) would cause the value of the CDS position to increase by this amount.

- (b) You are given the following transition matrix included in the report, where “D” corresponds to the default state.

	AAA	AA	A	BAA	BA	B	D
AAA	89%	10%	1%	0%	0%	0%	0%
AA	1%	89%	9%	1%	0%	0%	0%
A	0%	3%	90%	2%	3%	2%	0%
BAA	0%	0%	7%	83%	6%	1%	1%
BA	0%	0%	1%	6%	83%	6%	4%
B	0%	0%	0%	1%	6%	90%	3%
D	0%	0%	0%	0%	0%	1%	99%

Describe four (4) problems in the above transition matrix.

Commentary on Question:

Candidates performed above expectations on this part. Most candidates identified the 4 problems of the transition matrix.

9. Continued

1. The BAA-rating row does not add up to 100%.
 2. Cell (A, BA) should be less than Cell (A, BAA) because it should be more likely to migrate to a closer state than to more distant states.
 3. Cell (D, D) should be 100% and Cell (D, B) should be 0% since it is not possible to migrate out of the default state.
 4. Cell (BA, D) should be lower than Cell (B, D) but must still be higher than Cell (BAA, D) since higher rated bonds should have a lower probability of default than lower rated bonds.
- (c) Describe four (4) advantages or disadvantages of the DTS approach for analyzing spread sensitivity.

Commentary on Question:

Candidates performed as expected on this part. Most candidates provided a few advantages. Few candidates provided both advantages and disadvantages.

Advantages:

- The use of current spread levels allows for quicker adaptation to market conditions as reflected in the current level of spread (i.e. does not require a long period of increased spread volatility to warrant an increase in forward-looking estimates).
- Does not require a subjective selection of a historical calibration period.
- Lower tracking error when trying to replicate an index by matching DTS exposures.
- Limiting DTS contribution of any individual issuer imposes higher diversification among high spread (i.e. riskier) issues.
- DTS recognizes that changes in spreads are not parallel but linearly proportional to the level of spread (i.e. greater spread volatility for higher spread issues).

Disadvantages:

- If DTS limits are placed on a portfolio, it could cause a premature sale of bonds in a general credit market stress event.
- An additional calculation must be performed to compute DTS (i.e. duration for each bond).

9. Continued

- (d) Assess the relative merits of switching the approach from spread duration to DTS.

Commentary on Question:

Candidates performed below expectations on this part. Only a few candidates provided satisfactory responses other than the advantages already listed in part c. The question asked for “relative merits”; however, most candidates only provided reasons for, but not against, the switching.

Arguments in favor of switching to DTS:

- DTS is generally regarded as a superior measure due to the many advantages highlighted in (c) compared to its disadvantages, which can be easily managed.
- DTS is better for managing risk exposures since riskier issues will produce higher contributions to DTS than to spread duration.

Arguments against switching to DTS:

- A switch to a different method creates additional work and updates to processes. If clear benefits are not expected to outweigh the additional work, it may be desirable to keep the status quo
- The purpose of the spread sensitivity analysis is not specified, so it cannot be known with certainty whether the advantages identified could be realized.
- If the insurer generally holds bonds to maturity since they are used to match liability cash flows, monitoring DTS limits for breaches that would force a sale of bonds in a general market event would not be applicable.

- (e) The following formulas for the valuation of CDS contracts were included in the report:

$$V_{\text{premium}} = \frac{C(T)}{2} \sum_{i=1}^N \Delta(t_{i-1}, t_i) Z(t_i) (Q(t_i) + Q(t_{i-1}))$$

$$V_{\text{protection}} = (1 - R) \sum_{n=1}^M Z(t_n) (Q(t_{n-1}) - Q(t_n))$$

$$U(0) = V_{\text{protection}} - V_{\text{premium}}$$

Explain the key terms in the above formulas.

9. Continued

Commentary on Question:

Candidates performed well on this part. Most candidates were able to identify the key elements of the formula.

$V_{premium}$ measures the discounted value (using LIBOR rates) of the payment of a fixed coupon that continues at quarterly intervals until a credit event or maturity, whichever occurs first.

$\Delta(t_{i-1}, t_i)$ is the year fraction since the last coupon payment date.

N is the number of remaining coupons.

$Z(t_i)$ is the discount factor

$C(T)$ is the coupon accrued between payment dates and has to be paid if a credit event occurs between coupon payment dates.

$V_{protection}$ measures the probability of default at each small time period until the end of the contract and the protection seller having to pay the discounted value (using LIBOR rates) of $(1 - R)$.

$(1 - R)$ is the amount paid following a credit event, where R is the recovery amount.

$(Q(t_{n-1}) - Q(t_n))$ is the probability of defaulting between t_{n-1} and t_n .

$U(0)$ is the upfront cost that must be paid by a protection buyer to the protection seller to enter into a CDS contract.

If $U(0)$ is negative, it represents the amount that the protection seller must pay to the protection buyer to enter into a CDS contract.

10. Learning Objectives:

7. The candidate will understand the need for and goals of attributing the performance of a portfolio to various factors, evaluating this attribution against a benchmark, and recommending adjustments to portfolio strategy.

Learning Outcomes:

- (7c) Recommend a benchmark for a given asset or portfolio
- (7d) Calculate and interpret performance attribution metrics for a given asset or portfolio

Sources:

Maginn and Tuttle, *Managing Investment Portfolios*, 3rd Edition 2007, Ch.12

Commentary on Question:

This question tests the candidate's ability to decompose portfolio returns and reconcile differences in portfolio returns compared against an associated benchmark. As well, the question tests the candidate's ability to evaluate appropriateness of asset classes for benchmark inclusion.

Solution:

- (a) Calculate the values A & B above.

Commentary on Question:

Candidates performed as expected on this question. The majority calculated the value of B with nearly all candidates getting full marks. Candidates calculated the value of A as expected with about 50% of the candidates getting full marks. Common mistakes in calculating A were using an incorrect application of the formula where either of these terms, $(w_{pj} - w_{Bj})$ or $(r_{pj} - r_{Bj})$, were not included at all or only partly included. As an example, some candidates included w_{pj} but left out w_{Bj} . Various combinations of these components were used incorrectly or left out altogether.

- (i) Calculate B first as it is needed to determine A.

B is calculated by taking the weighted average of each sector return set equal to the overall benchmark return, given as 2.3%:

Benchmark Return: $R_b = 2.3\%$

Solve for B: $(30\% * 3\%) + (20\% * 4\%) + (10\% * (-2\%)) + (40\% * B) = 2.3\%$

Therefore, Technology Sector in the Benchmark has a return $B = 2\%$

10. Continued

- (ii) Calculate A, using B = 2% and the allocation/selection return given as -0.015%.

Use the allocation/selection interaction component of the following formula, since the result is given as -0.015% :

$$r_p = \underbrace{\sum_{j=1}^S (w_{pj} - w_{Bj})(r_{Bj} - r_B)}_{\text{Pure Sector Allocation}} + \underbrace{\sum_{j=1}^S (w_{pj} - w_{Bj})(r_{pj} - r_{Bj})}_{\text{Allocation/Selection Interaction}} + \underbrace{\sum_{j=1}^S w_{Bj}(r_{pj} - r_{Bj})}_{\text{Within-Sector Selection}} \quad (12-16)$$

Calculate $(w_{pj} - w_{Bj})$ and $(r_{pj} - r_{Bj})$ for all components, solving for A:

Solve for A:

$$(35\% - 30\%) * (2.7\% - 3.0\%) + (25\% - 20\%) * (6\% - 4\%) + (5\% - 10\%) * (A\% - (-2\%)) + (35\% - 40\%) * (3\% - 2\%) = -0.015\% \text{ as given.}$$

Therefore, Consumer Durables Sector in the Portfolio has a return of A = -1%

- (b) Calculate the total value-added return by showing the pure sector allocation and within sector allocation/selection components.

Commentary on Question:

Candidates calculated the pure sector returns at an above average performance and the within sector allocation returns as expected. Common mistakes were not applying the formulas correctly; for example, by using portfolio weights when benchmark weights were needed or calculating the excess return of the benchmark over the portfolio vs. the correct approach of portfolio return in excess of the benchmark. Candidates calculated the total value-added return at a below average performance with many candidates either not calculating it at all or not adding the three components to get the correct answer. The correct answer is the sum of the two components calculated in this part of the question added to the -0.015% given in part (a).

- (i) Calculate the pure sector allocation return by using the following formula:

$$r_p = \underbrace{\sum_{j=1}^S (w_{pj} - w_{Bj})(r_{Bj} - r_B)}_{\text{Pure Sector Allocation}}$$

10. Continued

Pure sector allocation return =

$$(35\% - 30\%) * (3\% - 2.3\%) + (25\% - 20\%) * (4\% - 2.3\%) + (5\% - 10\%) * (-2\% - 2.3\%) + (35\% - 40\%) * (2\% - 2.3\%) = 0.35\%$$

Therefore, the pure sector allocation return = 0.35%

- (ii) Calculate the within sector allocation/selection return by using the following formula:

$$\underbrace{\sum_{j=1}^S w_{Bj}(r_{pj} - r_{Bj})}_{\text{Within-Sector Selection}}$$

Within sector allocation/selection return =

$$(30\%) * (2.7\% - 3\%) + (20\%) * (6\% - 4\%) + (10\%) * (-1\% - (-2\%)) + (40\%) * (3\% - 2\%) = 0.81\%$$

Therefore, the within sector allocation/selection return = 0.81%

- (iii) Calculate the total value-added return:

$$\begin{aligned} \text{Total value-added return} &= \text{pure sector} + \text{within sector} + \text{allocation/selection} \\ &\text{return} \\ &= 0.35\% + 0.81\% - 0.015\% = 1.145\% \end{aligned}$$

Therefore, the total value-added return = 1.145%

- (c) The following asset classes have been suggested as new elements to incorporate in the portfolio benchmark:

- A REIT index
- MSCI EAFE

Critique the above suggestions.

10. Continued

Commentary on Question:

Candidates performed below expectations on this part of the question. Some candidates made the correct recommendation but gave partial reasons or provided a limited assessment of the pros and cons / limited critique. Many candidates either gave little to no critique or were incorrect in their recommendations. A common mistake was making the assumption that the REIT and MSCI EAFE were investment choices to add to the portfolio vs elements to consider adding to the benchmark.

(i) A REIT Index as a new element in the benchmark:

Pro: Unambiguous, specified in advance and may be investable

Con: Not consistent with current investments (not appropriate / not owned), likely does not reflect manager investment opinion, may be measurement issues and may not be investable

Recommendation: Exclude given the level of uncertainty and not appropriate given the current investment portfolio.

(ii) MCSI EAFE as a new element in the benchmark:

Pro: Broad market index meets most criteria - well recognized, measurable, investable

Con: Not appropriate given portfolio mandate is US, may not reflect manager investment opinion

Recommendation: Exclude given the portfolio mandate is the US.

11. Learning Objectives:

6. The candidate will understand:
- Investment dimensions of designing product offerings and managing inforce product liabilities.
 - Managing investment portfolios in the context of financial institution liabilities (asset liability management).
 - The theory and techniques of portfolio asset allocation.

Learning Outcomes:

- (6b) Demonstrate an understanding of risks associated with guarantee riders including: market, insurance, policyholder behavior, basis, and credit.
- (6e) Develop and critique asset allocation strategies appropriate to underlying liability profiles.

Sources:

QFIA-115-13: Stochastic Modelling, Theory and Reality from an Actuarial Perspective, pages IV- 25 to IV-26

QFIA-115-13: Stochastic Modelling, Theory and Reality from an Actuarial Perspective, pages IV-8 to IV-9

QFIA-115-13: Stochastic Modelling, Theory and Reality from an Actuarial Perspective, pages IV-5 to IV-16

Commentary on Question:

This question tests the candidates understanding of the underlying risks associated with guarantee riders and be able to suggest appropriate risk mitigation strategies

Solution:

- (a) Propose risk mitigation techniques for three key risk drivers behind the GLWB product.

Commentary on Question:

The candidates performed below average on this question. Some candidates were able to describe at least three of the risks. Many candidates identified the risks based on the observed sensitivity results rather than risks inherent in the variable annuity product itself. Others provided risk mitigation strategies without explicitly describing the corresponding risk.

- (i) **Policyholder Behavior Risk:** This risk is assumed using lapses, withdrawals and annuitizations. This risk is difficult to predict due to lack of shared industry-wide data. The risk can be mitigated by introducing restrictive clauses in the product design or adding margins in the pricing assumption to increase profitability to the insurer

11. Continued

- (ii) **Reinsurance Risk:** (or counterparty risk) Insurers add reinsurance agreements in order to protect against the downside risk of variable annuity contracts. However, reinsurance deals are subject to counterparty risk. This can be mitigated by requiring capital to be held or adding a cap on the total benefits.
 - (iii) **Market Risk:** GLWB cost as well as its profitability is significantly influenced by market volatility. This risk can be minimized by applying a dynamic hedge program or adding a reinsurance contract. However, both of these techniques do present additional operational risks as well.
 - (iv) **Basis Risk:** This risk is incurred when there is a mismatch in the underlying assets used to back the embedded insurance guarantee option. Effective management of a dynamic hedge program by investment specialists would typically limit the fluctuations in the economic liability of the insurance guarantee caused by the market volatility of the investment portfolio
- (b) Critique the suggestion of using 500 scenarios for calculating the cost of the GLWB.

Commentary on Question:

The candidates performed as expected on this section. Many candidates were able to illustrate that the cost of the GLWB would be understated using 500 scenarios and is therefore not correct for pricing. Beyond the impact on the cost of the product, some candidates did not demonstrate an understanding of the relationship between increasing the number of scenarios and pricing of the product

- The standard error of the expected charge is increased when the number of run-time scenarios are reduced significantly.
- The GLWB cost based on run-time scenarios of 1,500 indicate that the expected charge of 0.5 percent is adequate under the current pricing assumptions.
- Since the cost under 1,500 is close to the result with 1,000, this basically concludes that the pricing team's decision to use 1,000 run-time scenarios to calculate the GLWB charge was a reasonable trade-off between accuracy and run-time.
- 500 scenarios would not be appropriate because it would underestimate the cost.

11. Continued

- (c) Propose four modifications to the pricing and/or product design to reduce the risk exposure of the embedded guarantee of the GLWB product.

Commentary on Question:

Candidates performed below average on this section. Some candidates made recommendations using the observed sensitivity results. Other candidates made suggestions on the product features instead of the risks of the product

- I. Fund Allocation:** Given the sensitivity the GLWB cost due to the equity allocated in the fund, WIC might consider setting restrictions on the fund allocation such as maximum limits on equity proportion. Another option is to restrict the funds selected.
- II. Base Lapse:** Policyholder behavior is perhaps the most difficult risk to assess in the development of variable annuity products. The sensitivity of lapse factor increased the GLWB cost significantly. It may be prudent for WIC to add profit margins in the pricing assumptions or placing restrictive policyholder clauses within the VA contract.
- III. Mortality Risk:** The mortality sensitivity results indicate that the GLWB cost is not adequate in event that the mortality falls materially lower than the expected base assumptions. WIC should perform a further review of the mortality experience of both their book of business and industry in order to fairly revise the assumption used to develop the expected cost.
- IV. Dynamic Lapse Factor:** Policyholder behavior is perhaps the most difficult risk to assess in the development of variable annuity products. WIC is already using a dynamic lapse formula, but it may consider making it more conservative or changing the formula to model the lapse behavior based on the relative size of the guarantee value and account value.

12. Learning Objectives:

2. The candidate will understand:
 - The credit risk of fixed income portfolios, securities, and sectors and be able to apply a variety of credit risk theories and models.
 - How rating agencies rate corporate and sovereign bonds and securitized credit.

Learning Outcomes:

- (2a) Demonstrate an understanding of the basic concepts of credit risk modeling such as probability of default, loss given default, exposure at default, and expected loss.
- (2b) Demonstrate an understanding of modeling approaches for correlated defaults.
- (2c) Demonstrate an understanding of credit valuation models.
- (2d) Demonstrate an understanding of Merton (structural) asset valuation models in the context of credit risk.

Sources:

Bluhm – Introduction to Credit Risk Modeling, sections 1.2.2.2, 1.2.3, 2.4.1, 2.5.1, 2.6.1, 3.3.2

Commentary on Question:

This question is testing candidates' understanding of credit risk and default modeling. Most candidates scored at least partial credit, with parts a and b being the most-answered.

Solution:

- (a)(i) Interpret the meaning of factor Y in your model.

Commentary on Question:

Candidates generally performed above average on this part. Full credit was given for the answer below, or for stating that Y is the single global factor on which all asset returns depend.

Y is the state of the economy

- (a)(ii) Describe how the conditional default probability $p_i(Y)$ depends on Y.

Commentary on Question:

Candidates generally performed above average on this part.

As Y increases, probability of defaults decrease.

12. Continued

- (b) Choose the best statement from the four options below and explain your choice:
- (i) Set A corresponds to the portfolio of corporate loans and is expected to perform best
 - (ii) Set B corresponds to the portfolio of corporate loans and is expected to perform best
 - (iii) Set A corresponds to the retail banking portfolio and is expected to perform best
 - (iv) Set B corresponds to the retail banking portfolio and is expected to perform best

Commentary on Question:

Candidates performed below average on this part. Most candidates did not identify iv as the correct answer. Many who did get this correct did not provide a thorough explanation, although received partial credit.

iv is the correct answer. The analytical approach works better with homogeneous portfolios with similar risk and return characteristics. Retail banking fits this description – no exposure concentrations, probabilities are more uniform, lower asset correlation, etc. Retail banking has $\rho \sim 1-5\%$, while corporate loans are more like $\rho \sim 25\%-60\%$

- (c) Prove that the conditional default probability is now given by

$$p_i(Y, W) = N \left[\frac{\sqrt{W/n} * F_n^{-1}(p_i) - \sqrt{\rho} * Y}{\sqrt{1-\rho}} \right]$$

where F_n is the t-distribution function with n degrees of freedom.

Commentary on Question:

Candidates performed below average on this part. The candidates who followed the logical proof generally received full credit. Many candidates left this question blank or wrote down just the formulas from the question, receiving no credit.

Let c_i be the threshold such that the firm is in the default state one year from now if and only if $r_i' < c_i$. By definition, we have $p_i = Pr(r_i' < c_i)$

and since $r_i' \sim t(n)$, we conclude that $p_i = F_n(c_i)$ or $c_i = F_n^{-1}(p_i)$

12. Continued

We can then rewrite the default condition $r_i' < c_i$ as

$$Z_i < \frac{F_n^{-1}(p_i)/\sqrt{n/W} - \sqrt{\rho} * Y}{\sqrt{1 - \rho}}$$

Since Z_i are standard normal, we finally have

$$p_i(Y, W) = N \left[\frac{\sqrt{W/n} * F_n^{-1}(p_i) - \sqrt{\rho} * Y}{\sqrt{1 - \rho}} \right]$$

- (d) Describe the difficulty in estimating ρ from market data and how CreditMetrics handles this problem.

Commentary on Question:

The candidates performed poorly on this section. Some candidates received credit for stating that asset value processes are not observable, but most did not explain how CreditMetrics handles this problem.

Asset value processes are not observable. CreditMetrics models equity processes, taking equity correlation as a proxy for asset correlations.

13. Learning Objectives:

1. The candidate will understand how to work with the variety of fixed income instruments available for portfolio construction.

Learning Outcomes:

- (1b) Demonstrate an understanding of the characteristics of leveraged loans.
- (1d) Demonstrate an understanding of the characteristics and mechanics of fixed income ETFs.
- (1g) Demonstrate an understanding of commercial mortgage backed securities.

Sources:

Handbook of Fixed Income Securities, Fabozzi, F.J., 8th Edition, 2012: Chapter 13 & 21

Commentary on Question:

This question tests the candidates' knowledge of asset characteristics of fixed income securities.

Solution:

- (a) Describe the factors that might cause both deals to execute at the same spread.

Commentary on Question:

Most candidates performed below average on this section of the question. The most common mistake was not using the information provided to establish a reason why the two deals would execute at the same price. Candidates who performed well incorporated the information provided in their answer.

TMX has a lower credit rating than SEA so it will cause TMX to have a higher spread than SEA all else equal.

Since SEA has a higher loan amount, the market may need a higher spread to clear the larger amount relative to TMX. These effects could offset so that the deals wind up at the same price.

- (b) You then review a price sheet of defaulted unsecured corporate bonds and defaulted leveraged loans. You notice that all the unsecured corporate bonds are listed at higher prices relative to par than the leveraged loans. Your manager has asked whether or not you agree with the accuracy of the price sheet and to justify your response.

Outline your answer to your manager.

13. Continued

Commentary on Question:

Most candidates performed as expected on this section of the question. Candidates who performed poorly did not properly reflect the general seniority of leveraged loans in the corporate capital structure hierarchy. Candidates who performed well demonstrated comprehension of the capital structure and supported their answer with facts from the readings.

Disagree. Leveraged loans are generally senior to all other debt of a corporation in bankruptcy. Although absolute priority is often violated during bankruptcy settlement leveraged loans still enjoy higher recovery rates than other creditors. A Moody's study found that recovery rates for leveraged loans were higher than recovery rates for corporate bonds. Given the lower recovery rates for corporate bonds relative to leveraged loans one should question the accuracy of the report. Moody's studied post default trading prices and found that leveraged loans generally traded higher than corporate bonds.

- (c) Your team needs direction that both recommends a solution and demonstrates how that solution addresses each of your team members' stated concerns and observations. You have scheduled another meeting with your team to make the recommendation and describe how it addresses the points made at the first strategy meeting.

Outline your discussion with the team.

Commentary on Question:

Most candidates performed below average on this section of the question. The most common mistake was offering three solutions, one for each concern, rather than a single solution that addressed each concern. Candidates who performed well provided one solution and then showed how that solution addressed each concern.

Purchasing fixed income exchange traded funds will address all of the concerns. The concern about investing the real estate proceeds quickly is addressed because the ETF can be purchased quickly on an exchange giving the portfolio broad or targeted exposure as needed with reasonable transaction costs. The team can add on individual bond positions to the portfolio over time while minimizing the time the portfolio is underexposed. The ETF investment will act as a liquidity sleeve around the core portfolio that can be accessed as needed to achieve rebalancing. Additionally, the ETFs themselves can be bought and sold to help achieve investment targets at lower transaction costs than core investments. ETFs generally do not have the same tracking error problems that may exist with Treasuries or Treasury futures. ETFs are exchange traded so they are not subject to counterparty risk. ETFs are liquid and/or can be sold easily at lower transaction costs.

14. Learning Objectives:

3. The candidate will understand the variety and assess the role of equities in investment portfolios. The candidate will demonstrate an understanding of the distinguishing investment characteristics and potential contributions to investment portfolios of the following major asset groups:
 - Real Estate
 - Public Equity
 - Private Equity
 - Infrastructure
 - Commodities
 - Hedge Funds

Learning Outcomes:

- (3d) Demonstrate an understanding of the due diligence process for different types of equity investments.
- (3e) Demonstrate an understanding of the basic concepts surrounding passive, active, and semi-active investing.
- (3h) Demonstrate an understanding of equity indices and their construction, including distinguishing among the weighting schemes and their biases.
- (3l) Demonstrate an understanding of issues related to incorporating Environmental, Social, and Governance (ESG) criteria into the investment process.

Sources:

Maginn and Tuttle, *Managing Investment Portfolios*, 3rd Edition, Section 7.5 p.450-452

Maginn and Tuttle, *Managing Investment Portfolios*, 3rd Edition, Section 7.7, p.460.

Maginn and Tuttle, *Managing Investment Portfolios*, 3rd Edition, Section 7.7.3, p.465.

Maginn and Tuttle, *Managing Investment Portfolios*, 3rd Edition, Section 7.8.1, p.466.

Jagannathan et al., *ESG Criteria: Why Investors Should Care*, Section 2, p.19-20.

Lo, *What is an Index?*, p.25-26.

Commentary on Question:

This question tests the candidate's understanding of why certain firms might care about being environmentally conscious investors. It also tests their understanding of maintaining a portfolio of managers, and some of the relatively modern investment vehicles.

14. Continued

Solution:

- (a) Critique the CFO position on integrating the ESG criteria in the investment policy.

Commentary on Question:

The candidates performed below average on this section. Most candidates received credit for mentioning either protection against future regulation changes or reputation harm. Few candidates mentioned other reasons for considering ESG criteria in the investment policy.

- Firms may produce socially undesirable public bads, regulation may take time, but eventually may catch up with social concerns
 - Stocks are long lived asset, most of the value is from cash flows that occur in the future.
 - Many individual investors have ethical considerations. They want money managers to reduce negative externalities
 - As a social factor, this could impact their relations with local communities and supporting producers; Global media shaming can harm their image and hurt their profits, more easily due to social media use
- (b) List four characteristics, qualitative or quantitative, that you will use in evaluating various asset managers.

Commentary on Question:

The candidates performed below average on this section. Most candidates received partial credit for referencing investment style/philosophy. Few candidates mentioned the other criteria that are used to evaluate asset managers. Some candidates listed a variety of metrics (such as Sharpe ratio) without indicating what these ratios are used for (i.e. to allow for comparison of manager against peers or benchmark).

People and organizational structure (Qualitative)

Investment style/philosophy (Qualitative)

Decision-making process (Qualitative)

Strength of its equity research (Qualitative)

Performance comparisons with benchmarks and peer groups (Quantitative)

Measured style orientation and valuation characteristics (Quantitative)

14. Continued

- (c) Compare long-only, long-short, and market neutral long-short funds.

Commentary on Question:

The candidates performed as expected on this section. Most candidates explained the basic characteristics of each fund. Candidates that performed well were able to explain how a manager uses these characteristics to add value. (e.g, answering “long undervalued stock” instead of simply “long stocks”).

Long-only: Can only take long positions, long undervalued securities.

Long-short: Can take both long and short positions; long undervalued stocks and short overvalued stocks

Market neutral long-short: Special case of long-short, with zero overall market risk (beta).

- (d) Determine the best asset manager mix among the three options above, using the Information Ratio as the criteria.

Commentary on Question:

The candidates performed brilliantly on this section. Almost all candidates received full credit for their responses.

Active return (R) = sum of allocation rate x expected active return

$$R1 = 80\% * 0.5\% + 20\% * 2.5\% = .9\%$$

$$R2 = 60\% * 0.5\% + 40\% * 2.5\% = 1.3\%$$

$$R3 = 40\% * 0.5\% + 60\% * 2.5\% = 1.7\%$$

IR = Active Return / Active Risk

$$IR1 = 0.9\% / 1.13\% = 0.80$$

$$IR2 = 1.3\% / 1.71\% = 0.76$$

$$IR3 = 1.7\% / 2.43\% = 0.70$$

Based on the highest IR, the 80/20 mix is the best one.

- (e) Determine the optimal manager mix between asset manager A and C using the Information Ratio as the criteria.

Commentary on Question:

The candidates performed above average on this section. Most candidates received credit for providing the correct formula for tracking risk, active return and information ratio. Those candidates that solved the quadratic equation and calculated the active return and information ratio received full credit.

14. Continued

Let the new mix for A is $x\%$. Then C is $(100-x)\%$.

$$\text{Tracking risk of new manager mix} = 2\% = \sqrt{x^2 \times .01^2 + (1-x)^2 \times .05^2}$$
$$\Rightarrow x = .62 \quad (\text{the other root is } >1)$$

Therefore, the new mix is 62/38 between manager A and C

$$\text{Active return of new mix} = .62 \times .005 + .38 \times .04 = 1.83\%$$

$$\text{Information Ratio of this mix} = 1.83\% / 2.00\% = 0.92$$

15. Learning Objectives:

6. The candidate will understand:
- Investment dimensions of designing product offerings and managing inforce product liabilities.
 - Managing investment portfolios in the context of financial institution liabilities (asset liability management).
 - The theory and techniques of portfolio asset allocation.

Learning Outcomes:

- (6c) Demonstrate an understanding of liability driven investing (LDI) for pension plans
- (6e) Develop and critique asset allocation strategies appropriate to underlying liability profiles

Sources:

QFIA-128-18: The Evolution of LDI & Role of a Completion Portfolio

Commentary on Question:

This question tests the candidate's knowledge of liability driven investing and completion portfolios as they relate to pension plans.

Solution:

- (a) Identify catalysts for pension plans to de-risk as a result of the economic environment in QFI.

Commentary on Question:

The candidates performed as expected on this section. Many candidates identified several relevant catalysts and received full credit. Some candidates identified market volatility or low interest rates but did not link this to the funded status of the pension plan and therefore only received partial credit.

- Significant volatility of funded status – market volatility can cause sharp moves in the funded status in an environment of slow economic growth, uncertain central bank policy and reduced market liquidity.
- Increasing pension insurance premiums – a steady increase in pension guarantee insurance premiums (e.g. PBGC) provides further incentive for plan sponsors to de-risk and/or shrink the number of participants in their plans.

15. Continued

- (b) Explain three of the typical risk factors to consider when constructing a completion portfolio for a pension plan.

Commentary on Question:

The candidates performed as expected on this section. Most candidates correctly identified several of the risk factors. Many candidates identified three risk factors but did not fully explain them and so received partial credit.

- Interest rate risk (duration and yield curve risk) – markets can price a very different path for monetary policy compared to the central bank. Low rates increase the pension plan liabilities.
 - Credit risk – defaults or companies being downgraded from investment-grade to high yield (“fallen angels”) can impair the funded status of the pension plan.
 - Inflation risk – pension plan liabilities are linked to salaries and high inflation can significantly increase these liabilities. Mismatches occur when inflation-linked TIPS price in continued weakness in inflation despite a rise in actual core inflation.
 - Basis risk – slippages in funding levels can occur due to asset movements not being fully aligned with liability movements. Basis risk increases amid distortions in the capital markets, e.g. interest swap and credit derivative markets.
- (c) Recommend a strategy that might help the plan build a completion portfolio that meets the sponsor’s goals.

Commentary on Question:

The candidates performed as expected on this section. Most candidates identified an appropriate strategy that met at least some of the sponsor’s goals and received partial credit. Very few candidates got full credit because either their strategy did not achieve all the goals or they did not sufficiently explain how their strategy achieved each goal.

The company could use derivatives such as interest rate swaps or forward starting swaps to lengthen and manage the duration without making major changes to the overall asset allocation. This can allow the plan to hedge a much larger portion of the interest rate risk without sacrificing the expected return on assets often seen when shifting from equities to long-duration bonds.

This approach works particularly well for underfunded pension plans, where it could reduce overall risk by lowering the volatility of the funded status while still achieving a higher rate of return on the assets to help reduce the funding gap.

15. Continued

The company could further use equity derivatives, such as equity futures or total return swaps, to add more equity exposure and leverage to the portfolio to further achieve a higher rate of return.

The use of derivatives are capital efficient and do not require significant upfront funding.

- (d) Discuss the risks of the proposed strategy.

Commentary on Question:

The candidates performed as expected on this question. Many candidates received full credit by discussing several risks associated with their strategy. Most candidates discussed at least one relevant risk and received partial credit.

- Collateral and margin management risk – movements in rates or credit risk could require the plan to post additional margin or collateral

- Basis risk – movements in derivative-based hedges may not offset corresponding moves in the liability risk

- Leverage – adding more leverage to the portfolio could magnify losses in down market environments

16. Learning Objectives:

6. The candidate will understand:
 - Investment dimensions of designing product offerings and managing inforce product liabilities.
 - Managing investment portfolios in the context of financial institution liabilities (asset liability management).
 - The theory and techniques of portfolio asset allocation.

Learning Outcomes:

- (6d) Propose asset allocation strategies and explain the impact of asset allocation relative to various investor goals and constraints
- (6e) Develop and critique asset allocation strategies appropriate to underlying liability profiles

Sources:

Managing Investment Portfolios, Maginn & Tuttle, 3rd Edition, 2007

- Ch. 7: Equity Portfolio Management

QFIP-144-19: Risk Parity is All About Balance, Bridgewater Associates

Commentary on Question:

This question tests candidates' understanding of the theory and techniques of portfolio asset allocation.

Solution:

- (a) Identify the investment approach of each manager and your firm's investment strategy and justify your answers.

Commentary on Question:

The candidates performed above average on this section. Most candidates correctly identified the investment approach of the three managers, but some candidates did not identify the firm's overall strategy.

Manager A is an index or passive manager, because they have a tracking risk of 0%.

Manager B is a semi-active manager because they have low expected active return and tracking risk.

Manager C is an active manager because they have a very high expected active return and tracking risk.

The firm's overall investment strategy is a core-satellite portfolio. The index and semi-active managers constitute a larger portion of the AUM: the core holding.

The active manager represents a satellite around the core holdings.

16. Continued

- (b) Calculate manager C's "true" active return and "misfit" active return.

Commentary on Question:

The candidates performed brilliantly on this section. Most candidates received full credit for correctly calculating both returns.

$$\text{Manager's return} = 2.5\% + 4\% = 6.5\%$$

$$\begin{aligned}\text{True active return} &= \text{manager's return} - \text{manager's normal benchmark} \\ &= 6.5\% - 7\% = -0.5\%\end{aligned}$$

$$\begin{aligned}\text{Misfit active return} &= \text{manager's normal benchmark} - \text{fund benchmark} \\ &= 7\% - 4\% = 3.0\%\end{aligned}$$

- (c) Manager C claimed that since his active return of 2.5% is positive, he was doing a good job.

Critique his comment.

Commentary on Question:

The candidates performed as expected on this section. Most candidates concluded that Manager C did not do a good job because his true active return is negative. Some candidates also calculated his Information Ratio relative to Manager B as another reason to critique his claim.

Manager C's claim is not correct.

His true active return is negative, indicating that the manager underperformed a passive investment in his normal benchmark. The fund would have been better off if it was directly invested in the manager's normal benchmark rather than investing in Manager C.

His positive misfit active return indicates that he outperformed the firm's benchmark only because his normal benchmark outperformed the fund benchmark.

- (d) Describe why this traditional approach may be flawed through interpreting the relationships between: inflation, growth, stocks, and bonds.

Commentary on Question:

The candidates performed poorly on this section. Few candidates were able to identify the different correlations that the two risk factors have to the two asset classes. Most candidates did not correctly identify that the problem with the traditional approach is it is prone to volatility due to changes in economic risk factors.

16. Continued

Growth has positive correlation with stocks but negative correlation with bonds. If growth was the only risk factor, stocks and bonds would be negatively correlated. Inflation has negative correlation with both stocks and bonds. If inflation was the only risk factor, stocks and bonds would be positively correlated.

As a result, stocks and bonds do not always diversify risk. The performance of a portfolio constructed using the traditional approach will depend on the future economic environment and future correlation between stocks and bonds, which are unknown. Thus, it is hard to construct a portfolio using the traditional approach that performs well in all economic environments.

- (e) Explain why your recommended approach could circumvent the flaws of the traditional approach.

Commentary on Question:

The candidates performed below average on this section. The candidates that were able to describe the equal holdings of the All Weather Approach received the most credit. Those candidates that did not describe how the performance of the sub-portfolios offset, leaving the risk premium as the dominate source of return received the least credit. Most candidates could not identify that the benefit of the All Weather Approach is not having to rely on correlation assumptions.

The relationship between asset classes and the economic risk factors of growth and inflation are reliable and known. The All Weather Approach exploits these reliable relationship by holding 4 sub-portfolios with equal exposures to assets that do well when (1) growth increases, (2) growth decreases, (3) inflation increases, and (4) inflation decreases.

The result is that the underperformance of one sub-portfolio will be offset by the outperformance of another sub-portfolio. This produces a more stable return, leaving the risk premium as the dominant source of returns.

The All Weather Approach does not depend on unreliable correlation assumptions or predictions of volatile economic risk factors.