QFI PM Model Solutions
Fall 2021

1.

Learning Objectives:
7.   The candidate will understand the need for and goals of assessing the performance of a portfolio, and the methods and limitations of performance attribution.

Learning Outcomes:
(7b)   Apply performance measurement methodologies to various asset portfolios

(7c)   Describe and assess techniques to select or build an asset benchmark for a given investment objective

(7d)   Assess and interpret performance attribution metrics for a given asset or portfolio

Sources:
Managing Investment Portfolios: A Dynamic Process, Maginn & Tuttle, 3rd Edition, 2007, Ch. 12, p 724-729, 733-734, 740-742, 771-775

Commentary on Question:
This question tests the candidate's understanding of performance evaluation, as well as the fundamentals underlying benchmarks.

Solution:
(a)   List four criteria for establishing a good benchmark.

Commentary on Question:
Candidates performed brilliantly on this section. Most candidates were able to successfully recall four criteria for establishing a good benchmark. Several candidates confused the criteria for a good benchmark with the tests used to assess the quality of the benchmark in part (b).

The following items would be considered acceptable criteria for a good benchmark:
*   Unambiguous
*   Investable
*   Measurable
*   Appropriate
*   Reflective of Current Investment Opinions
*   Specified in Advance
*   Owned

Note that candidates were only required to list four of the above items to get full marks.

1. Continued

(b)   Describe three heuristic tests that can be performed to assess the quality of a benchmark.

Commentary on Question:
Candidates performed as expected on this section. Successful candidates were able to list and describe three separate tests – in many cases candidates only listed the tests without providing an adequate description. Several candidates confused the criteria for a good benchmark in part (a) with the tests used to assess the quality of the benchmark.

The following tests may be used to evaluate the quality of a benchmark:
- Systematic biases: There should be minimal systematic biases between the portfolio returns and the benchmark. One test for this would be to calculate the Beta between the portfolio and benchmark – the Beta should be close to 1 if there is no systematic bias.
- Tracking error: The tracking error between a portfolio and a benchmark should be less than the tracking error between the portfolio and a market index/alternative benchmark.
- Risk characteristics: A portfolio's exposure to systematic risk sources of risk should be consistent with the benchmark
- Coverage: There should be a high degree of overlap between the investments included in a portfolio relative to the assets included within a benchmark.
- Turnover: The turnover of assets within a benchmark should not be excessively high – benchmarks with high turnover may preclude the successful implementation of a passively managed portfolio
- Positive active positions: For long-only portfolios, there should not be a large proportion of negative active positions.

Note that candidates were only required to describe three of the above items to get full marks.

(c)   Assess the appropriateness of calculating returns using each of the methods listed below:

(i)   Time-weighted rate of return

(ii)   Dollar-weighted rate of return

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1. Continued

Commentary on Question:
Candidates performed as expected on this question. In order to receive full marks, candidates were expected to describe both the time-weighted and dollar-weighted rate of return and then to justify why the time-weighted rate of return was appropriate. One common pitfall was candidates only providing a description of the returns without making a recommendation on which metric is appropriate, or only providing a recommendation on which metric is appropriate without justifying it.

- Money-weighted returns calculate investment performance using all cash flows included in the portfolio
- Time-weighted returns calculate investment performance based on a single unit of account
- Using a time-weighted return would be appropriate for this scenario due to the fact that there are external cash flows that the investment manager does not control.

(d) A colleague is analyzing the following quality control chart for Portfolio Y, which is calibrated at the 80th percentile.
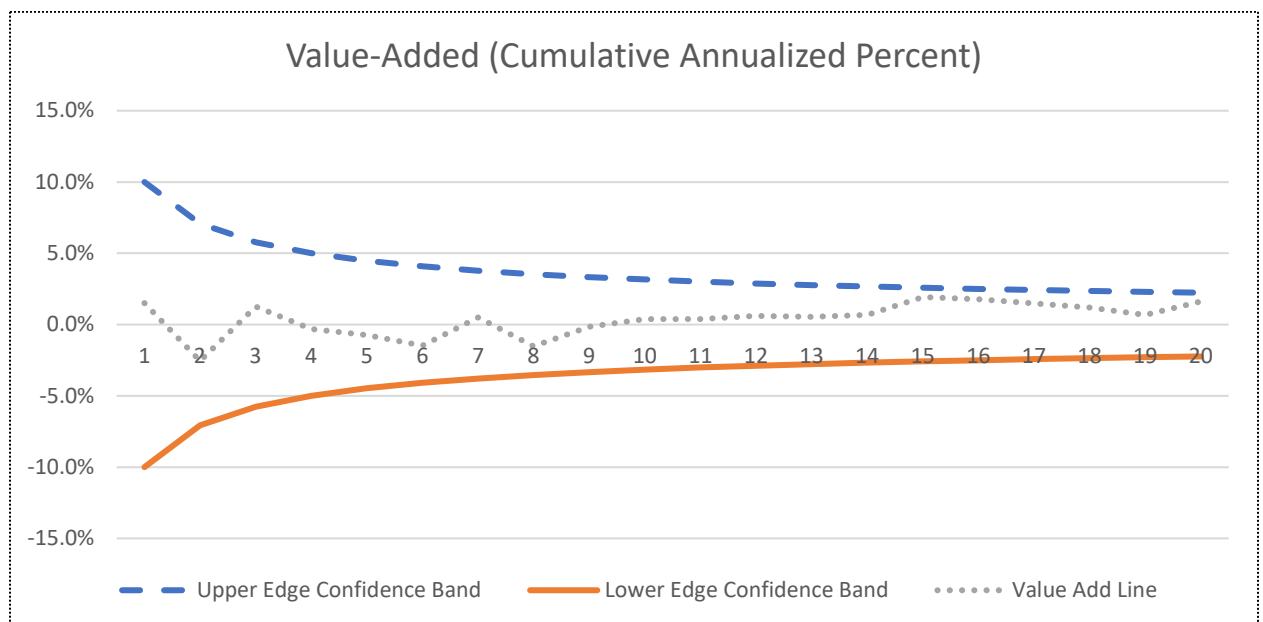
Your colleague claims that, based upon the above chart, the portfolio manager is truly skillful as they were able to outperform the benchmark by 1.6% per year over a 20 year period.

Critique your colleague's statement.

1. Continued

Commentary on Question:
Candidates performed as expected on this question. Many candidates were able to successfully identify that their colleague's statement is incorrect. One common omission from candidates' solutions was stating the null hypothesis of the quality control chart.

- Your colleagues cannot make this conclusion based on the quality control chart
- Null hypothesis of a quality control chart is that a portfolio manager has no skill
- Confidence bands represent the range of value-added returns we would expect the portfolio manager to provide during the specified time horizon, assuming the null hypothesis is correct.
- In this case, the portfolio manager's returns do not exceed the confidence bands within the quality control chart, so we fail to reject the null hypothesis that the portfolio manager has no skill

2.   **Learning Objectives:**
1.   The candidate will understand how to work with the variety of fixed income instruments and evaluate fixed income portfolios.

Learning Outcomes:
(1a)   Describe the cash flow of various fixed income securities considering underlying risks such as interest rate, credit and event risks

(1d)   Construct and manage portfolios of fixed income securities using the following broad categories:
- Managing funds against a target return
- Managing funds against liabilities

Sources:
Maginn & Tuttle, Managing Investment Portfolios: A Dynamic Process 3rd Edition, Ch 6

Commentary on Question:
This question tests the understanding of constructing a bond portfolio along with its associated risks. Candidates are reminded to always show their working, especially when asked to calculate, in order to receive partial credit. Overall, candidates performed below average on this question.

Solution:
(a)   Calculate the US dollar duration of the portfolio.

Commentary on Question:
Candidates performed as expected on this question. Some candidates did not use the correct direction for the currency conversion to USD, and many candidates did not consider the foreign country betas. Another common mistake was not dividing duration by 100, which showed a fundamental misunderstanding of the dollar duration measure.

$MV^A = 3MM \times 110.45\% \times 1 = \$3,314,155.68$
$MV^B = 3MM \times 102.18\% \times 1.2161 = \$3,727,734.58$
$MV^C = 4MM \times 104.00\% \times 0.8251 = \$3,432,423.96$

$Dur^A = MV^A \times \dfrac{4.71}{100} \times 1.00 = 156,114.76$
$Dur^B = MV^B \times \dfrac{3.99}{100} \times 0.42 = 62,547.06$
$Dur^C = MV^C \times \dfrac{2.92}{100} \times 0.47 = 47,147.18$

$ duration = 265,809.00

2. Continued

(b)   Calculate the rebalancing ratio for the portfolio given the stated goals.

Commentary on Question:
*Candidates performed below average on this question. Two common mistakes were estimating the bond prices at year 1 (instead of calculating the future bond prices from first principles using the projections), and subtracting 1 from the rebalancing **ratio**. Successful candidates used the provided information to calculate the new bond prices at year 1 before following similar steps to part (a) to derive the new dollar duration and the consequent rebalancing ratio.*

$$Price^A = 3\% \times (1+1.00\%)^{-1} \times \frac{1-(1+1.00\%)^{-4}}{1-(1+1.00\%)^{-1}} + 1 \times (1+1.00\%)^{-4}$$
$$= 107.80\%$$
$$Price^B = 0.2\% \times (1\pm.27\%)^{-1} \times \frac{1-(1\pm.27\%)^{-3}}{1-(1\pm.27\%)^{-1}} + 1 \times (1\pm.27\%)^{-1\times3}$$
$$= 101.42\%$$
$$Price^C = 2.25\% \times (1+0.97\%)^{-1} \times \frac{1-(1+0.97\%)^{-2}}{1-(1+0.97\%)^{-1}} + 1 \times (1+0.97\%)^{-2}$$
$$= 102.52\%$$

$$MV^A = 3MM \times 107.80\% \times 1 = \$3,234,117.97$$
$$MV^B = 3MM \times 101.42\% \times 1.10 = \$3,346,764.09$$
$$MV^C = 4MM \times 102.52\% \times 0.7692 = \$3,154,415.48$$

$$Dur^A = MV^A \times \frac{3.82}{100} \times 1.00 = 123,435.92$$
$$Dur^B = MV^B \times \frac{3.00}{100} \times 0.42 = 42,142.66$$
$$Dur^C = MV^C \times \frac{1.97}{100} \times 0.47 = 29,187.69$$

$ duration = 194,767.86

Rebalancing Ratio = 265,809 / 194767.86 = 1.365

(c)   Critique the portfolio manager's plan on hedging all currency exposures assuming Interest Rate Parity holds.

2. Continued

Commentary on Question:
Candidates performed poorly on this question. Many candidates provided the definition of Interest Rate Parity (IRP) without tailoring their answer to the context of the question, which is currency hedging. Successful candidates recognized that since currency is hedged and the sovereign bonds were assumed to have no credit risk, the returns should be equal under IRP. Partial credit was given to reasonable answers showing that hedged returns are higher than unhedged returns.

Since the yield curves are flat and Interest Rate Parity holds, we can approximate the hedged return (HR) as

$$HR \approx i_d + \left(r_l - i_f\right)$$

where $r_l - i_f$ is the bond's local risk premium.

There is no local risk premium since all bonds are sovereign risk-free bonds and given the flat yield curve, the hedged return will be the same for all of them and equal to the USD bond return, which is 0.85%.

3. **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.

Learning Outcomes:

(2c)   Apply both threshold and statistical models of the term structure of defaults to analyze credit risk exposure

(2d)   Demonstrate an understanding of modeling approaches for correlated defaults

Sources:
Bolder, *Credit-Risk Modelling*, Section 4.1.1 to 4.1.5

Commentary on Question:
This question tests the candidate's understanding of performance evaluation, as well as the fundamentals underlying benchmarks.

Solution:

(a)   Derive the covariance matrix of $[y_1, y_2]$.

    Commentary on Question:
    Candidates performed as expected on this section. A handful of candidates confused covariance matrix with a correlation matrix and did not derive the variances of y_1 and y_2.

$$E(Y_1) = E\left(\sqrt{\rho_1}G + \sqrt{1-\rho_1}\varepsilon_1\right) = \sqrt{\rho_1}E(G) + \sqrt{1-\rho_1}E(\varepsilon_1) = \sqrt{\rho_1}(0) + \sqrt{1-\rho_1}(0) = 0$$

$$E(Y_2) = E\left(\sqrt{\rho_2}G + \sqrt{1-\rho_1}\varepsilon_2\right) = \sqrt{\rho_2}E(G) + \sqrt{1-\rho_2}E(\varepsilon_2)$$
$$= \sqrt{\rho_2}(0) + \sqrt{1-\rho_2}(0) = 0$$

$$Var(Y_1) = Var\left(\sqrt{\rho_1}G + \sqrt{1-\rho_1}\varepsilon_1\right) = \rho_1 Var(G) + (1-\rho_1)Var(\varepsilon_1) = \rho_1(1) + (1-\rho_1)(1) = 1$$

$$Var(Y_2) = Var\left(\sqrt{\rho_2}G + \sqrt{1-\rho_2}\varepsilon_1\right) = \rho_2 Var(G) + (1-\rho_2)Var(\varepsilon_2) = \rho_2(1) + (1-\rho_2)(1) = 1$$

$$Corr(Y_1, Y_2) = Cov(Y_1, Y_2) = E\big((Y_1 - E(Y_1)) \times (Y_2 - E(Y_2))\big) = E(Y_1 Y_2) = E\big((\sqrt{\rho_1}G + \sqrt{1-\rho_1}\varepsilon_1) \times (\sqrt{\rho_2}G + \sqrt{1-\rho_2}\varepsilon_2)\big) = E(\sqrt{\rho_1}\sqrt{\rho_2}G^2) = \sqrt{\rho_1}\sqrt{\rho_2}Var(G) = \sqrt{\rho_1}\sqrt{\rho_2}$$

3. Continued

The covariance matrix of $[Y_1, Y_2]$ is:

$$\begin{bmatrix} 1 & \sqrt{\rho_1}\sqrt{\rho_2} \\ \sqrt{\rho_1}\sqrt{\rho_2} & 1 \end{bmatrix}$$

Candidates could use generalized variables such as $E(Y_i)$ but they are expected to substitute back i = 1 and 2 to arrive at covariance as $\sqrt{\rho_1}\sqrt{\rho_2}$ in the final step.

(b) Explain the implications of using the simplified model your coworker recommends.

Commentary on Question:
Candidates performed below average on this section. While most candidates could point out the statistical feature of the simplified structure, very few of them successfully highlighted the difference against the original structure in order to explain the implications of using the simplified model.

- The coworker's structure has a simplistic pattern in the correlation structure. Both bond obligors depend on the global factor G in the same way.
- The coworker's structure has a common covariance between all state variables.
- My structure has each credit counterparty affected by the global state variable in a different way
- My structure will have 3 parameters that need to be estimated. (If this was extended to include a larger portfolio of N bonds it would lead to N+1 parameters, in this case N=2.) Therefore the simplified model could reduce the computational efforts and statistical power of the estimated parameters.

(c) Derive an expression for $\rho\left(\mathbb{I}_{\mathcal{D}_1}, \mathbb{I}_{\mathcal{D}_2}\right)$, the correlation between default variables $\mathbb{I}_{\mathcal{D}_1}$ and $\mathbb{I}_{\mathcal{D}_2}$.

Commentary on Question:
Candidates performed below average on this question. Approximately half of the candidates successfully defined correlation and worked through covariances, variances, probabilities of correlated Bernoulli random variables to arrive at the answer using:

$$\rho\left(I_{D_1,} I_{D_2}\right) = \frac{cov(I_{D_1,} I_{D_2})}{\sqrt{var(I_{D_1})}\sqrt{var(I_{D_2})}} = \frac{P(D_1 \cap D_2) - P(D_1)P(D_2)}{\sqrt{P(D_1)(1 - P(D_1))}\sqrt{P(D_2)(1 - P(D_2))}}$$

3. **Continued**

The default variable is a Bernoulli random variable which allows us to simplify this further.

$$\frac{P(D_1 \cap D_2) - P(D_1)P(D_2)}{\sqrt{P(D_1)(1 - P(D_1))}\sqrt{P(D_2)(1 - P(D_2))}} = \frac{p_{1,2} - p_1 p_2}{\sqrt{p_1 p_2 (1 - p_1)(1 - p_2)}}$$

Note that directly copying from formula sheet without the required derivation would only receive partial credit.

(d) Explain how the expression for the correlation derived in part (c) compares to the correlation between latent variables y_1 and y_2.

Commentary on Question:
Candidates performed poorly on this section. Candidates were not able to explain in statistical terms the differences between the correlation of latent variables and of the correlation of default variables. A few even failed to infer from the correlation expressions to conclude they are different.

From part a) of the question, we know that the correlation of the latent variables is:

$\rho(Y_1, Y_2) = \sqrt{\rho_1}\sqrt{\rho_2}$ (note from the simplified model in (b), this simplifies to just ρ)

The correlation between default variables is different from the correlation between latent variables. The difference between the two correlations are:

- The correlation for the latent variables and the default variables are similar and are related however they are different. Default correlation depends on the unconditional default probabilities and also on the joint probability of default between the two counterparties
- The latent variables are composed of normal random variables while the default variable is a Bernoulli random variable.

(e) Explain why it would be inappropriate to use this default trigger as defined by your coworker.

Commentary on Question:
Candidates performed as expected on this section. Most candidates were able to articulate the nature of point-probability within a continuous distribution; a few were able to extend this interpretation of the default trigger.

3. Continued

Computation of the probability of default is not possible if threshold is defined in this way. The probability of default is $p_n = P(D_n) = P(Y_n = K_n)$. The latent variable is a normal random variable so this probability would not be defined given it is a continuous function.

It would be difficult to interpret this default threshold in real life. The way your coworker has defined probability of default means that default only occurs at a specific value. Hence, this can be interpreted as the obligor defaults only at a specific level of financial health which would not make sense in a real world context.

Note that solely stating that an alternative trigger could be based on a range would only receive partial credits.

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
- Timber and Farmland Investments
- Distressed debts

Learning Outcomes:
(3a)   Demonstrate an understanding of the investment strategies and portfolio roles that are characteristic of various types of equity and alternative investments

(3b)   Use different types of equity and alternative investments available for an investor's growth allocation in portfolio construction, considering portfolio design, risk management, liquidity management, manager selection, implementation, taxation, and benchmarking

(3d)   Recommend and justify an optimal portfolio allocation in a risk-return framework

Sources:
Alt-Inv-CAIA Level II-3rd-Ch 07

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   Define the VC investment strategy.

> **Commentary on Question**:
> *The candidates performed as expected on this section. Candidates received partial credit for stating that VC are investments in newly established companies. Candidates that identified the two categories/stages of VC and the typical sectors in which VC invested received full credit.*
>
> Venture capital (VC) relates to equity co-invested with entrepreneurs to fund their young and potentially fast-growing companies. VC is often active in technology sectors such as telecommunications, life sciences, and clean technology. VC has two subcategories, depending on the stage of development of the funded company, early stage and expansion stage.

4. Continued

(b)   Explain why it is more difficult to manage and value VC investments by traditional techniques compared to fixed income assets.

Commentary on Question:
The candidates performed as expected on this section. Candidates that included the cash-burning feature of the investment in their response received full credit. Candidates received partial credit for providing other reasonable responses, such as no market data and unpredictable cash flows.

These investments are still generally in the cash-burning stage and may be several years away from profitability. These characteristics make it difficult to apply traditional portfolio management techniques.

(c)   Compare and contrast moral hazard and adverse selection with examples.

Commentary on Question:
The candidates performed as expected on this section. Many candidates received partial credit for explaining moral hazard. Candidates that included examples related to VC or insurance received full credit.

Adverse selection takes place before a transaction is completed, when the decisions made by one party cause less desirable parties to be attracted to the transaction. For example, if an LP decides to seek GPs that charge very low fees and offer funds with very favorable terms, the LP is likely to attract unskilled GPs that claim to be skilled.

Moral hazard, in contrast, takes place after a transaction is completed and can be defined as the changes in behavior of one or more parties as a result of incentives that come into play once a contract is in effect. For example, without proper monitoring, a GP may take excessive risk in order to increase the potential performance fee, or an unskilled manager may decide not to make any investment and just collect the management fee.

(d)   Calculate the distribution of sale proceeds between the limited partner and the general partner.

Commentary on Question:
The candidates performed as expected on this section. Candidates that calculated preferred return for LP and catch-up for GP received full credit. Some candidates received partial credit for simply using 25%/75% to split the 100m gain.

4. Continued

Return of capital to LP +$200M
Preferred return for LP +$30M = $200*15%
100% Catch-up for GP +$10M = $30*25%/75%*100%
Residual amount = $300-$200-$30-$10 = $60M
75/25 split of residual amount; LP gets $60*3/4 = $45M, GP gets $15M

In total LP gets = $200+$30+$45 = $275M
GP gets $10+$15 = $25M

(e) Recommend the best route for investing in private equity, based on the Company's requirements.

Commentary on Question:
The candidates performed below average on this section. Many candidates received partial credit for successfully identifying co-investment as the best route or for explaining why other routes are not good. Candidates that explained how co-investment meets the requirement received full credit.

Avoid cash-burning: If an LP follows the policy of co-investment only in portfolio companies that are already profitable or that would reach profitability soon, this could, for example, mitigate the exposure to cash-burning start-ups.

Focus on specific industry - Co-investments are a tool for building a targeted allocation to specific investments. Co-investments provide flexibility to capitalize on industry-specific and country-specific opportunities as they arise.

Reduce information asymmetry: As an indirect benefit, a co-investment allows for improved monitoring of the funds and a further reduction of the information asymmetry between fund managers and their investors. It can help LPs better understand the investment process and environment, allowing for better fund selections and reinvestment decisions.

Recommend co-investment.

5. **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
- Timber and Farmland Investments
- Distressed debts

Learning Outcomes:

(3a) Demonstrate an understanding of the investment strategies and portfolio roles that are characteristic of various types of equity and alternative investments

(3b) Use different types of equity and alternative investments available for an investor's growth allocation in portfolio construction, considering portfolio design, risk management, liquidity management, manager selection, implementation, taxation, and benchmarking

Sources:

Alternative Investments, CAIA Level II, 3rd Edition, 2016, Section 27.2.1, 27.2.7 – 27.2.11

Commentary on Question:
This question tests the understanding of convertible arbitrage, and how to construct a convertible arbitrage portfolio and calculate the cash flows generated from the portfolio.

Solution:

(c) Describe a typical convertible arbitrage strategy and outline the broad steps to implement it.

Commentary on Question:
The candidates performed above average on this section. The candidates were not required to mention all three steps to obtain full credits. The majority of candidates correctly wrote down the definition of convertible arbitrage. Most candidates failed to mention managing the portfolio's risks. Some candidates failed to recognize that the portfolio is delta-hedged or market neutral.

A typical convertible arbitrage strategy entails buying underpriced convertible bonds, which allows bondholders to convert their holdings to equity at an agreed conversion ratio while selling short the underlying equity to create a delta-hedged market neutral portfolio.

5. **Continued**

Alternatively:
Convertible arbitrage is a form of relative value arbitrage that attempts to exploit relative mispricing of convertible bonds and equities of the same issuer.

1. Valuing the convertible bond to determine if the issue is indeed underpriced.
2. Using the valuation model to determine the appropriate hedge ratio, which will determine the size of the short position in the underlying stock.
3. Managing the portfolio's risks, which may include credit, interest rate, event, and liquidity risks

(d)   Calculate the conversion premium of the convertible bond.

Commentary on Question:
The candidates performed poorly on this section. Many candidates used the wrong formula for parity or did not calculate the parity. Only a few candidates used the correct formula for conversion premium.

Parity = (Conversion ratio * Stock price) / Par value = 36.65 * 25 / 1000 = 91.625%, can also be denoted as 91.625

Conversion premium = (Convertible bond market price – Parity) / Parity = (110 - 91.625)/ 91.625 = 20.05%.

(c)   Calculate the total cash flow of this convertible arbitrage trade.

Commentary on Question:
The candidates performed below average on this section. Most candidates correctly calculated the cost of leverage and the bond return. Many candidates correctly calculated the total annual cash flow. Some candidates did not include the interest income from long bond or the short rebate from short stock in the calculation.

The convertible strategy means longing 1,000 bonds.
   Interest income from long bond = 5% * 1,000,000 = $50,000
   Shares shorted = 36.65*1000*0.8 = 29,320
   The total amount shorted = 25 * 29,320 = $733,000
    Short rebate from short stock = $733,000 * 1% = $7,330
   Cost of leverage = $900,000 * 2% = $18,000
   Dividend payments on shorted shares = $733,000 * 1% = $7,330
   Total annual cash flow = $50,000 + $7,330 - $18,000 - $7,330 = $32,000

Bond return = (bond sold price – bond purchase price) * number of bonds = ($1,150 - $1,100) * 1,000 = $50,000

5. **Continued**

Stock return = (stock shorted price – stock covered price) * number of shares =
($25 - $28) * 29,320 = - $87,960

Total cash flow = Total annual cash flow + Bond return + Stock return
= $32,000 + $50,000 - $87,960
= - $5,960

(d)   Calculate the contribution of leverage of this convertible arbitrage trade.

Commentary on Question:
The candidates performed poorly on this section. Only a few candidates used the correct formula for the contribution of leverage. Many candidates omitted this part of the question.

Return on asset = -$5,960/$1,100,000 = -0.54%
Return on equity = -$5,960/$200,000 = - 2.98%
Contribution of Leverage = Return on equity - Return on asset = -2.98% - (-0.54%) = -2.44%

(e)   Identify four preferable features of convertible bonds or stocks in a convertible arbitrage trade.

Commentary on Question:
The candidates performed below average on this section. Many candidates only provided two or three preferable features. Some candidates discussed the preferable feature of the convertible arbitrage instead of the convertible bonds or stocks, and as such received no credit for this part.

For the stock:
* high return volatility
* low dividend yield
* liquid
* easy to borrow

For the convertible:
* have low premiums relative to their conversion value
* credit risk can be managed
* has good covenant protection

6.

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)   Develop and critique asset allocation strategies appropriate to underlying liability profiles such as pension plans and long tail insurance liabilities

(6c)   Evaluate the difficulties of investing for long tail liabilities (i.e. beyond 30 years) such as inflation indexed pension plans and secondary guarantee universal life insurance

Sources:

QFIP – 141-19 – Liability Driven Investment Explained

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

QFIP – 153-20 – Asset Allocation in a Low-Yield Environment

Commentary on Question:

This question tests the ability of the candidate to demonstrate an understanding of liability driven investing (LDI) for pension plans.

Overall, candidates performed below average on this question.

Solution:

(e)   Explain the major benefits and limitations of this proposed allocation.

Commentary on Question:
The candidates performed below average on this part. Many candidates provided only one benefit and one limitation of the proposed allocation. Some candidates were not able to distinguish that the proposed allocation is entirely in fixed income.

Benefits:
Price of bonds behave in the same way as pension liabilities. By holding bonds, pension plan can protect itself against changing interest rates.
Bonds are widely tradeable.

Limitations:
Scarcity of suitable long-dated bond assets available to set against long-dated liabilities.

6. Continued

Plan needs to sell out of equity to fund the purchase of bonds, which will exacerbate funding deficit.
Creditworthiness of bond issuer can change over time, which will influence bond price independent of interest rates.

(f)   Describe derivative securities that will help achieve capital efficient liability hedging that address a plan's interest and inflation risks.

Commentary on Question:
The candidates performed as expected on this part. Some candidates suggested TIPS, which are not derivative securities, and, thus, did not receive credit for that answer.

Interest rate swaps used to manage interest rate risk. Plan will receive fixed interest and pay variable interest.
Inflation swaps used to manage inflation risk. Plan will receive variable rate and pay fixed rate. Fixed rate equates to what the market expects inflation will average over the life of the swap.
Real rate swaps combine interest rate and inflation elements in one contract. Plan receive fixed real rate and pay variable rate.
Other derivatives and instruments such as total return swaps and futures.

(c)   Three options are being considered to improve the funding ratio of the plan and limit the volatility of the funding ratio. The plan would like to use up to 4 times the leverage.

Option A: Keep the current portfolio and rebalance between equity and bonds based on the correlation and volatility assumptions.

Option B: Invest 100% in bonds but increase equity exposure to 60% using synthetic equity.

Option C: Invest 100% in a pooled LDI fund.

Evaluate each of the three options in order of their ability to achieve the plan's goal.

Commentary on Question:
The candidates performed as expected on this part. While many candidates were able to correctly rank each of the options, some candidates did not provide a justification for the ranking they provided..

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6. Continued

Option B is the best strategy: the strategy is good since it better hedges interest rate risk by investing 100% in bonds while increasing equity exposure for higher returns, which may help improve the funding ratio.

Option A is the worst strategy: the performance of a portfolio constructed using this approach depends on the future economic environment and future correlation between equities and bonds, which are unknown. Thus, it is hard to construct a portfolio that would, in the long term, improve the funding ratio and the volatility.

Option C is the second-best strategy: the strategy is good since it better hedges interest rate risk by investing in swaps and cash and are usually leveraged; however, the level of leverage is limited to that offered by the fund and is generally lower than what's desired (4x).

(d) Justify the plan's allocation to fixed income given the current environment.

Commentary on Question:
The candidates performed poorly on this part. Rather than providing a rationale for having any allocation to fixed income, many candidates did not agree with any fixed income allocation and instead recommended the plan reallocate to equities, which received no credit.

Long term evidence shows low correlation between bonds and other asset classes tend to persist across interest rate environments.
Asset allocation decisions should be made based on expected return in excess of risk-free rate, not expected total return.
Positive long term excess returns in bond markets not generated by high yield levels but rather the average upward slope of yield curves.
Even in a low yield environment, there are plausible scenarios where yields could go much lower.

7.

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 liquidity risk and the threat it represents to financial intermediaries and markets

(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) Create liquidity risk management plans and procedures, including addressing appropriate product design, investment guidelines, and reporting given a desired liquidity risk level

Sources:
AAA Liquidity Note

Commentary on Question:
This question tests the candidate's understanding of liquidity risk, and the various tradeoffs associated with managing liquidity in a life insurance context. Candidates performed above average overall, and many different answers were eligible for points so long as the candidate's response was well-defended and consistent.

Solution:
(a) Describe two types of liquidity management concerns

> **Commentary on Question**:
> *The candidates performed poorly on this question, and only a handful of candidates received any credit. While most candidates attempted this question candidates that identified or closely described two liquidity management concerns from the text received full credit. All other answers received no credit.*

-Day-to-day cash management – this type of liquidity involves handling day-to-day cash flow variability through a combination of cash positions and lines of credit.

-Ongoing/intermediate term cash flow management – On-going liquidity needs over the next 6 to 24 months, and involves analyzing cash inflows and outflows.

-Stress liquidity risk – the ability of the company to meet the demands of contract-holders should many termination provisions be invoked.

7. Continued

(b)   Analyze the appropriateness of ABC's current asset portfolio for supporting universal life or long-term care products.

Commentary on Question:
Candidates performed above average on this question. Most candidates recognized that the current asset portfolio was very liquid, that it was not appropriate for long-duration liabilities, and that they should consider allocating a portion of this portfolio to longer-duration, higher yielding assets. Candidates were awarded partial credit for arguing the current portfolio was appropriate, so long as other parts of their answer were well-defended.

ABC currently has a very liquid portfolio. Nearly all of the assets can be quickly converted to cash and used to pay liabilities. However, while this portfolio may be appropriate for short term life insurance it may be too safe for long-term liabilities like universal life or long-term care. The Company should consider allocating some of their positions, especially the cash position, into a higher yielding asset. This could have a minimal impact on overall liquidity risk while providing substantial benefits in other areas, such as reinvestment risk.

(c)   Assess the President's concern about interest rates and early policy surrenders.

Commentary on Question
Candidates scored above average on this question. Nearly every candidate recognized the higher likelihood of early surrender with increasing interest rates. For full credit, graders looked for a brief discussion of how early surrender might impact liquidity risk. A wide range of possible answers were awarded full credit, so long as the response was defensible.

The President's concerns are not currently justified. Short duration term products for young adults rarely have a cash value and so disintermediation isn't a risk. However, if the Company decides to offer universal life products, the President's concerns about interest rates could very well be justified.

(d)   Describe two policy provisions that would address concerns about surrenders.

Commentary on Question
Candidates performed as expected on this question. While most candidates correctly identified surrender penalties, there was a wide variation in the second policy. Graders specifically looked for surrender penalties and market-value adjustments, with other answers considered on a case-by-case basis. Some candidates listed very similar policy provisions (e.g. increasing surrender penalties and extending the surrender period); graders did not consider these different enough to warrant full credit.

7.

Continued

Surrender penalties are a schedule of charges that penalize a policyholder for surrendering their life insurance policy early. These typically are high in the early years of a policy but lower over time.

A market value adjustment (MVA) modifies the cash surrender value according to current interest rate levels. In practice, an MVA usually reduces the surrender value when rates are high and vice versa. This reduces the opportunity for policyholders to surrender their policy just to find a better rate

(e) Recommend whether or not ABC should begin developing these new products

Commentary on Question
Candidates performed as expected on this question. Many different answers were eligible for full credit so long as the justification was sound. Some candidates did not make a clear recommendation and lost points. Other candidates provided very brief or inadequately defended answers; graders expected substantial answers given the point value of this question. Finally, some candidates' responses were inconsistent with characteristics of ABC provided early in the question, which cost them points. Candidates that made a clear recommendation, provided a sound argument with a handful of points, and were consistent with the facts of the question were typically awarded full credit.

ABC should not begin offering these products due to:

- Lack of expertise in the product line.
- Different liability profile from current product line – universal life and long-term care are much longer than the short duration term life products
- Investment portfolio better suited for short duration products – would need to increase asset duration and potentially add investment resources to meet new strategic demands
- Need to understand insurance product filing requirements
- Need to understand capital requirements – especially for small insurance company
- Entry into new product line typically requires a lot of research and understanding before commencing, so rushed decision is not necessarily the best strategic choice

8.

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
- Timber and Farmland Investments
- Distressed debts

Learning Outcomes:
(3a) Demonstrate an understanding of the investment strategies and portfolio roles that are characteristic of various types of equity and alternative investments

(3b) Use different types of equity and alternative investments available for an investor's growth allocation in portfolio construction, considering portfolio design, risk management, liquidity management, manager selection, implementation, taxation, and benchmarking

(3c) Explain the basic active equity selection strategies including value, growth and combination approaches, and compare techniques for characterizing investment style of an asset manager

(3e) Demonstrate an understanding of issues related to incorporating Environmental, Social, and Governance (ESG) criteria into the investment process

Sources:
Maginn & Tuttle, Managing Investment Portfolios: A Dynamic Process 3rd Edition (Chapter 7)

QFIP-133-19-Environmental Social and Governance

Commentary on Question:
This question tests candidates' understanding of equity selection strategies, investment styles of asset managers, and issues related to ESG.

Solution:
(a) Assess if the current portfolio of managers is expected to meet the investment objectives.

---

8. **Continued**

Commentary on Question:
The candidates performed above average on this section. Many candidates received full credit on this section. Some candidates assessed each portfolio manager separately against the stated investment objectives rather than the aggregation of all 3 portfolio managers and thus received partial credit.

The portfolio's expected alpha is $(5/10)(2\%) + (3/10)(2\%) + (2/10)(4\%) = 2.4\%$

The portfolio's tracking risk is $[(5/10)^2(2\%)^2 + (3/10)^2(3\%)^2 + (2/10)^2(5\%)^2]^{1/2} = 1.68\%$

The portfolio's information ratio $= 2.4/1.68 = 1.43$ which is higher than the required ratio of 1, and the portfolio's tracking risk is lower than 2%. Both investment objectives are met.

(b)   Assess if the current portfolio of managers is expected to meet the investment objectives, based on the revised benchmark and managers' true active return and active risks.

Commentary on Question:
The candidates performed below average on this section. Most candidates correctly calculated the managers' true active returns and the portfolio's expected alpha. Most candidates didn't correctly calculate the managers' true active risks and thus also came up with an incorrect portfolio tracking risk.

Manager's return − Manager's normal benchmark = Manager's true active return.

As the revised benchmark's return is 1% higher than the outdated benchmark, the true active return for Manager A, B, C are 1%, 1%, and 3%, respectively.

Manager's total active risk $= [(\text{Manager's true active risk})^2 + (\text{Manager's misfit active risk})^2]^{1/2}$

Manager's misfit active risk $= 1\%$ for all three managers

Mangers' total active risks are 2%, 3%, and 5% from the table

Managers' true active risks are 1.73%, 2.83%, and 4.90%, respectively

The portfolio's expected alpha is $(5/10)(1\%) + (3/10)(1\%) + (2/10)(3\%) = 1.4\%$

The portfolio's tracking risk is $[(5/10)^2(1.73\%)^2 + (3/10)^2(2.83\%)^2 + (2/10)^2(4.90\%)^2]^{1/2} = 1.56\%$

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8. **Continued**

The portfolio's information ratio = 1.4/1.56 = 0.90. The portfolio's tracking risk is 1.56%. The information ratio objective is no longer met, but the tracking risk objective is still met.

(c)   Compare and contrast these two types of techniques for identifying investment styles.

Commentary on Question:
The candidates performed above average on this section. Most candidates accurately compared and contrasted several aspects of these techniques. Partial credit was awarded for each valid statement about these techniques.

- Returns-based style analysis:
    - Focuses on characteristics of the overall portfolio as revealed by a portfolio's realized returns
    - Involves regression portfolio returns (generally monthly returns) on return series of a set of securities indices
    - Can be used to calculate the portfolio's beta with respect to various styles
    - The coefficient of determination can measure the style fit
    - Pro: Aggregates the effect of the investment process
    - Pro: Different models usually give similar results
    - Con: May be ineffective in characterizing current style
    - Con: Error in specifying indices in model may invalidate result

- Holding-based style analysis:
    - Categorizes individual securities by their characteristics
    - Aggregates results to reach a conclusion about the overall style of the portfolio at a given point in time
    - Pro: Characterizes each position and facilitates comparisons of individual positions
    - Pro: May capture style changes more quickly
    - Con: Not consistent with how portfolio managers select securities
    - Con: Different specifications will lead to different results
    - Con: More data intensive

(d)   Analyze Manager B's investment style.

Commentary on Question:
The candidates performed as expected on this section. Many candidates concluded that manager B's investment style was growth because of the P/E, P/B, and dividend yield metric; however, given these metrics are quite similar to the benchmark, manager B's investment style is more appropriately considered market-oriented with a slight tilt towards growth. Candidates that concluded the investment style was growth received partial credit.

8. Continued

The holdings-based analysis suggests a market-oriented portfolio with a slight tilt to growth.

The portfolio's P/E, P/B, are slightly higher than those of the benchmark, and the dividend yield is slightly lower than the benchmark. All three metrics suggests a slight tilt toward growth.

(e) Describe four benefits of incorporating ESG criteria in portfolio management.

Commentary on Question:
The candidates performed above average on this section. Many candidates received full credit on this section. Nearly all candidates provided at least two benefits of incorporating ESG criteria in portfolio management. Partial credit was awarded for each appropriate benefit provided.

- A lack of an ESG framework can have a negative impact to these firm's image and hurt profits
- Establishing ESG criteria can be useful to identify firms that are inattentive to ESG issues
- Environmental crises can cause sudden changes in regulations, technology, and consumer tastes, which can cause large swings in asset prices
- With ESG criteria in place, portfolio managers can select firms that are well prepared to deal with these sudden changes
- ESG-related risks can be rare, large, and non-diversifiable
- ESG criteria will help investors assess exposure to risks better than a purely statistical model that relies on historical data

9.

Learning Objectives:
1.   The candidate will understand how to work with the variety of fixed income instruments and evaluate fixed income portfolios.

Learning Outcomes:
(1c)   Demonstrate an understanding of the cash flow patterns and risks of whole loan commercial mortgages

Sources:
Commercial Real Estate Analysis and Investments, Miller & Geltner, 3rd Edition, 2014 - Ch. 16: Mortgage Basis I: An Introduction and Overview

Commentary on Question:
This question tests the candidate's knowledge on commercial mortgage-backed securities prepayment and default options.

Solution:
(a)

(i)   Describe possible non-litigious options you could consider.

(ii)   Describe steps of litigious actions you could take.

Commentary on Question:
The candidates performed below average on this part. Many candidates received partial credit for providing one non-litigious option and for answering to sue the borrower in part ii). Those candidates that fully described the steps of litigious actions received full credit.

(i)   One of nonlitigious actions is a transfer of the loan to a new borrower. A variation on this is to negotiate a 'short sale", whereby the lender allows the borrower, threatening default, to sell the property on the borrower's own. The sale must be approved by the lender.
Another common type of nonlitigious resolution is to a mortgage problem is the procedure known as deed in lieu of foreclosure. In this case, the borrower simply gives the property to the lender in return for the lender releasing the borrower from the debt.
A third approach is for the lender and borrower to work together to restructure the loan, to bring new equity partners into the deal, or otherwise creatively "work out" the problem.

(ii)   As a first step of litigious actions, they can sue for specific performance under the promissory note.
A second level of recourse is for the lender to sue for damages under the promissory note, without invoking the mortgage deed.
The third step is to invoke the mortgage deed to bring a foreclosure action.

9. **Continued**

The borrower is a "single-asset" wealth-maximizing borrowing entity of sufficient size such that it can pay or prepay this loan. The loan is non-recourse and has one payment remaining of 800,000 due one year from now. The borrower has the right to prepay the mortgage today. One year from today, there are only three possible scenarios for the underlying value of the property.

Scenario 1 - 1,000,000
Scenario 2 - 850,000
Scenario 3 - 700,000

If foreclosure occurs, the costs paid to third parties will be 150,000.

If the borrower decided to pursue a strategic default situation, it is expected the borrower and lender would agree to equally share the difference between the amount owed and what the lender would receive in the event of a default.

(b)   Describe four ways to mitigate the prepayment and/or credit risks of this loan at issue.

Commentary on Question:
The candidates performed poorly on this part. Many candidates received partial credit for providing one way to mitigate the prepayment risk such as setting high penalties. Candidates that recognized that the borrower is a "single-asset" and recommended ways to avoid a nonrecourse loan situation received full credit.

Unless a prepayment clause is explicitly stated in the mortgage agreement, the borrower does not have the right to pay the loan off early, that is, prior to its original stated maturity. For this loan, we could remove prepayment clauses to reduce the prepayment risk.
We could set prepayment penalties so high as to effectively eliminate the value for the borrower of refinancing the loan at a lower rate or prepaying the loan.
Lockout clause – allows prepayment only after a set period of time.
Defeasance Provisions – Borrower could pay off the mortgage only by providing a series of US Treasury bonds
We could avoid a nonrecourse loan situation by requiring the parent holding company or an individual with large net worth to sign the note with joint and several liability, or may require additional collateral for the loan.
We also want insurance protection against possible borrower bankruptcy and loan modification "cramdown" during a Chapter 11 bankruptcy proceeding, i.e., the "single-asset" borrowing entity really is sufficiently independent of any larger corporation such that the larger corporation's bankruptcy doesn't jeopardize the mortgagee's claim on the property.

9. **Continued**

(c)   Explain the course of action the borrower should take in each scenario above.

Commentary on Question:
The candidates performed as expected on this part. Many candidates received partial credit for recognizing the correct course of actions the borrower should take. Those candidates that further provided justifications for those actions received full credit.

In scenario 1, the borrower would pay the loan amount because he would receive $200,000 but only 1,000,000 – 150,000 – 800,000 = $50,000 if default.

In scenario 2, the borrower would take strategic default because the property value after foreclosure cost (850,000 – 150,000 = 700,000) is lower than loan payment $800,000 while the property is worth more than the outstanding payment. Thus, the borrower is incented to negotiate a lower payment amount.

In scenario 3, the borrower would take foreclosure because property value $700,000 is lower than the loan payment $800,000.

10.

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:
(5f) Analyze international accounting treatment for insurance liabilities and the investments and hedging that supports them

Sources:
QFIP-156-21: Minimizing accounting mismatches relating to financial risk for insurers, June 2020

Commentary on Question:
This question tests the fundamentals of accounting mismatches that may arise under IFRS17 and IFRS9 and how those mismatches could be addressed.

Solution:
(g) Explain the asset and liability accounting mismatches that ABC could experience for each IFRS 9 measurement choice as it relates to:

    (i) The contracts measured using GMM

    (ii) The contracts measured using VFA

Commentary on Question:
The candidates performed poorly on this section, especially in section (ii). Not all changes are recognized in CSM. There are parts of the insurance contract that do not vary with the underlying fund. For example, participating contracts that have a fixed death benefit + participate in the fund. The fixed death benefit part is not variable. For the variable parts of the contract, the changes in financial risks are recognized in the CSM. For the rest of the contract, it will cause a mismatch, similar to GMM.

10. Continued

Note that ABC has elected the OCI option for its insurance liabilities.

(i) Under GMM, the effects of changes in financial risk are recognized as insurance finance income or expenses in the periods in which the change occurs (ie in PnL). ABC elected the OCI option. So it recognizes insurance finance income or expenses partly in PnL and partly in OCI.

- Under FVPL, the accounting mismatch occurs when the effect of change in financial risk in liability is recognized partly in OCI and the corresponding change in asset value is in PnL.
- Under FVOCI, the accounting mismatch occurs when the effect of change in financial risk in liability is recognized in P&L. Or in partly in OCI due to timing differences of recognition.
- Under amortized cost, the mismatch would occur if the effects of change in financial risks are recognized in OCI.

(ii) Under VFA, the effects of changes in financial risk **might** adjust the contractual service margin (CSM).

- Under FVPL, the accounting mismatch occurs when the effect of change in financial risk in liability is recognized partly in OCI and the corresponding change in asset value is in PnL
- Under FVOCI, the accounting mismatch occurs when the effect of change in financial risk in liability is recognized in P&L. Or in partly in OCI due to timing differences of recognition
- Under amortized cost, the mismatch would occur if the effects of change in financial risks are recognized in OCI.

(h) Explain how fair value hedge accounting can reduce the accounting mismatches for ABC's contracts that are measured using GMM.

Commentary on Question:
The candidates performed below average on this section. Only a handful of candidates demonstrated their understanding well.

- The carrying value of the hedged item (the insurance contract) is adjusted for fair value changes attributable to the risk being hedged. Those fair value changes are recognized in profit or loss (or, for a hedge of an equity investment measured at FVOCI, OCI).
- The hedging instrument (the financial instrument) is measured at fair value, with changes in fair value also recognized in profit or loss (or, for a hedge of an equity investment measured at FVOCI, OCI).

10. **Continued**

(c) Explain how the IFRS 17 risk mitigation option could help reduce the accounting mismatches that ABC will experience on the VFA contracts.

Commentary on Question:
The candidates performed poorly on this section. A number of candidates explained successfully that the IFRS 17 risk mitigation option allows an insurer to recognize immediately in PnL amounts that otherwise adjust the CSM. Unsuccessful candidates were unable to explain assets measured at FVPL or 'switching off' the VFA to the extent that financial risk is mitigated.

- The risk mitigation option in IFRS 17 will allow insurers to avoid accounting mismatches created by the variable fee approach by permitting them to not adjust the contractual service margin for changes in the fulfilment cash flows
- where the insurer holds financial instruments measured at FVPL, or reinsurance contracts, intended to mitigate financial risks arising from those insurance contracts.
- The risk mitigation option permits an insurer to 'switch off' the variable fee approach to the extent that financial risk is mitigated.
- Applying the risk mitigation option, an insurer recognizes immediately in profit or loss some or all of the changes in the effect of financial risk on insurance contracts with direct participation features that would otherwise adjust the contractual service margin of those contracts.

(d) Explain the respective advantages and limitations of fair value hedge accounting and the IFRS 17 risk mitigation option.

Commentary on Question:
The candidates performed poorly on this. Some candidates answered only for one option (fair value hedge accounting or IFRS risk mitigation option) without specifying which one. No credit was given for those answers. Candidates should state two advantages and two disadvantages for each option to receive full credit.

For IFRS9 – Fair value hedge accounting:

Advantages:

- Allows insurers to manage open portfolios of insurance contracts.
- Could be effective to mitigate volatility arising from duration mismatches.
- The ability to designate the hedged item as an amount in each time bucket, rather than specific liabilities, allows more flexibility in how much to designate in each period.

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10. Continued

Limitations:

- Might have limited use for longer-term reinvestments because it could be difficult to demonstrate that reinvestments are highly probable.
- Hedging highly probably expected reinvestments might restrict the insurer from being able to sell the existing bonds that are designated as the hedged item
- Ineffectiveness arises from common insurance contracts such as interest sensitive lapses.
- Hedge accounting can only be applied prospectively
- Fair value hedging is operationally challenging and requires complex tracking.
- It might be difficult to demonstrate that the interest rate component is separately identifiable and reliably measurable.

For IFRS17 risk mitigation option:

Advantages:

- Operationally simple. No need for complex designations or tracking and testing hedge effectiveness
- This option is applied to the extend that insurer has a previously documented risk management objective and can be used with flexibility to determine the extent to which this risk mitigation option is applied.

Limitations:

- Only available for contracts to which the variable fee approach applies.
- Only available prospectively, so it will not mitigate mismatches for risk mitigation approaches already in place at the date of transition.

11. **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.

Learning Outcomes:
(2d)   Demonstrate an understanding of modeling approaches for correlated defaults

Sources:
Bolder, D, Credit Risk Modeling, 2018, Chapter 3

Commentary on Question:
This question tests the concept of credit risk mixture models and its significance in risk calculation.

Overall, candidates performed as expected on this question. Some left parts of this question blank.

Solution:
(a)
  (i)   State the relationship between ω_0 and ω_1

  Commentary on Question:
  The candidates performed brilliantly on this section. Candidates that identified the sum of $\omega 0$ and $\omega 1$ equals to 1 received full credit.

  $\omega_0 + \omega_1 = 1$

  (ii)   Explain $\omega 0$, $\omega 1$ and S using the general ideas of the CAPM framework.

  Commentary on Question:
  Candidates performed above average on this question. Candidates didn't mention all three factors received partial credit.

  w0 is the idiosyncratic risk factor loading, w1 is the systematic risk factor loading, and we can think of S as common economic factor, a large outcome scales up the default probability for all obligors.

(b)   Describe how the CreditRisk+ model in part (a) addresses one major shortcoming of binomial- and Poisson-mixture models.

11. Continued

Commentary on Question:
The candidates performed as expected on this section. They either received close to full credit or none. Candidates who identified the shortcoming and explained how the CreditRisk+ model handles it received full credit. The candidates must mention the individual creditworthiness to get full marks.

- One major shortcoming of all of binomial- and Poisson- mixture models is, all obligors are forced to share a common default probability and thus information on individual creditworthiness is lost.

- With the CreditRisk+ mentioned in (a), instead of a common, portfolio wide unconditional default probability of p, this approach allows each obligor to, in principle, have its own characterization of its creditworthiness.

(5)   I   Calculate each of the following:

Commentary on Question:
Overall, the candidates performed as expected on this section. Many candidates left the first part blank. Among the candidates that answered the part, some candidates applied the correct formulas but did the calculation wrong. A few candidates correctly calculated the $\omega 1$, but did not realize $\omega 0$ is the final answer. The candidates performed as expected on the second part. Many candidates answered third part correctly.

(i)   The percentage of default probability that can be explained by this classification

- $\rho A,B = [w12 / a] \times [(pA\ pB)/(\sqrt{(pA\ (1-pA))}\ \sqrt{(pB\ (1-pB))})]$
- $50\% = ((w12)/0.01) \times [(0.05*0.1)/ /(\sqrt{0.05\ (1-0.05)})\ \sqrt{0.1\ (1-0.1)})]$, w1 =0.2557, so w0 = 1- 0.2557 = 0.7443

(ii)   The variance of conditional default probability for C

- $var(pc(S)) = (pc2w12)/a = (0.152\times0.25572)/0.01= 0.1471$

(iii)   The variance of S

(5) $var(S)=E(S^2 -E(S)^2)=1+ 1/a-1=1/0.01 = 10$d)   Describe critical assumptions that are needed for the multi-factor version of the model.

11. Continued

Commentary on Question:
Candidates performed below average on this section. Most candidates were able to provide some assumptions that are needed but not all of the critical ones.

- The first step is to add additional systematic factors S=[S1I...Sk]
- A critical assumption is that each Sk is independent, and given S, each default event is also independent.

12.

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:

(6a) Demonstrate an understanding of how the behavioral characteristics of individuals and firms influence liability design, management, and ALM

(6b) Develop and critique asset allocation strategies appropriate to underlying liability profiles such as pension plans and long tail insurance liabilities

Sources:

Managing Investment Portfolios: A Dynamic Process, Maginn & Tuttle, 3rd Edition, 2007: Ch. 5: Asset Allocation (sections 1-7, 9 & 10)

Commentary on Question:

This question tested candidate understanding of Mean Variance Theory and its application in the Efficient Frontier. Candidates were also tested on how to calculate risk in a portfolio and how to construct portfolios on the Capital Allocation Line.

Solution:

(i) Define the following:

   (i) Efficient Portfolio

   (ii) Global Minimum Variance Portfolio

   (iii) Tangency Portfolio

   (iv) Capital Allocation Line

Commentary on Question:

The candidates performed above average on this section. Many candidates accurately defined Efficient Portfolio and Global Minimum Variance Portfolio. A common mistake was mixing up the definitions of Tangency Portfolio and Capital Allocation Line.

12. Continued

    (i)   An efficient portfolio is one that makes efficient use of risk; that is, for any given level of risk (standard deviation), the portfolio that maximizes the return (mean)

    (ii)   Out of all the available efficient portfolios, it is the portfolio that minimizes risk (standard deviation)

    (iii)   A Tangency Portfolio is an efficient portfolio with the highest Sharpe Ratio

    (iv)   The Capital Allocation Line connects the Risk-Free rate on y-axis to the Tangency Portfolio. It represents combinations of Standard Deviations and Returns available to an investor when they combine their optimal portfolio with a Risk-Free asset.

(b)   Calculate the standard deviation of the client's current portfolio. (Solve for X)

Commentary on Question:
The candidates performed brilliantly on this section. Most candidates earned full credit for their answers. Candidates received partial credit for providing the correct formulas, even though the standard deviation was not calculated correctly.

$$\sigma_P^2 = w_{Bond}^2 \sigma_{Bond}^2 + w_{Equity}^2 \sigma_{Equity}^2 + 2w_{Bond}w_{Equity}\sigma_{Bond}\sigma_{Equity}\rho$$

Where $w_{Bond} = 0.928$; $w_{Equity} = 0.072$; $\sigma_{Bond} = 0.05$; $\sigma_{Equity} = 0.12$; $\rho = 0.25$ (all provided as part of the question)

$\sigma_P^2 = (0.928 \times 0.05)^2 + (0.072 \times 0.12)^2 + 2 \times (0.072 \times 0.12) \times (0.928 \times 0.05) \times 0.25$

$\sigma_P^2 = 0.00215296 + 0.00007465 + 0.000200448$

$\sigma_P^2 = 0.00242806$

$\sigma_P = 4.928\%$

12. Continued

(c)

    (i)   Explain why your manager is incorrect.

            Assess possible impacts to your client's portfolio if your manager's recommendation is followed. (Hint: be sure to compare to your client's IPS notes and comment on the change in standard deviation and expected

    (ii)   return.)

Commentary on Question:
The candidates performed as expected on this section. Candidates who performed well recognized that the portfolio was already on the minimum variance frontier, so no portfolio using the available assets could reduce the variance. A common mistake was to state that risk could be further reduced by introducing risk-free assets, even though the question was focused on changing bond and equity allocations in the current portfolio.

    (i)   As the portfolio is a Minimum Variance Portfolio, which is an efficient portfolio, which is part of the minimum variance frontier; any portfolio on this frontier, has the lowest level of risk for the given level of return. By definition, using the assets available, there is no portfolio that can reduce the variance. Any change to the portfolio will only increase the risk.

    (ii)   As bonds and equities already provide sufficient diversification, the risk is already minimized, while maximizing returns. As the MVP portfolio already represents the lowest risk, adding more bonds will only increase the standard deviation, while reducing the overall return. This is opposite of what the client wants.

(d)

    (i)   Describe how to use the capital allocation line to create a portfolio for your client with less risk (smaller standard deviation) but same expected return as his current portfolio (MVP).

    (ii)   Calculate the asset mix and standard deviation of the portfolio that has the same expected return as the client's current portfolio but smaller standard deviation.

Commentary on Question:
The candidates performed as expected on this section. Candidates who accurately defined the Capital Allocation Line in (a) generally performed well on (i). Candidates who calculated an incorrect value of X in (ii) received partial credit for providing the correct formulas and coming up with a standard deviation lower than the MVP portfolio.

12. Continued

(i) The capital allocation line represents the combination between the tangency portfolio and the risk-free asset. Using this line, proportions can be set between the Tangency Portfolio, to increase the return, and the risk-free asset, to reduce the risk, can be determined. The overall proportions would result in a portfolio that has the same expected returns as the current portfolio, with a lower level of risk.

Using the formula $r_P = X \cdot r_{TangencyPortfolio} + (1-X) \cdot r_f$, where X is the proportion of the Tangency Portfolio, and the remaining amount is the Risk-Free asset, solve for X.

$$r_{TangencyPortfolio} = 4.92\%; \ r_f = 1\%; \ r_P = 4.29\%$$

$$X = 83.5\%$$

To calculate the Standard Deviation σ_P:

$$\sigma_P^2 = X_{TangencyPortfolio}^2 \sigma_{TangencyPortfolio}^2 + (1-X)_{Risk\ Free\ Asset}^2 \sigma_{Risk\ Free\ Asset}^2$$
$$+ 2X_{TangencyPortfolio}(1$$
$$- X)_{Risk\ Free\ Asset} \sigma_{TangencyPortfolio} \sigma_{Risk\ Free\ Asset} \rho$$

However, as $\sigma_{Risk\ Free\ Asset} = 0$, $\sigma_P^2 = $
$$X_{TangencyPortfolio}^2 \sigma_{TangencyPortfolio}^2$$

$$\sigma_P = (83.5\% * 5.29\%) = 4.42\%$$

This is less than the Standard Deviation of 4.93% calculated in (b).

13.

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

(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:
Managing Investment Portfolios: A Dynamic Process, Maginn & Tuttle, 3rd Edition, 2007 Ch.1 and Ch.3.

Commentary on Question:
This question tests understanding of considerations and constraints to consider in an IPS with a new pension plan for a P&C insurer.

Solution:
(a)   Describe four reasons why an Investment policy statement (IPS) is important to ABC's pension plan.

    Commentary on Question:
    Candidates performed above average in this section. Candidates were successful at identifying the importance of IPS for setting the return objectives, the management of risks and constraints. Most candidates did not identify the IPS as a formal document but described general components in the IPS.

13. Continued

An IPS provides:
- A governing document for all investment decisions and portfolio management process.
- Return objectives and risk tolerance over the relevant period of time.
- Potential constraints such as liquidity, tax, regulation.
- Guidance for other issues such as reporting, performance measurement and investment strategy.

(b) Describe how each of the following relates to ABC's IPS:

   (i) Capital market expectation (CME)

   (ii) Strategic asset allocation (SAA)

Commentary on Question:
Candidates performed below average in this section. For the CME candidates failed to mention the optimization of expected return versus the level of risk in the portfolio.
Candidates specified for SAA the determination of asset class but rarely mentioned the long-term objective of the risk and expected return of the portfolio.

   (i) CME form the basis to establish a portfolio of investment and maximize the expected return for a given level of risk or minimize risk for an expected return.

   (ii) SAS establishes acceptable exposures to IPS and describes permissible asset classes to achieve long-term objectives as to return on investment and constraints of the portfolio.

(c) The board suggests to use ABC's IPS for insurance products with minor modifications.

   Critique this suggestion.

Commentary on Question:
Candidates performed as expected on this section. Almost all candidates mentioned risks are different especially for the return, liquidity, and time horizon. A few candidates specified the need to reflect the differences associated with the liabilities. Most candidates missed addressing the distinction between a DB plan or DC plan and the insurer as to the owner of investment risk.

13. Continued

Major modifications are required and we need a distinct IPS for the pension plan.
The risks and returns of the pension plan are interdependent and different from
the insurer.
Also, constraints are different for liquidity need, time horizon of investment and
liabilities, tax, and regulation.

Specific aspects of which party bears the risk in a pension plan as to the plan
sponsor (ABC) in a DB plan or the participants in a DC plan which are not
present for the insurer business.

(d)   Explain how an IPS is used for investment risk management of a DC plan.

Commentary on Question:
*Candidates performed below average in this section. Many candidates did not
mention the IPS as a document to guide the selection of investment options or is
periodically offered to plan participants to evaluate those options.*
*Few candidates mentioned the risk associated with the investment by participants
in the company stock program and the objective of the IPS to promote
diversification with multiples options for investments.*

The IPS of a DC plan documents the process for selecting the investment options
offered to plan participants with a periodical valuation of such options.

The IPS establish procedures to ensure that a multitude of individual investor
objectives and constraints by addressed.

The IPS promotes diversification of investments in the portfolio by participants
with a specific concern to limit investments in the sponsor company stock.

(e)   Explain the relevant considerations for ABC to incorporate in the IPS for a DB
and DC plan, respectively, for each of the following:

- Risk and return objectives;
- Liquidity;
- Time horizon;
- Investment options.

Commentary on Question:
*Candidates performed below average in this section. Many candidates did not
address distinct issues for both the DB and DC plans, and instead focused on the
DB plan only. Some candidates described generic considerations and did not
tailor their answer to ABC's situation, as requested in the question.*

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13. Continued

Almost all candidates who provide an explanation for a DB plan were able to identify relevant considerations for each aspect except for investment options. Two key areas missed by most candidates, for investment options, are the complexities of investing in alternative assets and the conflict of interest in plan sponsors investing in their own company stock.

For a DC plan, few candidates successfully explained that the plan participant, not insurance company, is responsible for their risk and return and the need for these participants to receive investment advice. Almost all candidates were not able to explain that they need to value liquidity and time horizon of investments according to their own choices. Similar to a DB plan, candidates missed the risk associated with investment into company stock of plan sponsor as an investment option.

a) For a DB plan

Risk and return:
With young workforce and all active participants then greater duration of liability and greater risk tolerance for plan sponsor.
Objective to obtain higher investment return with alternative assets justified by greater risk tolerance.

Liquidity:
The young workforce indicates long duration and little need for immediate liquidity.
Then may invest into long-term less liquid assets with potential of higher return to improve the funding status of a pension plan.

Time horizon:
Without employees close to retirement and little departure may focus on long-term duration and justify aggressive return objective and capital appreciation of assets.

Investment options:
Invest into alternative assets often require complex due diligence.
Also beware of the conflict of interest with sponsor-company stock.

b) For a DC plan

Risk and return:
Only the plan participants set their own risk, return objectives and constraints.
Plan sponsor may provide educational resources for employee needs to educate himself.

13. Continued

Liquidity:
Each participant must choose investment considering his limited time left until he needs to draw his assets for departures or retirement.

Time horizon:
Given the time horizon for retirement, varies by participant and each participant must value his ability to take risk to match the time left to retirement.

Investment options:
Sponsor must offer a menu of investment options and limit holding of sponsor-company stock for diversification.

14. Learning Objectives:
1. The candidate will understand how to work with the variety of fixed income instruments and evaluate fixed income portfolios.

Learning Outcomes:
(1a) Describe the cash flow of various fixed income securities considering underlying risks such as interest rate, credit and event risks

Sources:
Fabozzi, Handbook of Fixed Income Securities, Chapters 13 and 18.

Commentary on Question:
This question tested the ability of the candidates to construct an unusual set of cash flows from a fixed income security in order to be used as a hedge against inflation. The question also tested the concepts of a breakeven inflation rate and the objectives in a syndicated loan agreement.

Solution:
(a) Calculate the expected principal levels of the TIPS portfolio at the 3 payment dates.

Commentary on Question:
The candidates performed below average on this section. Many candidates received partial credit for using the formula based on inflation rates to calculate the CPI levels. Candidates received full credit for using the index provided to calculate the principal growth.

The beginning of month CPI levels are 250, 256, and 275 respectively (TIPS securities have a three-month lag. End of month CPI levels are 255, 262, and 274 respectively. Linearly interpolating to each coupon date gives CPIs of 251.5, 257.57, and 274.71. The principal for the April coupon is 150 x 251.5 / 250 or 150.9. Similarly, the remaining principal levels are 154.65 and 164.83.

(b) Calculate the total of all three expected coupon payments.

Commentary on Question:
The candidates performed as expected on this section. Most candidates received partial credit for calculating the coupon payments at each point in time, recognizing that the coupon rate is the yield as the bond was sold at par. Candidates that multiplicatively derived the coupon rate received full credit.

The yield is the coupon rate since the bond is sold at par (3%), compounded quarterly, for a coupon rate of 0.74%. Multiplying this rate by the principal balances in the previous part of this question gives coupons of 1.1275, 1.1555, and 1.2316 for total payments of 3.515.

14. Continued

(c)   Calculate the breakeven inflation rate for the April payment

Commentary on Question:
The candidates performed below average on this section. Most candidates received partial credit for calculating a breakeven rate with the nominal inflation rate. Candidates received full credit for removing the risk premium from the nominal rate.

The nominal rate of inflation is 4.3%, which is 3.8% after subtracting the 0.5% risk premium. The breakeven inflation rate is 1.043/1.03 - 1 or 0.78%.

(d)   Describe three purposes that common covenants in a leveraged loan obligation serve.

Commentary on Question:
The candidates performed below average on this section. Candidates received partial credit for the main points, while those candidates that elaborated on the relevant sub points received full credit.

- Preservation of capital – not just of existing assets but those acquired as well.
- Appropriateness of excess capital – cash flows from excess capital should be used to repay loans.
- Business risk – curb the borrower's ability to make business decisions that benefit equity holders before lenders.
- Performance requirements – tracking against coverage ratios, leverage ratios, etc.
- Reporting requirements – require budgets, projections, and other internal reports.

15.

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
- Timber and Farmland Investments
- Distressed debts

Learning Outcomes:

(3a)   Demonstrate an understanding of the investment strategies and portfolio roles that are characteristic of various types of equity and alternative investments

(3b)   Use different types of equity and alternative investments available for an investor's growth allocation in portfolio construction, considering portfolio design, risk management, liquidity management, manager selection, implementation, taxation, and benchmarking

(3d)   Recommend and justify an optimal portfolio allocation in a risk-return framework

Sources:

Alternative Investments, CAIA Level II, Chapter 19

Commentary on Question:

This question tests various topics related to infrastructure investments.

Solution:

(a)   Explain why the following characteristics of infrastructure investments are desirable for your portfolio:

        (i)   Resilience to economic downturns

        (ii)   Inflation indexing

        Commentary on Question:
        The candidates performed as expected on this part. Candidates that described the characteristics specifically relating to the nature of infrastructure assets, and also made a connection to the company in question received full credit. Many candidates only made a connection to the company in question and as such received partial credit.

15. Continued

      (i)   Infrastructure assets support the overall functioning of society. Their essential nature means that demand for infrastructure investments is generally inelastic and are resilient to economic downturns. Contractually fixed cash flows tend to be less sensitive to changes in economic conditions.
This will in turn reduce the volatility of an investor's overall performance during various stages of a business cycle, particularly when the rest of your portfolio may be performing poorly. In other words, there is diversification benefit for your portfolio.

      (ii)   Infrastructure assets often have contractual or regulatory revenue structures that are adjusted for changes in inflation. They provide cash flows indexed to inflation.
This attribute is desirable for hedging liability cash flows that are also linked to inflation, particularly because equity and fixed income assets are not as strong an inflation hedge.

(b)   Explain the reasons for this growing opportunity, centering your discussion around each of the following factors:

      (i)   Demand for infrastructure investment

      (ii)   Role of government & public-private partnership (PPP)

Commentary on Question:
The candidates performed below average on this part. For part (i), most candidates did not describe and explain why there is always demand for infrastructure investment. For part (ii), many candidates were able to provide reasons why government has the incentive to increase the involvement of the private sector.

      (i)   Infrastructure assets provide essential services and contribute to the overall functioning of society. There is always a need for them. Financing needs for infrastructure investments are large and growing larger both in mature and developing countries. Good infrastructure facilitates the growth of business, promotes trade, and enhances economic welfare by improving access to vital resources. This, in turn, furthers demand for infrastructure.

15. Continued

      (ii)   Role of government is diminishing. Government is looking more into the private sector through means such as PPP. PPP has grown, giving more entry point for private sector investors. Government has the incentive to increase the involvement of the private sector for a variety of reasons:
- Access private-sector management skills, technical expertise, and efficiency, which in turn reduces the cost and increases the quality of infrastructure
- Pass on risk those better positioned to take within the private sector
-Frees up government resources to be directed elsewhere

(c)   Recommend one of the two investment opportunities based on the following criteria:

- Stage of maturity
- Geographical location
- Sector scope

Commentary on Question:
The candidates performed as expected on this part. The candidates are expected to recommend Infra-X overall, however they can also recommend Infra-Y and get credit if appropriate justification. Candidates that recommended Infra-X or Infra-Y with sufficient justification received full credit. For part (ii), candidates received partial credit for only stating that investing in Vietnam is risker than Canada as the justification for their recommendation of Infra-X. In part (iii), many candidates received partial credit for only mentioning that the company has prior experience in healthcare infrastructure As justification for their recommendation of Infra-X.

      (i)   Justification for recommending Infra-X:
- Infra-X is greenfield but it is near completion, therefore design and construction risks are significantly reduced. Environmental, legal and political risks are largest during early stages of greenfield and therefore are also reduced.
- Infra-Y is risky even though it is brownfield. It is at a very early stage of the brownfield phase. There is very limited operating / usage history, which is usually what makes brownfield investments less risky as it would provide cash flow predictability. Overestimating level of use and/or the output of power plants can be a significant risk.

Justification for recommending Infra-Y:
- Infra-X is riskier as it is under construction

15. Continued

       (ii)   Justification for recommending Infra-X:
              - Vietnam is a less developed economy compared to Canada, and there are significantly larger political and economic instability risks. That comes with potential for high returns but that is not what senior management wants.
              - Your prior experience is in North America. With respect to infrastructure investments, there is competitive advantage if you have familiarity and/or connection to local entities having local knowledge, industrial and regulatory expertise. There is no evidence that the company has competitive advantage in Vietnam.

              Justification for recommending Infra-Y:
              - Your company is based in U.S., so there may be some unwanted correlation between returns of Infra-X and the rest of your firm's portfolio.

       (iii)   Justification for recommending Infra-X:
              - Often hospital sector is subsidized, with reduced usage variation and risk.
              - Competitive advantage as you have prior experience in healthcare infrastructure.
              - Infra-Y is using new technology and it just started operations, so there is high growth potential. This is however not what senior management wants. Employment of cutting-edge technology can also mean high technological uncertainty, resulting in risk of much higher than anticipated cost for repairs or upgrades.

   (d)   Describe the talents needed for successful direct investment in infrastructure.

        Commentary on Question:
        The candidates performed below average on this part. Candidates that discussed and explained at least two talents required received full credit. Many candidates only provided the talent needed but did not provide justification.

        Direct investment involves active management of the infrastructure asset and/or working with construction companies and project operators.

        A large team of high-caliber individuals must be built to have both varied and deep talents required for successful direct investment in infrastructure.

        For example, valuation of infrastructure assets necessitates a strong understanding of the intertwined dynamics of various economic factors, such as demand forecasts, interest rates, inflation. and tariffs.

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15. Continued

Expertise in the local regulatory framework is also essential. This is even more demanding if you want to access foreign investment opportunities, especially in developing countries.

Other necessary experience includes sourcing, screening, selecting, structuring, bidding, negotiating, and managing infrastructure assets.

It may be difficult to attract suitably qualified talents. Once a team is built, there is also significant cost involved in retaining it.

16.

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.

Learning Outcomes:

(2a)   Demonstrate an understanding of credit risk analysis and models

(2b)   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

(2e)   Demonstrate an understanding of measuring and marking-to-market counterparty credit risk in credit derivatives

Sources:

Gregory, *The xVA Challenge*, Chapter 12

Commentary on Question:

This question tests candidates' understanding of the basic concepts of credit risk modeling, and considerations when using market information to measure credit risk.

Solution:

(a)   Calculate each of the following for this bond:

1.   risk-neutral probability of default;

2.   real-world probability of default; and

3.   credit risk premium.

Commentary on Question:

The candidates performed as expected on this section. Most candidates were able to identify the real-world probability of default as given in the question. A common error when calculating the risk-neutral probability of default was not reflecting the recovery ratio.

Price = (1 – RN probability) * face amount + RN probability * recovery ratio * face amount
980 = (1 - RN probability) * 1000 + RN probability * 50% * 1000
RN probability = 4%
RW probability = 1%, as given in question
Credit risk premium = RN probability – RW probability = 4% - 3% = 1%

16. Continued

(b)   Describe one advantage and one disadvantage of using risk-neutral probabilities in credit risk management.

Commentary on Question:
The candidates performed as expected on this section. Most candidates were able to adequately describe one advantage or disadvantage; however, many candidates noted that risk-neutral probabilities were higher than real-world probabilities, without adequately describing why that was an advantage or disadvantage.

Advantage: RN probabilities are market-consistent, making it easier to calculate the market price of the credit risk.
Disadvantage: RN probability estimates are more volatile, making hedging and capital management harder.

(c)   Describe a process for selecting the appropriate market information to use in determining credit spreads for any counterparty.

Commentary on Question:
The candidates performed below average on this section. Successful candidates were often able to fully describe the possible market information sources, and their relative priority; however, many candidates focused their answer on how to segment the universe of counterparties by tenor, rating, geography, etc. without reference to market information.

The best available market information should be used.
1. If there is a liquid credit-default swap, use the CDS price to derive credit spread.
2. Otherwise, if there is another liquid benchmark from the counterparty (e.g. bond prices), use that to derive credit spread, with appropriate basis adjustments.
3. Otherwise, if there is a suitable single-name proxy, use the proxy bond or CDS to derive credit spread, with appropriate basis adjustments and credit spread adjustments.
4. Otherwise, use a generic proxy, e.g. based on counterparty rating, sector, and geography.

(d)   You find that there is a liquid credit default swap (CDS) for the company that issued your bond; however, you observe that the credit spread estimated from the CDS is not the same as the actual spread on the bond.

Explain four reasons why these spreads may differ.

16. Continued

Commentary on Question:
The candidates performed as expected on this section. Most candidates were able to explain how market conditions (e.g. liquidity) of the CDS vs. bond markets may be different. Most candidates were not able to identify intrinsic properties (e.g. tenor or seniority) of the CDS vs. bond which may differ. Other reasonable answers than those listed in the model solution below may have also received credits.

Possible reasons are:
- Reference instrument: the CDS could reference a different debt instrument than the bond purchased.
- Tenor: the CDS could cover a different duration than the bond.
- Seniority: the CDS could reference a more or less senior claim than the bond.
- Liquidity: the market for the CDS could be more or less liquid than the bond's.

17. **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:
(6a) Demonstrate an understanding of how the behavioral characteristics of individuals and firms influence liability design, management, and ALM

(6b) Develop and critique asset allocation strategies appropriate to underlying liability profiles such as pension plans and long tail insurance liabilities

(6c) Evaluate the difficulties of investing for long tail liabilities (i.e. beyond 30 years) such as inflation indexed pension plans and secondary guarantee universal life insurance

Sources:
Maginn & Tuttle, ch 5

Liability Driven Investing, chapter 1 and 3

QFIP-153-20 Asset Allocation in a Low Yield Environment

Commentary on Question:
This question tests candidates understanding of asset liability management and asset allocation for pension plan.

Overall, candidates performed poorly on this question. Many left parts of this question blank and in some cases did not answer any parts of the question.

Solution:
(a) Identify four strategic asset allocation concerns for the pension plan

Commentary on Question:
Candidates performed as expected on this section. Some candidates identified the risks for the pension plan, not the SAA concerns. Candidates who identified the risks for the pension plan without explanation received no credit. Candidate that identified four of the concerns received full credit.

17. Continued

The strategic asset allocation for a pension plan should
- Meet the regulatory limitation on asset-class holdings
- Have sufficiently high liquidity requirement
- Meet the pension plan 's return objective
- Be consistent with the plan's risk tolerance level
- Acceptable funding shortfalls risk
- Acceptable pension's surplus volatility
- Acceptable contribution anticipated volatility
- Inflation protection

(b) Explain unrewarded risks and how they impact the value of the pension plan.

Commentary on Question:
Candidates performed either poorly or brilliantly on this question. Candidates that identified and explained the two unrewarded risks received full credit.

Unrewarded Risk
- Interest rate risk: The present value of the pension liabilities depends on the discount rate used to value them. The decrease of interest rate would result in higher liabilities.

- Inflation risk: A proportion of the pension liabilities will be linked to inflation therefore, changes in inflation will affect the amount a pension pays out when a liability falls due. The increase in inflation would lead to higher future pension payouts.

(c) Justify the decision of using an LDI strategy

Commentary on Question:
Candidates performed poorly on this question, many left the question blank. Among the candidates that answered the question, many focused only on the mitigation of unrewarded risk on the liabilities. Some candidates simply restated the mitigation statement without further explanation. A few candidates justified the use of bonds and swaps for the LDI strategy.

The LDI strategy
- combines hedging techniques with return strategies to meet the plan's SAA objectives and minimize the interest and inflation risks.
- The growth assets generate higher return to meet the return objective
- The LDI allocation are designed to move in line with the value of its liabilities as interest rates and inflation change by matching all (or a portion of) the interest rate and inflation risks in the pension liabilities.
- In doing so, the pension's funding ratio is also protected from volatility arising from changes in the liability valuation.

17. Continued

(d)   Evaluate the appropriateness of these two investment tools to hedge the liabilities through the use of +100 bps and -100 bps shocks at t=0

Commentary on Question:
Candidates performed poorly on this question. Many candidates left the question blank. Among the candidates that answered the question, many evaluated only one of the investment tools. Some candidates made statements without +/- 100bps shock evaluation.

Liability Value	t=0	t=1
Current interest rate 3%	$=100*(1+3\%)^{-1}=97.09M$	100M
Interest rate fall 1%	$=100*(1+2\%)^{-1}=98.04M$	100M
Interest rate rise 1%	$=100*(1+4\%)^{-1}=96.15M$	100M

Solution: Match with Bond Principal = 100M	t=0		t=1
	Cash	Bond	Maturity
Current interest rate 3%	0	97.09M	100M
Interest rate fall 1%	0	98.04M	100M
Interest rate rise 1%	0	96.15M	100M

Solution: Match with Swap (fixed rate 3%, Notional 97.09M)	t=0		t=1
	Cash	Swap	
Current interest rate 3%	97.09M	0	$=97.09*(1+3\%)=100M$
Interest rate fall 1%	97.09M	$\frac{97.09(1+3\%)-97.09(1+2\%)}{(1+2\%)}=+.95$	$=97.09*(1+3\%)100M$
Interest rate rise 1%	97.09M	$\frac{97.09(1+3\%)-97.09(1+4\%)}{(1+4\%)}=-.93$	$=97.09*(1+3\%)=100M$

The above example shows that the bond and swap has the same movement as the liability value for interest rate changes.

At current interest rate 3%, the liability value is 97.09M which is equal to Bond value 97.09M and Swap+ cash value (0+97.09M) at t=0. When interest rate falls by 1% to 2%, the liability value increases to 98.04M so does bond 98.04M and Swap+Cash (97.09+.95). When interest rate rises 1% to 4%, the liability value decreases to 96.15M so does bond 96.15M and Swap+Cash (97.09-.93).

(e)   Critique the appropriateness of the CFO's suggestion

Commentary on Question:
Candidates performed below average on this question. Most candidates were able to reach the right conclusion and provided some reasons to support the conclusion.

17. Continued

Disagree with the suggestion.
- The consideration for asset allocation decision is excess return and not expected return of the asset.
- Low yields don't imply a low risk premium or low excess return. The risk premium for bond has been related to yield curve slope than yield level. Given that the yield curve is upward sloping, the risk premium for bond is positive.
- Bond can still be useful diversifiers even if the correlation between bonds and other asset classes to average about zero.