

QFI PM Model Solutions

Spring 2022

1. 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
- (6d) Understand and apply the concept of risk factors in the context of asset allocation

Sources:

QFIP-139-19: Ch. 13 of IAA Risk Book, Asset Liability Management: Techniques and Practices for Insurance Companies, Gilbert

Commentary on Question:

This question will evaluate the candidate's ability use ALM in a life insurance setting, specifically in the context of improving portfolio performance in the context of risk constraints.

Solution:

- (a) Describe two ALM-related risks that this block of business is exposed to.

Commentary on Question:

Candidates performed brilliantly on this section. Most candidates described at least two ALM-related risks to which the business was exposed.

Applicable ALM-related risks include, but are not limited to:

- Interest rate risk: Risk of gains and losses generated on a portfolio through reinvestment and disinvestment activities
- Liquidity risk: Risk of having insufficient liquid assets to service liability payments
- Credit risk: Risk of gains and losses through defaults or changes in credit spreads on risky assets
- Currency risk: Risk associated with backing liabilities with assets in a different currency

1. Continued

- Asset-liability mismatch risk (C3 risk): Risk of losses from assets and liabilities moving in opposing directions
- (b) Assess the appropriateness of each strategy with regards to addressing senior management's concerns.

Commentary on Question:

Candidates performed below average on this question. Successful candidates provided adequate commentary on both the immunization and interest rate swap overlay. Some candidates only provided sufficient comments on the immunization strategy.

Immunization:

- Immunization addresses interest rate risk by ensuring that, among other things, the duration of the assets equals the duration of the liabilities
- By its nature, immunization covers small changes in the yield curve
- Immunization only addresses parallel shocks – if management is concerned about specific interest rate tenors then immunization would not be an adequate strategy
- There may also be issues with implementing an immunization strategy if there are no traditional fixed income assets available in the market that have sufficient duration

Interest Rate Swap Overlay:

- Interest rate swaps are an effective tool to execute ALM strategies and facilitate risk optimization of a portfolio
 - Interest rate swaps can be used to target specific durations, or extend the duration of an asset portfolio
 - Company does not have interest rate swaps in its current portfolio, so may need to hire/gain expertise with this new type of asset
 - An interest rate swap overlay would do a better job at addressing senior management's concerns relative to an immunization approach
- (c) Propose a carve out strategy for this block of business.

Commentary on Question:

Candidates performed as expected on this question. Successful candidates identified approaches to identify carve out points, as well as how assets are treated before and after the carve-out point. One common mistake was that candidates did not mention needing to immunize the liabilities.

1. Continued

The following approaches can be used to implement a carveout strategy for a block. Note that candidates only needed to provide one method to achieve full points.

Method 1:

- A carve out point is established for investments (i.e. the period after which investments will be allocated to equities)
- Construct an immunized portfolio using bonds up until the carve out point
- Calculate/hold the required amount of equities for cash flows after the carve out point

Method 2:

- Determine the amount of equities that will be held as part of the portfolio
- Based on the amount of equities held, determine the corresponding carve out point for liability cash flows
- Construct an immunized portfolio using bonds up until the carve out point

- (d) Critique the decision to add equity to the portfolio.

Commentary on Question:

Candidates performed as expected on this question. Those candidates that provided several critiques with commentary on the decision to add equity to the portfolio received full credit. Some candidates did not provide supporting statements.

Examples of statements in favour/against the decision include, but are not limited to:

- Equity provides an attractive method to improve investment performance
- Can set carveout point to be after the longest duration bond is available to minimize impacts to interest rate risk
- Using equities to manage returns may expose the portfolio to greater interest rate risk, as well as expose the insurance company to equity risk
- Addition of equity may result in higher capital/reserve requirements, which may be against the best interests of the insurance company
- May require more sophisticated modelling approaches (e.g. stochastic processes) to ensure asset adequacy

2. 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

Sources:

Commercial Real Estate Analysis and Investments, Geltner, David M. & Miller, Norman G., 3rd Edition, 2014, Chapter 12

Alternative Investments, CAIA Level II, 3rd Edition, 2016, Chapter 14

Commentary on Question:

This question tests candidates' understanding of the four-quadrant model of the real estate market, the distinction between the market value and investment value of a property, and how they relate.

Solution:

- (c) Explain how increased economic activity drives rent in the short term.

Commentary on Question:

The candidates performed as expected on this section. Most candidates received partial credit for correctly noting that there would be an increase in demand for rent. Those candidates that commented that this would shift the demand curve upward and also that rent prices would go up in the short term since the supply of space is largely fixed in the short term received full credit. Some candidates incorrectly concluded that the supply of rental space would increase significantly in the short term, therefore causing rental prices to decrease in the short term.

- In the short term, available commercial and residential space is largely fixed.
- The increased economic activity is an exogenous shock to this dynamic system, which shifts the demand for space upward.
- This increased demand for the relatively fixed space causes rent prices to increase.

2. Continued

- (d) Explain how increased economic activity drives construction activity and rent in the intermediate term.

Commentary on Question:

The candidates performed as expected on this section. Most candidates received partial credit for noting that the value of real estate will increase and that this would lead to additional construction activity, thereby increasing supply of space. The most successful candidates concluded that this increased supply of space would then lead to a decrease in rent prices, but that rent prices would still be higher than their initial level. Some candidates omitted this part of the question.

- In the intermediate term, available commercial and residential space is not fixed, and the supply of space will increase.
 - In the asset market, the value of real estate is a function of rent, $P=R/i$. Increased rent drives prices up.
 - The construction industry compares the higher real estate values to construction costs.
 - All else being equal, higher prices make more construction economically viable and construction activity increases.
 - Over time, this results in more rentable space becoming available, and the stock of rentable space increases.
 - The increased available space drives rents partway back down to their initial level.
- (c) Explain investment value (IV) considerations for different investors and developers in a given geographic area.

Commentary on Question:

The candidates performed as expected on this section. Most candidates received partial credit for correctly noting that the IV for a given property can vary between investors depending upon their use of it and also that IV is what the asset is worth if you hold it for a long time. The most successful candidates also explained that the IV is determined by the discounting the user's projected cash flows at their opportunity cost of capital.

- IV is what the asset is worth to you if you don't sell it for a long time.
- IV may differ for different investors for the same asset at the same point in time.
- IV uses a cash flow projection specific to the user.
- IV determined by discounting the projected cash flows, at the opportunity cost of capital. A lower discount rate increases the DCF of the property.

2. Continued

- (d) Propose a negotiating strategy for ABCD to sell the property to the semiconductor company for more than the general market price for each of the scenarios above.

Commentary on Question:

The candidates performed as expected on this section. Some candidates received partial credit for providing appropriate answers for Scenario 1. Some candidates confused the buyer and seller while other unsuccessful candidates simply compared IVs and MVs and did not provide any negotiation strategies. Some candidates omitted this part of the question. The model solution below represents a plausible (but not exhaustive) list of negotiation points for each Scenario.

- Scenario 1:
 - This is a unique investor and unique asset as part of their plan, so IV and MV may differ greatly.
 - This buyer's campus will give it a unique way to profit from developing this property, giving it a high IV.
 - The pension plan's asset manager's objective is to achieve a sale price close to the IV, extracting the excess value.
 - Research the geographic area and beyond for other potential locations for the buyer's campus.
 - Estimate the buyer's IV, possibly by hiring a real estate appraiser specializing in tech campuses
 - Locate a second-most-motivated buyer, which would increase the MV faced by the tech buyer to this level.
 - Set a reservation price at (or near, to allow for uncertainty) the estimated second-most-motivated buyer's price.
 - Show how the parcel in question is particularly valuable to the desired set of properties for the campus.
 - Emphasize how this geographic area is uniquely suited for the buyer's project.
 - The semiconductor company may have a relatively high IV for the property, so they would enter the market first at a higher price.

- Scenario 2:
 - The pension plan's asset manager's goal is to negotiate the buyer up to the MV
 - Present comparable sale data for similar properties in the geographic area.
 - Identify other potential buyers willing to pay the MV to induce this buyer to pay the MV.
 - Work with the buyer to develop a plan to raise their IV of the property.

2. Continued

- Scenario 3:
 - The usual approach of simply observing the transaction prices of similar assets to estimate the of MV for this property may be used to quickly arrive at a transaction price.
 - Identify ways to reduce transaction costs such as realtor and closing fees.
 - Expedite closing of transaction, so buyer can take control of property sooner.

3. 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
- (7d) Assess and interpret performance attribution metrics for a given asset or portfolio

Sources:

Maginn & Tuttle: Managing Investment Portfolios: A Dynamic Process 3rd Edition (Ch. 12)

Commentary on Question:

Candidates performed as expected on this question.

Solution:

- (a) Calculate the time-weighted rate of return of the surplus portfolio from January 1 to May 1.

Commentary on Question:

Candidates performed below average on this section. While most candidates were able to identify the surplus to liability-backing portfolio transfer as an external cash flow, many also incorrectly classified dividends, coupons and cash reinvestment as external cash flows as well.

Time-weighted rate of return should take into consideration the impact of external cash flows on the market value of the portfolio. The only external cash flow between January 1 and May 1 is the \$10M cash transfer from the surplus portfolio to the liability-backing portfolio.

$$\text{time-weighted return} = \frac{110+10}{115} \cdot \frac{120}{110} - 1 = 13.8\%$$

- (b)
- (i) Calculate the overall portfolio return and overall benchmark return.
- (ii) Calculate the active asset class allocation return and active security selection return, assuming interaction returns are folded within security selection.

Commentary on Question:

Candidates performed above average on this section. Most candidates were able to correctly calculate the overall portfolio return and overall benchmark return. Some candidates only calculated active security selection returns without interaction returns. These candidates did not receive full credit.

3. Continued

(i)

$$\begin{aligned}\text{portfolio performance} &= \sum w_{p,i} r_{p,i} = 50\% \cdot 7.5\% + 30\% \cdot 10.0\% + 20\% \cdot 5.0\% \\ &= 7.75\% \\ \text{benchmark performance} &= \sum w_{b,i} r_{b,i} = 45\% \cdot 4.5\% + 40\% \cdot 9.0\% + 15\% \cdot 6.0\% \\ &= 6.53\%\end{aligned}$$

(ii)

$$\begin{aligned}\text{active sector allocation return} &= \sum_{i=1}^S (w_{p,i} - w_{b,i})(r_{b,i} - r_b) \\ &= (50\% - 45\%) \cdot (4.5\% - 6.53\%) + (30\% - 40\%) \\ &\quad \cdot (9.0\% - 6.53\%) + (20\% - 15\%) \cdot (6.0\% - 6.53\%) \\ &= -0.375\%\end{aligned}$$

$$\begin{aligned}\text{active security selection return} &= \sum_{i=1}^S w_{b,i}(r_{p,i} - r_{b,i}) \\ &= 45\% \cdot (7.5\% - 4.5\%) + 40\% \cdot (10.0\% - 9.0\%) \\ &\quad + 15\% \cdot (5.0\% - 6.0\%) \\ &= 1.60\%\end{aligned}$$

$$\begin{aligned}\text{interaction return} &= \sum_{i=1}^S (w_{p,i} - w_{b,i})(r_{p,i} - r_{b,i}) \\ &= (50\% - 45\%) \cdot (7.5\% - 4.5\%) + (30\% - 40\%) \\ &\quad \cdot (10.0\% - 9.0\%) + (20\% - 10\%) \cdot (5.0\% - 6.0\%) \\ &= 0.00\%\end{aligned}$$

(c) Assess the performance of the portfolio in meeting its objectives.

Commentary on Question:

Candidates performed above average on this section. Most candidates were able to correctly calculate portfolio and benchmark return correctly. Most candidates also correctly identified the relationship between credit spread return and credit sensitivity but failed to associate carry return with book yield.

Carry return due to passage of time is an indicator of the portfolio's and benchmark's book yield.

$$\begin{aligned}\text{portfolio carry return} &= 15\% \cdot 1.50\% + 85\% \cdot 3.0\% \\ &= 2.775\% \\ \text{benchmark carry return} &= 30\% \cdot 1.0\% + 70\% \cdot 2.5\% \\ &= 2.050\% \\ \text{net carry return} &= 2.775\% - 2.050\% = 0.725\%\end{aligned}$$

3. Continued

Since the next carry return is positive, the portfolio is successful in meeting the first objective of exceeding the benchmark in book yield.

Return from credit spread is an indicator of the portfolio/benchmark sensitivity to changes in credit spreads.

$$\begin{aligned}\text{portfolio credit spread return} &= 85\% \cdot 2.50\% = 2.125\% \\ \text{benchmark credit spread return} &= 70\% \cdot 2.70\% = 1.890\% \\ \text{net credit spread return} &= 2.125\% - 1.890\% = 0.235\%\end{aligned}$$

The credit spread return of the portfolio is higher than that of the benchmark on an absolute basis, this indicates that the portfolio is more sensitive to credit spread than the benchmark (e.g. due to credit spread compression). Therefore, the portfolio is not meeting the second objective.

- (d) Calculate the active sector allocation return and active security selection return under the new framework.

Commentary on Question:

Candidates performed below average on this section. Many candidates failed to understand the implications on performance and attribution when bond prices are not marked-to-market.

Under the new accounting framework where bond prices are not marked-to-market, only carry return would impact portfolio and benchmark performance.

$$\begin{aligned}\text{active sector allocation return} &= \sum_{i=1}^S (w_{p,i} - w_{b,i})(r_{b,i} - r_b) \\ &= (15\% - 30\%) \cdot (1.00\% - 2.05\%) + (85\% - 70\%) \\ &\quad \cdot (2.50\% - 2.05\%) \\ &= 0.225\%\end{aligned}$$

$$\begin{aligned}\text{active security selection return} &= \sum_{i=1}^S w_{b,i}(r_{p,i} - r_{b,i}) \\ &= 30\% \cdot (1.50\% - 1.00\%) + 70\% \\ &\quad \cdot (3.00\% - 2.50\%) \\ &= 0.500\%\end{aligned}$$

$$\begin{aligned}\text{interaction return} &= \sum_{i=1}^S (w_{p,i} - w_{b,i})(r_{p,i} - r_{b,i}) \\ &= (15\% - 30\%) \cdot (1.50\% - 1.00\%) + (85\% - 70\%) \\ &\quad \cdot (3.00\% - 2.50\%) \\ &= 0.00\%\end{aligned}$$

4. Learning Objectives:

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

Learning Outcomes:

- (4b) Demonstrate an understanding of various liquidity measurement tools and metrics

Sources:

Ben Dor: Quantifying the Liquidity of Corporate Bonds, Ch 5, 6

Commentary on Question:

This question tests candidate's understanding of the liquidity measure.

Solution:

- (a) Compare LCS and TES.

Commentary on Question:

Candidate performed below average on this section. There are five areas as shown in the table below that can be used to compare LCS vs. TES. Partial credit was given for each area that was covered correctly.

Area	LCS	TES
1. Definition	LCS represents a round-trip cost of institutional-size transaction in a bond.	TES is a bond level liquidity ranking from 1 (best) to 10 (worst).
2. Purpose	Provides an investor with a bond's liquidity measure at a given point-in-time.	Provides a liquidity ranking that allows an investor to quickly judge a bond's relative liquidity, both currently and over time.
3. Stability	LCS will fluctuate over time as both the overall market liquidity and the bond's relative liquidity, ebb and flow	Being a ranking system, TES is unlikely to change as much as LCS as the overall market changes
4. Sensitivity to OASD	Sensitive because $LCS = OASD * \text{bid-ask spread}$.	Insensitive because TES is adjusted by OASD
5. Level of bond trading	Does not directly measure the level of trading in a bond	Reflects trading level as it combines both LCS and trading volume into one score.

- (b) Construct a ranking of the LCS's of bonds A, B, C, and D.

Commentary on Question:

Candidate performed below average on this section. Candidates needed to observe that LCS for bond A and B can be calculated directly. For bonds C and D, the relative LCS size could be inferred from the information given. Partial credit was given for each step that was completed correctly.

$$LCS(A) = \text{bid-ask spread} * OASD = (4.65\% - 4.40\%) * 12.5 = 3.125\%$$

$$LCS(B) = \text{Non-Benchmark Adjustment Factor} * (\text{Ask price} - \text{Bid price}) / \text{Bid price} \\ = 1.2 * (95.6 - 93.6) / 93.6 = 2.56\%$$

4. Continued

Based on the LCS model from Ben Dor:

lower trading volume generally implies higher LCS

lower issue size generally implies higher LCS

higher Age generally implies higher LCS

higher DTS generally implies higher LCS

Trading volume and issue size for bond C are lower than for Bond B.

In addition, age and DTS for bond C is higher than for Bond B.

So $LCS(B)$ would be a lower bound for $LCS(C)$ if they were both quoted.

However Bond C is not trader-quoted, so applying that adjustment factor, the lower bound is such that $LCS(C) \geq 1.3 * LCS(B) = 1.3 * 2.56\% = 3.33\%$, and therefore $LCS(C) > LCS(A)$.

Comparing Bonds C and D, the net effect of trading volume and age can be calculated from the information provided, and is the same for both bonds:

$$\text{Bond C } 0.002 * 6 - 0.002 * 10 = -0.008$$

$$\text{Bond D } 0.002 * 1 - 0.002 * 5 = -0.008$$

Issue size is the same for C and D. So the only other distinguishing factor between the two bonds is DTS, which is higher for bond D. So we expect $LCS(D) > LCS(C)$.

Conclusion: $LCS(D) > LCS(C) > LCS(A) > LCS(B)$.

- (c) Approximate the proceeds from selling Bond A.

Commentary on Question:

Candidate performed poorly on this section. While a few candidates correctly solved the bid price and used it to derive sales proceeds, many used an incorrect approach, such as using the “ask price” or “par value” and then subtracting $\frac{1}{2}$ of LCS for trading cost to derive sales proceeds.

Bond A's bid price can be estimated by its $LCS = (\text{ask price} - \text{bid price}) / \text{bid price}$

Bid price = ask price / (1 + LCS) = 92.4 / (1 + 3.13%) = 89.60 per \$100 face

Sales proceeds = 89.6 / 100 * 10 million = 8.96 million.

- (d) Explain two possible scenarios for the widened option adjusted spreads.

Commentary on Question:

Candidate performed above average in this section. Many were able to correctly identify the scenarios leading to the higher OAS.

4. Continued

Market liquidity may have dried up causing investors to demand a greater OAS to compensate for enhanced liquidity risk.

The market risk premium may have increased. The general level of risk aversion may be heightened due to market turmoil, causing investors to demand greater OAS

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

Sources:

Alt-Inv-CAIA Level II-3rd-Ch 08

Commentary on Question:

Commentary listed underneath question component.

Solution:

- (a) Explain the four main purposes of a benchmark.

Commentary on Question:

The candidates performed as expected on this section. Most candidates were able to explain at least two purposes (strategic asset allocation and performance evaluation), but many didn't explain investor communication and marketing.

As a component of the strategic asset allocation process, during which the risk return properties of asset classes are evaluated and the optimal allocation within a diversified portfolio is determined.

As a standard or point of reference against which the performance of a security or an investment manager can be assessed.

5. Continued

As a standard used by investment managers to compare their performance against in order to market their services to and communicate with current and potential investors.

As part of the process of providing the right incentives to managers, determining where and what types of improvements are needed in the investment process, and analyzing how competing managers achieve their high performance levels.

- (b) Explain the difficulties meeting four of the properties when developing PE benchmarks.

Commentary on Question:

The candidates performed above average on this section. Most candidates were able to explain at least two to three properties properly. To receive full credit, the candidates must provide an explanation on why it is challenging to meet these properties for PE benchmarks.

Unambiguous/knowable: The names and weights of entities that make up the benchmark should be clearly identifiable. PE benchmarks provide only aggregate data and do not give a complete representation of the available opportunity set.

Investable: There should be an option to forgo active management and simply hold all assets that make up the benchmark. Beating an index, for illustration, would require holding assets that are not part of the benchmark or over- or underweighting assets relative to the benchmark. In private equity, one cannot choose, as in public markets, between being active and passive, as investors do not have access to the whole market. It is notably this fundamental difference that explains why PE portfolios exhibit widely diverging results.

Measurable: It is possible to frequently calculate the benchmark performance. Private equity data are insufficient for measuring risk and return characteristics accurately, as in the case of listed securities. Valuation guidelines, such as those put in place by various industry associations, define an appraisal policy for improving coherence and consistency, which makes comparisons between funds more meaningful. However, private equity remains subject to infrequent and subjective valuations, and interim performance figures are of limited value.

Specified in advance: The benchmark is constructed and mutually agreed on before the manager's evaluation. PE fundraisings are uncertain, so the weights and composition of any benchmark cannot be known in advance.

5. Continued

Appropriate: The benchmark is consistent with the manager's investment style. As private equity is essentially the search for overlooked opportunities, any benchmark will not fully represent the style, specialization, and expertise of the fund manager (such as in the case of emerging markets or VC investments in innovation, both of which, by definition, are not yet presented in the benchmark), and comparisons are problematic.

Reflective of current investment opinion: This requires understanding a benchmark enough to have opinions about whether to deviate from it. PE investors will not have full knowledge of the entities that make up the benchmark.

- (c)
- (i) Compare the performance of the two funds by IRR and TVPI.
 - (ii) Explain the key difference between IRR and TVPI.

Commentary on Question:

The candidates performed as expected on this section. Most candidates calculated the IRR correctly. Some candidates didn't clearly explain that TVPI does not take the time value of money into consideration, hence received partial credit.

Fund1	0	1	2	3	4	5	6		
Drawdowns	-100	-500		-1000	-400				
Repayments			200			800			
Terminal NAV							2000	14.80%	<- IRR
Cashflows	-100	-500	200	-1000	-400	800	2000	1.5	<- TVPI

Fund2	0	1	2	3	4	5	6		
Drawdowns	-800	-500	-1000	-200					
Repayments					500	1500			
Terminal NAV							2000	11.95%	<- IRR
Cashflows	-800	-500	-1000	-200	500	1500	2000	1.6	<- TVPI

Fund 1 performs better on IRR basis while Fund 2 performs better on TVPI basis.

The difference between IRR and TVPI is that TVPI does not take time value of money into consideration.

- (d) Explain how PME works and why it is critical in performance benchmarking.

Commentary on Question:

The candidates performed below average on this section. To receive full credit, the candidates must point out that the PME converts the time-weighted measures to cashflow-weighted measures, which is why the PME is critical in PE benchmarking.

5. Continued

The public market equivalent (PME) is an index return measure that uses market indices to reflect the opportunity cost of capital.

PE return measures, which are cashflow weighted, cannot be compared directly to publicly quoted asset return measures, which are time weighted. The public market equivalent (PME) methodology converts the time-weighted measures used for publicly quoted assets into a cash-flow-weighted methodology, which can then be used to benchmark a PE fund.

- (e) Recommend the PE fund that has a higher excess IRR compared to the benchmark, answer this part in Excel.

Commentary on Question:

The candidates performed poorly on this section. Most candidates didn't properly start with calculating the number of units in the first step.

	0	1	2	3	4	5	6			
Index value	5962	4625	3064	3558	3821	4715	5542			
Number of units 1	0.017	0.108	-0.065	0.281	0.105	-0.170				
Cumulated units 1	0.017	0.125	0.060	0.341	0.445	0.276				
Equity Cashflows 1	-100	-500	200	-1000	-400	800	1527.8		8.64%	<- IRR
									6.16%	<- excess IRR

	0	1	2	3	4	5	6			
Index value	5962	4625	3064	3558	3821	4715	5542	-1.21%		
Number of units 2	0.134183	0.108108	0.326371	0.056211	-0.13086	-0.31813				
Cumulated units 2	0.134183	0.242291	0.568662	0.624873	0.494018	0.175884				
Equity Cashflows 2	-800	-500	-1000	-200	500	1500	974.7		4.52%	<- IRR
									7.43%	<- excess IRR

Fund 2 has a higher excess IRR so recommend fund 2.

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:

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

Sources:

QFIP-154-20 – The Evolution of Insurer Portfolio Investment Strategies for Long-Term Investing, OECD 2016

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

Commentary on Question:

This question tests the candidate's understanding of factors affecting ALM. Overall, candidates performed as expected on this question.

Solution:

- (e) Describe four ways in which insurers may take excessive risks that could impact investment decisions.

Commentary on Question:

The candidates performed as expected on this section. Most candidates received credit for describing insurers changing their asset allocation towards risky investments or charging insufficient premiums for products. Some candidates only described multiple ways in which insurers could allocate assets towards risky investments.

1. Insurer charges insufficient premium or has imprudent underwriting policy, which could rapidly expand volume of business.
 2. Insurer changes asset allocation toward riskier investment portfolio.
 3. Reduce equity capital endowment to the minimum regulatory capital required, which leads to higher probability of insolvency.
 4. Fail to sufficiently manage risks through reinsurance arrangements.
- (f) Describe three measures used to examine the performance of an investment taking its risk into account.

6. Continued

Commentary on Question:

The candidates performed as expected on this section. Most candidates received partial credit for listing and succinctly describing the Treynor and Sharpe Ratios. Most candidates did not discuss systematic vs. unsystematic risk.

- Jensen's Alpha – measures difference between expected return of an investment and the investment's fair rate of return. Often used to evaluate fund manager performance and can be seen as measure of how much an investment beats the market.
- Treynor ratio – measures the excess return over the risk-free rate per unit of market risk.
- Sharpe ratio – used to compare different investment opportunities with different risk levels, since it measures expected excess return per unit of risk.
- Jensen's Alpha and Treynor ratio are built on systematic risk. Fund managers are expected to eliminate unsystematic risk in the portfolio by diversifying, thus leaving only systematic risk to manage.

(c)

- (i) Calculate the Sharpe ratio and Treynor ratio for each fund.
- (ii) Recommend which fund to invest in based on your results from part (c) i).

Commentary on Question:

The candidates performed brilliantly on this section. Many candidates received credit for correctly recommending Fund A, but did not recognize that the portfolio is well-diversified and, thus, should use Treynor ratio as the comparison basis.

(i)

- Treynor Ratio = [expected return – risk free rate]/systematic risk
- Sharpe Ratio = [expected return – risk free rate]/standard deviation
- Manager A – Treynor Ratio = $[10\% - 3\%] / 1.25 = 5.6\%$, Sharpe Ratio = $[10\% - 3\%] / 5\% = 1.4\%$
- Manager B – Treynor Ratio = $[12\% - 3\%] / 1.75 = 5.14\%$, Sharpe Ratio = $[12\% - 3\%] / 6\% = 1.3\%$

- (ii) Recommend manager A, since Treynor ratio is higher, which suggests that the amount of excess return per unit of systematic risk is greater. Treynor ratio should be used as the metric rather than Sharpe ratio, since it's a well-diversified portfolio.

6. Continued

- (d)
- (i) Explain why a prolonged low interest rate environment poses additional risk.
 - (ii) Critique your assistant's suggestions.

Commentary on Question:

The candidates performed as expected on this section. Most candidates received partial credit for describing the risks associated with the recommendations, but did not explain how the risks apply in this case.

- (i)
- Low interest rates constrain profits by generating insufficient investment returns.
 - Value of liabilities increases when applying a reduced rate for discounting.
- (ii)
- Infrastructure investments provide attractive returns and are a good match for long duration liabilities, such as whole life and pension liabilities. However, the optionality and uncertainty in mortality introduces liquidity risk that is inappropriate to be matched with long-term, illiquid assets like infrastructure. Capital requirements are also substantially higher for infrastructure investments.
 - Allocating to emerging market debt exposes the company to currency risk, and, thus, the interest earned is not risk-free. When investing in an asset denominated in a foreign currency, the currency risk should be hedged by purchasing exchange rate swaps, which translates into earning a rate close to Treasury rates anyway.
 - Equities generally generate higher yields and also hedge against inflation and are tax-efficient. However, the capital charge is substantially higher than that for high quality bonds. Duration mismatch will produce additional regulatory challenges in terms of cash flow and stress testing.

7. 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-148-20: IFRS 17 Standards Effects Analysis

QFIP-150-20: IFRS 9 for Insurers

Commentary on Question:

This question tests the candidate's understanding of IFRS 9 and IFRS 17, and some of the expected impacts that these changes are expected to have on insurance company balance sheets. Overall, candidates performed as expected on this question. The required responses come directly from the source text, although additional reasonable and well-defended responses were also considered for partial credit. Many candidates only provided a list when a description was asked for in the question. Other candidates did not sufficiently respond to the question being asked.

Solution:

- (g) Describe five of the improvements that IFRS 17 makes to existing insurance accounting practices.

Commentary on Question:

Candidates performed as expected on this question. Many candidates provided only a brief list without any accompanying detail and were only awarded partial credit, whereas a meaningful description for five of the 14 improvements listed directly in the source text was needed in order to obtain full credit.

Five improvements that IFRS 17 makes to existing insurance accounting practices include:

- Use of current estimates: Using updated assumptions provides transparent and timeline information about insurance risks.
- Appropriate Discount Rates: IFRS 17 requires companies to discount their cash flows from insurance contracts using discount rates that reflect the characteristics of the cash flows, rather than rates based on the characteristics of the assets backing the liability.

7. Continued

- **Explicit Risk Adjustment:** IFRS 17 requires companies to always include an explicit risk adjustment, which provides insight into the company's view of the economic burden imposed by insurance contracts.
 - **Current Value of Financial Options and Guarantees:** IFRS 17 requires a company to include all financial options and guarantees embedded in insurance contracts in the measurement of fulfilment cash flows in a manner consistent with observable market prices.
 - **Grouping Contracts at Initial Recognition** in a way that reflects profitability: IFRS 17 requires companies to identify portfolios of insurance contracts of divide in groups that are onerous at initial recognition, contracts at have no significant possibility of becoming onerous, and any remaining contracts.
- (h) Assess your coworker's comment on changes to the economic environment and how IFRS 17 could improve ABC's understanding of their liabilities.

Commentary on Question:

Candidates performed below average on this question. Many candidates only discussed IFRS 17's improvements for ABC without directly addressing their coworker's comment . Some candidates did not recognize that today's economic environment, particularly as related to interest rates, is different than the 1990's. The most complete responses criticized their coworker's statement and then described why using current interest-rate assumptions would improve ABC's understanding of their liabilities.

My coworker's statement that the economic environment hasn't changed since the 1990's is wrong. Long-term interest rates in particular have declined for decades. Before IFRS 17, insurance companies could measure contract liabilities using 'locked-in' assumptions from when those policies were sold. The effect of a lower interest rate environment wouldn't be reflected in contemporary financial statements and may understate liabilities.

- (c) Describe the expected impact of IFRS 17 on insurance contract liabilities for each of the above cases.

Commentary on Question:

Candidates performed above average on this question. Most candidates correctly indicated the directional impact of IFRS 17 on liabilities for short term contracts versus long-term contracts. Some candidates did not specifically discuss IFRS 17's effect on liabilities as asked in the question or provided responses that were too vague, which received only partial credit.

7. Continued

For short term contracts where liabilities for incurred claims are not currently discounted, insurance contract liabilities are expected to decrease. For long-term insurance contracts where the historical rate is higher than the current rate, insurance contract liabilities are expected to increase. For risk margins that are higher than the risk adjustment in IFRS 17, insurance contract liabilities are expected to decrease.

- (d) Assess which measurement bases for financial assets under IFRS 9 are appropriate for ABC.

Commentary on Question:

Candidates performed as expected on this question. Since debt instruments were covered more explicitly in the text, most credit related to recognizing the proper measurement bases for debt instruments. Only some candidates recognized that debt instruments could be measured under any of the three bases, depending on the business model, although partial credit was awarded for identifying one or two bases. Almost every candidate recognized that derivatives would need to be measured through FVTPL.

Debt instruments can be measured on any of the three bases, amortized cost, fair value through other comprehensive income (FVOCI), or fair value through profit or loss (FVTPL) depending on the business model the instrument is held in and whether the contractual cash flows are Solely Payments of Principal and Interest ('SPPI').

Derivatives can only be measured using Fair value through profit or loss ('FVTPL').

8. Learning Objectives:

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

- (4b) Demonstrate an understanding of various liquidity measurement tools and metrics
- (4c) Demonstrate an understanding of the levels of liquidity available with various asset types and the impact on a company's overall liquidity risk
- (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:

QFIP-137-19: Managing your Advisor: A Guide to Getting the Most Out of the Portfolio Management Process, Section 2, p.24-5.

QFIP-106-20: Liquidity Risk: Measurement and Management - A Practitioner's Guide to Global Best Practices, Matz, Leonard & Neu, Peter, 2006, Ch. 2, p.15-28.

QFIP-105-13: Report of the Life Liquidity Group

Commentary on Question:

This question tests investment policy and liquidity risk management associated with managing liquidity of a guaranteed insurance contract. 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.

8. Continued

Solution:

PQR has decided to begin selling Guaranteed Investment Contracts (GIC). To make their GIC more attractive to investors, PQR is planning to add a put feature, where contract owners can demand full payoff of the GIC within 7 days if the company's credit rating is downgraded by one notch. Historically, the company has maintained high credit ratings, typically A+.

The sale plan is \$10 billion in the first year. Below is the proposed asset allocation to support the sales.

Types of Assets	Total (in Billions)
Secured funded assets	\$6.4
Liquid unencumbered assets	\$2.0
Illiquid unencumbered assets	\$1.6

Liquidity Profile (estimated time to sell)	Total (in Billions)
Within 1 week	\$0.7
Within 2 weeks	\$0.6
Within 1 month	\$0.4
Longer than 1 month	\$0.3

- (a) Describe the liquidity risk associated with this GIC.

Commentary on Question:

The candidates performed above average on this section. Most candidates identified the liquidity risk posed by the redemption put option and the limited liquidity of the assets. Few addressed the spiral effect on the execution cost and the company rating.

GIC is an investment contract guaranteeing a specific return/payout on a specific date. The expected cash flow has known amount and timing. When a put option on company's downgrade is included, the timing of the payments is sensitive to company's credit rating. Upon the company's downgrade, the funding agreement will be surrendered, creating a need to sell assets quickly given the 7-day clause.

The current planned asset portfolio does not have enough liquidity for the stressed scenario. Company has \$0.7B of assets estimated to be able to be sold within one week. Depending on market conditions and reactions, the next \$0.6B available within 2 weeks may be subject to greater transaction costs due to the urgency of the transactions.

8. Continued

If the amount of contract holders exercising the put is large enough, the company may not be able to raise enough liquidity to meet the demands. The situation can cause further downgrades, hence more surrenders, etc. Market participants will demand a higher haircut, or bid-ask-spread, seeing the sales as urgent (fire sale), hence exacerbating the liquidity issue.

- (b) Propose measures to manage the liquidity risk above.

Commentary on Question:

Candidates performed as expected on this section. While most candidates provided one or two proposals to mitigate the liquidity risk, very few candidates were able to provide the full list.

Liquidity management should be on both sides of balance sheet.

Liabilities: Avoid offering features which could cause severe liquidity issue, or at least revise it to reduce the impact. For example, instead of 7 days of redemption notice, make it longer such as one month; specify the downgrade to a much lower level, such as BBB. Or compete in other areas such customer service, higher crediting rate, to earn the business instead of offering the put option.

Assets: To the extent possible without sacrificing too much yield and credit quality, increase the liquidity of the assets: Set up the mechanism for entering into repo transactions if needed; set up lines of credit with reliable and creditable banks, entering credit default swaps on itself.

Perform ongoing liquidity stress testing and manage accordingly.

PQR has obtained lines of credit from several banks, with 80% of the total credit limit is from bank S. You have noticed that S has been issuing preferred stock as well as large amounts of subordinated debt during last two years. Below are the liquidity ratios of bank S for the last 4 quarters.

	1Q	2Q	3Q	4Q
Liquidity Ratio	116	111	106	101

- (c) Recommend whether PQR should continue with the current credit line.

Commentary on Question

Candidates performed above average on this section. Nearly all candidates commented not to continue or seek other sources for line of credit given the decreasing liquidity ratio of Bank S and the concentration risk for PQR.

8. Continued

Most banks target a liquidity ratio well above 100%. Over the last year, the liquidity ratios for bank S have been dramatically decreasing toward 100% potentially signaling the deterioration of the bank's liquidity. Newly issued preferred stocks and subordinated debt further strain the net cash flow hence pose more liquidity risk on Bank S.

With the bank's deteriorating liquidity position, the bank may not be in a position to provide the credit to PQR when PQR requests it.

80% of PQR line of credit is sourced from S. PQR should seek additional LOCs or other means to provide liquidity.

9. Learning Objectives:

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

Learning Outcomes:

- (5a) Describe the regulatory and rating agency contexts in which various institutions operate and how those contexts affect portfolio strategy
- (5b) Explain how investment policies and strategies can manage risk and create value
- (5c) Identify a fiduciary's obligations and explain how they apply in managing portfolios
- (5d) Determine how a client's objectives, needs and constraints affect investment strategy and portfolio construction. Considerations and constraints include:
- Capital and expected return on allocated capital
 - Risk appetite and risk-return trade-off
 - Tax
 - Accounting
 - Regulators
 - Rating agencies
 - Liquidity
- (5e) Incorporate financial and non-financial risk into an investment policy, including currency, credit, spread, liquidity, interest rate, equity, insurance product, operational, technology, legal, political, reputational, and environmental, social, and governance (ESG) risks

Sources:

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

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

Commentary on Question:

This question tests the fundamentals of an investment policy statement. Candidates are asked to analyze and recommend an investment policy subject to constraints

9. Continued

Solution:

- (a) List eight typical elements of an investment policy statement.

Commentary on Question:

Candidates performed above average on this part. Many candidates received full credit by providing the typical elements of the investment policy.

- A brief client description
- The purpose of establish policies and guidelines
- The duties and investment responsibilities of parties involved, particularly those relating to fiduciary duties, communication, operational efficiency, and accountability. Parties involved include the client, any investment committee, the investment manager, and the bank custodian.
- The statement of investment goals, objectives, and constraints.
- The schedule for review of investment performance as well as the IPS itself.
- Performance measures and benchmarks to be used in performance evaluation.
- Any considerations to be taken into account in developing the strategic asset allocation.
- Investment strategies and investment style(s).
- Guidelines for rebalancing the portfolio based on feedback.

- (b) Describe the return objectives and liquidity requirements of the ABC pension plan

Commentary on Question:

Candidates performed as expected on this part. Most candidates were able to identify that two distinct groups of employees have different liquidity needs and should be addressed separately.

Return objective:

Since the pension fund was earning 6.5% historically and is just funded at 100%, the return objective is to maintain at least 6.5% to avoid the pension fund from being under funded.

Liquidity requirements:

For the older workforce, the liquidity requirement is short term. Therefore, the assets to support this part of pension liability should be relatively liquid.

For younger workforce, the liquidity requirement is long term. Therefore, the assets to support this part of pension liability can be relatively illiquid in order to pursue excess return

9. Continued

The risk tolerance for the liquid portion of the pension fund is low since the liability will be due soon and the pension fund is just 100% funded with no surplus. The risk tolerance for illiquid portion of the pension fund is relatively high due to long duration.

- (c) Evaluate whether the proposal fulfills four standard investment constraints.

Commentary on Question:

Candidates performed below average on this part. Many candidates did not provide the investment constraints and relate how BitCoin was suitable under them. Those candidates that did analyze BitCoin's suitability under each constraint received full credit.

Liquidity: Liquidity requirement consist of both liquid and illiquid assets. BitCoin is actively traded and relatively liquid. The investment strategy fulfills the liquidity constraint.

Time horizon: The time horizon for the pension fund is long term. Since BitCoin has only came about in recent years and has no long-term history, it is unclear whether investing in BitCoin can fulfill the time horizon requirement.

Tax concerns: Investment income is tax-exempt for pension funds.

Regulatory factors: No information to decide. However, given the volatility of the BitCoin, it might not be suitable for pension funds.

Unique circumstances: Since BitCoin is not traded using the local currency, investing in BitCoin does introduce currency risk.

10. 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:

Overall, the candidates performed as expected for this question. Most candidates were able to get at least partial marks for parts (a) and (b).

Solution:

- (a) Describe a key shortcoming of the binomial and Poisson independent-default setting models, and how the mixture models address this shortcoming.

Commentary on Question:

The candidates performed above average in this section. Most of the candidates were able to mention the interaction of counterparties. Only a few candidates explained that assuming default independence across the portfolio may not be appropriate, and were able to obtain full marks.

The assumption of default independence is not, from a risk perspective, particularly conservative. Assuming default independence is actually a strong assumption on the potential for diversification in one's credit portfolio.

For sufficiently large portfolios, all idiosyncratic risk can be diversified away. In the limit, therefore, the risk of independent-default models can be made arbitrarily small by spreading out the specific risk of each obligor among many other equally small positions.

The most important advantage for the mixture model is they capture the inherent interaction between the default outcomes of multiple counterparties.

- (b) Calculate the following:
- (i) Expected number of defaults for the portfolio
 - (ii) Covariance of the default indicators for any two issuers

10. Continued

Commentary on Question:

The candidates performed above average in this section. Partial marks were given for providing the correct formula.

$$E[I_{Dn}] = p = \exp(\mu + \sigma^2/2) = e^{\ln(1/20)} e^{\ln(9)/2} = (1/20) \times \sqrt{9} = 0.15$$
$$E[D_n] = Np = 100 \times 0.15 = 15$$

$$\text{Cov}(I_{Dn}, I_{Dm}) = \text{Var}(p(Z)) = (\exp(\sigma^2) - 1) \times \exp(2\mu + \sigma^2) = (e^{\ln(9)} - 1) \times e^{2\ln(1/20)} e^{\ln(9)} = (9 - 1) \times (1/400) \times 9 = 0.18$$

- (c) Explain one advantage of mixing the Poisson model with another distribution, such as the Gamma distribution.

Commentary on Question:

The candidates performed below average in this section. Most of the candidates failed to mention how the mixing can improve the properties of the distribution, compare with the standard Poisson model.

One of the beneficial consequences of mixing the Poisson model with another distribution is that it breaks one of the standard features of the Poisson distribution: equal variance and expected value.

The base Poisson methodology fails to capture default dependence.

The loss volatility and the expected loss are both equal to a single default in the independent-default Poisson setting.

- (d)
- (i) Calculate the probability that there are exactly 2 defaults for the portfolio.
 - (ii) Calculate the default correlation ρ_D for any two issuers using the quick and dirty calibration method described in the Bolder reading (assuming $p(S) = S$).

Commentary on Question:

The candidates performed as expected in this section. Some candidates interpreted the parameters as pertaining to the portfolio; therefore, they divided b by 100 for section i. In those cases, equivalent credit was still given. Partial marks were given for providing the correct formula.

$$q_1 = b/(b+1) = 4/5 = 0.8$$
$$p(D_n = k) = (\Gamma(a+2)/(\Gamma(k+1) \times \Gamma(a))) \times q_1^a \times (1-q_1)^k = (\Gamma(2+2)/(\Gamma(2+1) \times \Gamma(2))) \times 0.8^2 \times (1-0.8)^2 = 0.0768$$

$$\rho_D = \text{var}(S)/(E(S)(1-E(S))) = (a/b^2)/((a/b) \times (1-a/b)) = 1/(b-a) = 1/(4-2) = 0.5$$

11. 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

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:

- (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

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

Sources:

Alternative Investments, CAIA Level II, chapters 22 and 24

Commentary on Question:

This question tests candidates' understanding of allocation of commodity investments in a portfolio.

Overall, candidates performed below average on this question.

Solution:

- (a) Explain two reasons why commodities serve as an inflation hedge during a rapidly expanding economy.

11. Continued

Commentary on Question:

The candidates performed below average on this part. Many candidates received partial credit for pointing out that demand increases. Most candidates did not identify exposure increase as the second reason.

- Rapid economic expansion tends to be accompanied by elevated inflation rate
- During expansion, demand for commodities which are direct inputs into industrial production increases, which in turn puts upward pressure on price
- During expansion, investors increase exposure to assets thought to have inflation hedging properties including commodities, further driving up demand and thus price

(b) Describe how each of the following characteristics can weaken the well-documented inflation hedging property of commodities:

- (i) High volatility of energy commodities
- (ii) High storability of industrial metals
- (iii) High price sensitivity of agricultural commodities to factors other than inflation

Commentary on Question:

The candidates performed below average on this part. Many candidates receive partial credit for providing some of the characteristics for either industrial metals or agricultural commodities. Most candidates did not correctly provide characteristics for energy commodities.

- i) Energy commodities are often not included in central banks' calculation of the core inflation rate due to their high volatility. [1 pt] Small movements in such commodity prices do not directly affect core inflation. Larger moves are however often correlated with inflation.
- ii) Price of highly storable commodities responds to demand only after the inventory runs out, while less storable commodities would respond quicker. [1 pt] Highly storable commodities therefore do not provide as strong a hedge against unexpected inflation.
- iii) Unlike other commodities such as energy, price of many agricultural commodities is affected more by interest rates than inflation. [1 pt] They may provide a better business cycle hedge than an inflation hedge, and during recessions rather than expansions.

11. Continued

Demand and supply of agricultural commodities are so dependent on non-economic factors such as weather patterns or crop sizes, to the point where correlation to inflation may not be strong enough.

- (c) Explain why each of the following alternative investment vehicles may not be suitable for your portfolio.
- (i) Direct physical ownership
 - (ii) Public commodity-based equity
 - (iii) Bonds issued by commodity firms

Commentary on Question:

The candidates performed as expected on this part. Many candidates received partial credit for identifying the main reasons that these alternatives are not suitable for hedging inflation risk. Many candidates failed to mention the high correlation of those alternatives to existing portfolio.

i) - Need to commit 100% capital unlike futures-based investments
- Spot return have not kept up with inflation over long periods
- Storage and associated transportation and logistics are costly for many commodities

ii) - Commodity firms often hedge their commodity exposure actively, so exposure is not pure
- High stock market exposure, so high correlation to equity assets you already own

iii) - Sensitivity to commodity returns is low for investment grade issuers
- Need high-yield bonds but then you are exposed to default and spread risk from business factors unrelated to commodity returns (operational etc.)
- High exposure to fixed income market / interest rates, so high correlation to fixed income assets you already own

- (d) Your colleague tells you to avoid agricultural commodities. His analysis shows that the returns over the last five years are comparable to those of government bonds but with significantly higher volatility. He quotes Hotelling theory to back up his statement, concluding that agricultural commodity investments will always result in negative Sharpe ratios over the long term.

Critique your colleague's argument.

11. Continued

Commentary on Question:

The candidates performed poorly on this part. Many candidates received partial credit for defining hoteling theory and for pointing out that five years is a short time horizon over which to evaluate an investment decision. Many candidates failed to explain that hoteling theory is not applied to agricultural commodities.

- Hoteling theory only applies to exhaustible commodities. Agricultural commodities are not exhaustible.
- Commodities go through supercycles, and 5 years is a short time horizon to make an (whether short or long term) investment decision about commodity investments.
- Hoteling theory does not predict Sharpe ratio to be always negative. It can be negative once factors such as rising cost of extraction are taken into account, but your colleague's statement is not correct.
- According to Hoteling theory, investors should be indifferent between keeping the commodity and selling to invest the proceeds at the prevailing interest rate. Investors are generally risk averse however, and requires compensation for volatility. Your colleague's data is then inconsistent with the argument that these investors should be indifferent between these two options.

- (e) Describe how collateral return and roll yield could contribute to enhanced returns compared to direct investments.

Commentary on Question:

The candidates performed as expected on this part. Many candidates received partial credit for mentioning that collateral return and roll yield are sources of excess yield. Candidates only received full credit for providing a full description of how excess yield is generated.

Collateral is usually assumed to earn the Treasury bill rate in futures-based indices, with 100% collateralization. Fund managers however are often required to post less than 100% in collateral, and it can be in other liquid assets such as TIPS and money market securities. Effective collateral management can be a source of outperformance.

Unlike direct investment, futures-based investments involve rolling of futures contracts before expiry. The fund manager has the freedom to control the timing and other approaches to roll futures contracts, which may contribute to excess yield or cost reduction.

Effective futures trading program may also allow a fund manager to charge lower fees, creating competitive advantage.

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:

- (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
- (6d) Understand and apply the concept of risk factors in the context of asset allocation

Sources:

QFIP-141-19: Liability Driven Investment Explained

Commentary on Question:

This question tests the concept of LDI by considering various investment approaches and associated risks given a simple liability cash flow profile.

Solution:

- (a) Calculate the funding ratio.

Commentary on Question:

The candidates performed brilliantly on this section. Many candidates were able to obtain the full points. A few candidates did not consider inflation and interest rates in the PVL or discounted the zero-coupon bond using the wrong maturity period.

Funding ratio = Present value of assets (PVA) / Present value of liabilities (PVL)

With zero-coupon bond of \$120 in 30 years, $PVA = 120 / 1.05^{30} = 27.765$

With a lump sum pension payment currently worth \$100, that will be made in 34 years,

$PVL = 100 * (1.01/1.05)^{34} = 26.699$

Therefore, the funding ratio = $PVA / PVL = 104.0\%$

12. Continued

- (b) Identify key risk factors that can adversely affect the funding ratio.

Commentary on Question:

The candidates performed brilliantly on this section. Some candidates received full credit for identifying at least three key factors, inflation, interest / discount rate, and an additional factor such as bond credit spread. Majority received at least partial credit.

Key risk factors that can adversely affect the funding ratio include:

- The rate of inflation because pension payment is linked to inflation.
- Interest rate / discount rate. If the interest rate falls, the PV liability will increase more than the PV of assets, thus decreasing the funding ratio.
- Bond's credit spread because if the bond is downgraded then the value of the bond will be severely negatively affected.

- (c) Identify advantages of using swaps instead of bonds.

Commentary on Question:

The candidates performed as expected on this section. Almost all candidates received at least partial credit when they commented that swaps were more capital efficient than bonds. To obtain the full credit, the candidates needed to discuss either the availability of swaps to match the liability duration, or the limitation with respect to the availability of long-term bonds.

- Swaps are available for longer maturities and maturity can be more easily customized to meet the requirement to match the liabilities.

- Swaps are more capital efficient. Since swaps are priced to have no initial value, the only capital required will be collateral while bonds need to be purchased with capital.

- (d) Calculate the Liability Driven Investment (LDI) leverage, defined as the value of liabilities as a percentage of LDI assets value.

Commentary on Question:

The candidates performed as expected on this section. A few candidates received full credit for successfully completing the calculation of all components. Three main types of mistakes were made by the other candidates: recognizing the equity investment as the LDI asset values, ignoring the collateral cash value, and not identifying the swap component. Candidates received partial credit for showing intermediate steps of calculation.

12. Continued

The amount of collateral available is 30% of the bond value, which is 30% of \$27.765 = \$8.330.

The swap has zero value at initiation. This is used to hedge the liabilities valued at \$26.699.

The remaining amount of \$19.436 is invested in equity.

Therefore, the LDI leverage is $26.699 / (8.330 + 0) = 320.5\%$

- (e) Calculate the new funding ratio.

Commentary on Question:

The candidates performed below average on this section. A few candidates were able to correctly determine the funding ratio with the formula using all asset components and received the full credit. Many candidates incorrectly calculated the value of the swap using the wrong liability value. A few candidates calculated the funding ratio as $(\text{Equity value} + (\text{Liabilities} / \text{LDI leverage})) / \text{Liabilities}$ which was also appropriate. Candidates received partial credit for showing intermediate steps of calculation.

Funding ratio = (equity value + cash value + swap value) / PVL

$$\text{PVL} = 100 * (1.015/1.055)^{33} = 27.929$$

$$\text{Cash value} = 8.330$$

$$\text{Equity value} = 19.436 * (1-0.1) = 17.492$$

$$\text{LDI_leverage} = \text{PVL} / (\text{cash value} + \text{swap value}) = 575\%$$

$$\text{then swap value} = -3.472$$

$$\text{Funding ratio} = (17.492 + 8.330 + (-3.472)) / \text{PVL} = 80.0\%$$

An alternative method:

Funding Ratio = (equity value + (PVL / LDI_leverage)) / PVL

$$\text{PVL} = 100 * (1.015/1.055)^{33} = 27.929$$

$$\text{LDI_leverage} = 575\%$$

$$\text{Equity value} = 19.436 * (1-0.1) = 17.492$$

$$\text{Funding Ratio} = (17.492 + (27.929 / 575\%)) / 27.929 = 80\%$$

- (f) Evaluate the situation (increase in leverage / decrease in funding ratio) and potential courses of action for the fund manager.

12. Continued

Commentary on Question:

The candidates performed below average on this section. A minority of candidates who explained the significant deterioration of funding ratio also recognized the negative impact of inflation and equities investment as required. Almost all candidates missed mentioning the risk associated with the increase in leverage and its impact on the funding ratio. Very few candidates recognized the contribution of equity to future performance.

The funding ratio dropped significantly because the large exposure to equity with more than 78% of assets, the impact of inflation on liability and the important increase of leverage all these factors adversely affected the fund position.

The fund manager may consider capital injection from the pension sponsor or the equity position has to be partially liquidated at a loss. However, the reduction in equity exposure would sacrifice potential future performance.

13. 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
- (1b) Demonstrate an understanding of common techniques to enhance yield and manage liquidity in fixed income portfolios

Sources:

Handbook of Fixed Income Securities, Fabozzi, F.J., 8th Edition, 2012, Ch. 12 Corporate Bonds pp. 260-288

QFIP-135-19: High-Yield Bond Market Primer

QFIP-146-20: Private Debt in an Institutional Portfolio

Commentary on Question:

This question tests candidates' understanding of corporate bond cash flows, comparisons with other fixed income investments, and risks associated with corporate bond investments. Overall, the candidates performed below average on this question.

Solution:

- (a) Identify four advantages of private debt over high yield bonds.

Commentary on Question:

The candidates performed as expected on this section. The most common problem observed was a lack of familiarity with private debt. Candidates who did well were familiar with the characteristics of private debt and high yield bonds.

Private Debt offers several advantages over high yield:

- Can get a floating rate resulting in lower mark to market volatility
 - Typically more secure through covenants.
 - Realize an illiquidity premium
 - Benefit from further diversification
 - Targets higher returns
- (b) Compare and contrast the cash flows for a PIK note with an equity clawback and a bond with a bullet structure.

13. Continued

Commentary on Question:

The candidates performed below average on this section. Many candidates were unfamiliar with the cash flows of a PIK bond. Many did not understand how an equity clawback worked. Candidates who did well focused on when cash flow would be paid by each bond.

- The bullet structure bond is not callable so it pays semi-annual coupons until maturity at which point it pays a final coupon and the par value of the bond.
 - The PIK note – allows the issuer for a period of time to make semi-annual coupon payments or pay in kind with more bonds that have the same coupon rate and a par value equal to the coupon. During this PIK period it is possible that no cash is paid by the issuer or cash is paid irregularly or that the cash flow pattern matches the bullet structure bond. After this period ends the issuer can only make coupon payments so the cash flow patterns would be the same.
 - The equity clawback gives the issuer the right to refinance some of the bond issue with proceeds from an equity offering. The payment is usually a % of the outstanding bond issue at par value plus one year of coupon. So the cash flow during this time can include payment of a % of par value plus the clawback premium of one year of coupons.
- (c) Explain the event risk the team is concerned about due to this recent increase in merger and buyout activity with regards to the rating of ZZZ Life Insurance.

Commentary on Question:

The candidates performed below average on this section. Many candidates either did not understand event risk or else applied the concept incorrectly. Candidates who did very well were able to explain how the increased merger activity could lead to a potential downgrade for ZZZ life.

- One or more of the companies represented in the collateral could become a merger or buyout target. If that happens, the outstanding bonds of that company could decline in value (spreads could widen) due to the risk that the company will be restructured with higher debt than before the merger or buyout.
- The second risk is that the increased activity alone could cause buyers and traders to withdraw from the industrial bond market causing spreads to widen for all industrial bonds resulting in reduced market value for the current collateral.
- In either case, this increased activity could cause more collateral to be needed to cover the loan. The increase in collateral could result in a rating decrease as forewarned by the rating agency.

13. Continued

- (d) Explain two covenants that may appear in the indentures that would make you less concerned about the recent increase in merger and buyout activity.

Commentary on Question:

The candidates performed below average on this section. Most candidates were unfamiliar with the key bond covenants that could protect bondholders against the negative effects of a merger or buyout.

Poison put.

- The bondholder can force the company to buy back the debt.
- This can reduce the likelihood that the company becomes a target.
- If it does become a target it reduces the chance that it will be restructured as a below investment grade credit.

Maintenance of net worth clause.

- If the company is a target and is left with a lower net worth following the buyout or merger this clause may force the company to buy back some of the debt at par.
- This can be valuable if the market price has dropped below par.
- An offer to redeem also may be included instead and the offer is not mandatory. The bondholders may or may not elect to have the bonds redeemed, thus preserving the high coupon debt in low interest rates.

14. 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:

Handbook of Credit Risk Management, Bouteille, Sylvain & Coogan-Pushner, Diane, 2013

- Ch. 1: Fundamentals of Credit Risk
- Ch. 4: Measurement of Credit Risk
- Ch. 5: Dynamic Credit Exposure
- Ch. 9: Credit Portfolio Management

Commentary on Question:

This question objective is to test the candidate understanding in a practical situation and to uses his/her knowledge in a specific context.

Solution:

- (a) Describe the credit risk present in this agreement.

Commentary on Question:

The candidates performed below average on this section. Most candidates received credit for correctly recognizing the prepayment risk. Most candidates did not describe the other credit risks.

- Prepayment of goods and services
 - Payments are made 30 days before delivery
 - In case of non-delivery, BYR is short 1000\$
- Derivatives
 - BYR is paying fix 1000\$
 - SLR is delivering a fix quantity, but of varying value
- Long term supply agreement

14. Continued

- (b) Describe the four parameters of credit risk for each of the parties.

Commentary on Question:

The candidates performed below average on this section. Many candidates received partial credit for identifying the four parameters of credit risk. A common mistake was not recognizing the dynamic nature of the exposure which was a key element of this question.

Exposure

- Gross exposure
 - In this agreement, there is bilateral exposure – either party could have exposure to the other
 - from the perspective of SLR, the exposure is limited to the value of the future payments BYR is obligated to pay
 - from the perspective of BYR, the exposure is limited to the value of future alternative flour deliveries SLR is obligated to make
- Net exposure
 - There is no collateral pledge here
- Dynamic exposure
 - The market price of the flour may vary within the 3 years period
 - Thus it may be more than 1000\$ per month of exposure
 - The exposure is a function of the time remaining in the contract

Default probability

- SLR is a start up, we have no history. The risk is unknown and may be high.
- BYR seems more solid, but we know little about it too.

Recovery rate

- For BYR, they may at best get their next delivery of flour
- For SLR, given that they are paid in advance, they won't have to recover any \$
- BUT, both parties will lose, a stream of income for one and delivery of goods at a guaranteed price for the other.

Tenor

- 3 years

- (c) Describe the steps to calculate the supply agreement's mark-to-market value after two years.

14. Continued

Commentary on Question:

The candidates performed below average on this section. Candidates received partial credit for identifying the correct replacement vehicle and used the appropriate discount rate. Most candidates did not recognize that the replacement vehicle no longer included prepayment risk..

- There is 1 year left in the contract
 - Thus the correct replacement vehicle to pick is 1 year at \$1,500 per month
- The previous contract was at \$1,000 per month
 - So the replacing that deal will cost 500\$ more per month, but payable 30 days later.
- It is a market value, the correct rate to used is the market rate.
- = PV of 11 monthly payment of \$500\$ + 1 payment of \$1,500 in year – \$1,000 that would be payable immediately to SLR, all discounted at 3%.

(d)

- (i) Critique this proposal
- (ii) Propose a more appropriate measure for the credit risk.

Commentary on Question:

The candidates performed poorly on this section. Some candidates received partial credit for correctly identifying the limitation of marking-to-market in part (i). A common error for part (ii) was only providing a reformulation of marking-to-market.

- (i) Proposal is not appropriate because:
 - MTM is a snapshot of credit risk at the time it is computed
 - doesn't provide information about the range of exposure, and the range of loss, that one may encounter
 - price of commodities may be volatile
- (ii)
 - VAR: Value At Risk
 - Extracted from a probability weighted distribution
 - Add a probability dimension to the MTM concept
 - VaR is a percentile of the distribution of exposure at a future point in time,for the particular transaction
 - Provide information about what the MTM values might be in the more extreme and rare cases

15. 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, Jon - The xVA Challenge: Counterparty Risk, Funding, Collateral, Capital and Initial Margin, Gregory, Jon, 4thEdition, 2020: Chapter 12

Bolder, David - Credit Risk Modelling, Chapters 1 and 2

Commentary on Question:

This question tests the candidate's understanding of basic concepts of credit risk, and considerations when constructing credit risk models.

Solution:

- (a) State a formula defining the default loss random variable in terms of the exposure at default and recovery rate of each bond, giving definitions for each term in the formula.

Commentary on Question:

The candidates performed as expected on this section. To receive full credit, candidates needed to describe or give definition for each term in the formula.

$$L = \sum_{n=1}^N EAD_n \times (1 - RR_n) \times I_n$$

EAD_n is the exposure at default of the n-th bond. It is the maximum amount that could be lost at default.

RR_n is the recovery ratio of the n-th bond. It is the ratio of the amount recovered on default over the exposure at default.

I_n is the indicator variable of default for the n-th bond, equals 1 if the n-th bond defaults and 0 if the n-th bond does not default.

15. Continued

- (b) Calculate the variance of the default loss defined in part (a).

Commentary on Question:

The candidates performed above average on this section. Most of the candidates were able to show full calculation of the variance. The most common mistake candidates made was to not include the total number of bonds in the portfolio.

$\text{Var}(\# \text{ of defaults}) = \# \text{ of bonds} * \text{probability of default} * (1 - \text{probability of default})$

$\text{Var}(\# \text{ of defaults}) = 1000 * 0.02 * (1 - 0.02) = 19.6$

Since the risks are independent, EAD = \$1000, and RR = 0%

$\text{Var}(L) = \text{Var}[1000 * (1 - 0\%) * \# \text{ of defaults}]$

$\text{Var}(L) = 1000^2 * \text{Var}(\# \text{ of defaults}) = 19,600,000$

- (c) Calculate the approximate 95th percentile VaR of the default loss.

Commentary on Question:

The candidates performed above average on this section. Most candidates were able to show full calculation. The most common mistake candidates made was to not include the total number of bonds in the portfolio.

For large number of investments N and small probability of default p, the default loss distribution can be approximated using the normal distribution.

$E(\text{default loss}) = E(\# \text{ of defaults}) * \$1000 = N * p * \$1000$

$E(\text{default loss}) = 1000 * 0.02 * \$1000 = \$20,000$

$\text{Stdev}(\text{default loss}) = \text{Stdev}(\# \text{ of defaults}) * \$1000 = \sqrt{N * p * (1-p)} * \1000

$\text{Stdev}(\text{default loss}) = \sqrt{1000 * 0.02 * 0.98} * \$1000 = \$4427$

$\text{VaR}_{0.95}(\text{default loss}) = \text{mean} + z_{0.95} * \text{stdev} = \$20,000 + 1.64 * \$4427 = \$27,282$

- (d) You review the credit risk report of the portfolio and note the following statements:
- A. Credit risk management is solely concerned with managing the magnitude of the expected default loss.
 - B. Where possible, the real world probability of default is estimated by looking at market price data, which add additional conservatism.
 - C. We have chosen to use a structural model over a reduced-form model – its ability to model the reason for default leads to a superior fit.
 - D. Model parameters can be easily calculated analytically using the method of maximum likelihood.

Critique each of the statements above.

15. Continued

Commentary on Question:

The candidates performed as expected on this section. The majority of candidates were able to identify the statements as false and provide clear explanation for each statement. Candidates who performed poorly either confirmed the statements as correct or identified the statements as false without clear explanation.

A: This is incorrect. Risk management should also be concerned with the tail of the default loss distribution – the extreme events.

B: This is incorrect. Market prices are based on risk-neutral probabilities, which cannot be directly compared to real world probabilities.

C: This is incorrect. While structural models seek to model the reason for defaults, they are not inherently better.

D: This is incorrect. Calculating maximum likelihood estimates is mathematically complex and often require numerical methods.

16. 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
- (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 a variety of methods to manage a portfolio against liabilities, testing concepts relating to cashflow matching and duration matching. Successful candidates identified the relation between cashflows and funding status and recommended solutions, then proceeded calculating and comparing asset and liability durations.

Solution:

- (a) Calculate the unfunded liability position of your matching strategy at the end of each of years 1-3 for the liabilities and the supporting assets.

Commentary on Question:

Candidates performed above average on this section. Most candidates identified the magnitude of the coupon payments and compared it to the liability cash flows as required. Failing to recognize the maturity payment in year three was a common mistake.

The coupons from bonds 1, 2, and three are \$0.35, \$0.13, and \$0.01 million respectively from multiplying their par values and coupon rates, or \$0.49 million per annum. Since the liability is 1 each year there is a deficiency of \$0.51 million in years 1 and 2. There is a maturity payment of \$1 million in year 3, thus the fund is not underfunded in that year.

- (b) Calculate the minimum value of bonds to purchase to fully cashflow match the liabilities.

Commentary on Question:

Candidates performed as expected on this section. Many candidates recommended purchasing the thirty-year bond to fill the deficit and performed a calculation on the number of bonds needed. Recommending a bond with a lower coupon rate was a common mistake.

16. Continued

The company should purchase more of the thirty-year bond to fill the deficit because that has the highest coupon payment. $\$0.51 / 0.035 = 14.57$ bonds are needed.

- (c) Evaluate if cashflow matching is an appropriate method for these liabilities.

Commentary on Question:

Candidates performed below average on this section. Most candidates made the wrong recommendation that cash flow matching was inappropriate.

Cashflow matching works well in this case since the liabilities are known in advance. Available assets can be found to match the fixed stream of cashflows.

- (d) Calculate the amount of assets above that you will need to purchase to immunize this net asset/liability position.

Commentary on Question:

Candidates performed as expected on this section. Most candidates calculated the dollar duration of assets and liabilities correctly and recognized the difference. Occasionally, they miscalculated the amount to purchase.

The dollar duration of assets is $550 \times 8 \times 0.01 = 44$. Similarly, liability duration is $540 \times 12 \times 0.01 = 64.8$. This difference of 20.8 is hedged by purchasing $20.8 / 0.08 = \$260$ million of assets.

- (e) Calculate the number of full future contracts that would be needed to be bought or sold to successfully immunize the net position.

Commentary on Question:

Candidates performed above average on this section. Many candidates received full credit. Common mistakes included calculation errors in the final answer.

The formula is dollar duration to hedge / asset dollar duration x price of the bond to hedge x CTD factor. We know the dollar duration to hedge from part d: \$20.8 million. Substituting, the answer is $20.8 / (7 \times 0.01 \times 10) \times 1.2 = 35.66$, requiring 36 contracts.

- (f) Calculate the number of full future contracts that would need to be bought or sold to achieve this.

16. Continued

Commentary on Question:

Candidates performed as expected on this section. Most candidates recognized the correct formula and calculated an answer. Receiving full credit was not uncommon. Calculation errors were a common reason full credit was not achieved.

The formula needed is $(\text{Target} - \text{initial duration}) \times 550 / (\text{duration of hedge contract} \times \text{price of CTD bond}) \times \text{CTD factor}$. Substituting, the answer is $-2 \times 550 / (7 \times 10) \times 1.2 = -18.57$, 19 contract sales are required.

17. 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:

Handbook of Fixed Income Securities, Fabozzi, F.J., 8th Edition, 2012 Ch 24 p. 494-505

Commentary on Question:

This question tests the candidate's understanding of mortgage underwriting and prepayment risk

Solution:

- (a) Since the liability has a duration of 15 years, we can duration-match the liability by purchasing a Mortgage Backed Security (MBS) which uses 15 year fixed-term mortgages as the underlying asset. Since the mortgage rate is locked in at issue for fixed rate mortgages, as long as we can purchase MBS with the right interest rate, we can eliminate the interest rate risk.

Critique his comment.

Commentary on Question:

The candidates performed as expected on this section. Most candidates were able to identify prepayment risk but omitted the duration mismatch or failed to provide comment on interest rate risk.

The Statement is flawed. Unlike conventional Fixed-Maturity Bond, MBS has a unique risk associated with prepayment. The borrower of a mortgage has the ability to prepay their loan before it matures. The duration of MBS with a 15-year fixed-term mortgage is smaller than 15 years. This creates a duration mismatch. Prepayments occur for several reasons: sale of property, destruction of property, default on the part of borrower, curtailments (partial prepayments), and refinancing. While some prepayments are rate-insensitive, refinancing is highly sensitive to current interest rates. In addition, duration matching only protects against parallel yield curve movement. Therefore, fixed-rate MBS still has exposure to interest rate risk.

- (b) Describe the characteristics of Securities A and B to identify which is the Fixed-Maturity Bond and which is the MBS.

17. Continued

Commentary on Question:

The candidates performed above average on this section. Most candidates were able to identify the securities for A and B. Candidates who correctly identified the securities without proper reasons were not rewarded points.

Security B is MBS and Security A is Fixed-Maturity Bond. When the interest rate declines, the prices of bond and MBS rise. However, prepayments in MBS increase as interest rate declines, mortgages and MBS shorten in average life and duration, therefore performance of MBS price lag that of bond without prepayment exposure. Conversely, prepayments slow down when interest rate is rising, causing duration and average life of MBS to increase. This causes MBS price to decrease more than comparable Fixed-Maturity bond. This phenomenon is called “Negative Convexity”. This causes MBS to underperform those of assets that do not have prepayments exposure.

- (c) Explain three sources for the difference between the WAC and a pool’s coupon rate.

Commentary on Question:

The candidates performed poorly on this section. Some candidates did not answer the question. A number of candidates identified the risks or the tranches of MBS, instead of the sources for the difference between the pool’s WAC and the pool’s coupon rate.

- Base servicing – Loan’s note rate that is required to be held by the servicer of the loan. Entity collects payments from mortgagors, makes tax and insurance payments for the borrowers and remits payments to investors. The amount of base servicing fee differs based on the agency and program.
- Guarantee fees (g-fees) – Paid to agencies to insure the loan. Represents the credit risk insurance. There is variation across loan types. Riskier loans require higher g-fees for securitization.
- Excess servicing – Remaining amount of the note that reduces the interest rate to the desired coupon.

- (d)
- (i) Explain how this information could be used to determine the credit risk of MBS.
 - (ii) Identify which pool has a higher likelihood of default.

17. Continued

Commentary on Question:

The candidates performed brilliantly on this section. Some candidates did not answer the question. For part (i), most candidates were able to explain the factors and the relationship between the factors and the credit risk of MBS. For part (ii), most candidates were able to identify the correct MBS. Candidates who made the correct conclusion without explanations received partial credit.

(i) Credit score:

- A numerical grade of the credit history of borrower.
- The lower the score, the higher the likelihood of default.

Loan to Value Ratio (LTV):

- Indicator of borrower's leverage at the point when loan application is filed.
- A higher LTV may indicate a greater likelihood of default.

Income Ratio (Debt-to-Income Ratio):

- Compares potential monthly payment to borrower's monthly income.
- A higher DTI indicates a higher likelihood of default.

(ii) MBS B has a lower credit score, a higher LTV and a higher DTI, so it has a higher likelihood of default.