INV 101 Model Solutions
November 2025

1. Learning Objectives:

1. The candidate will understand the nature and the variety of asset classes that can be used in constructing a portfolio.

Learning Outcomes:

(1a) Demonstrate an understanding of cash flow characteristics, underlying risks and roles in investment portfolios of various fixed income investments, including:

- Government and corporate bonds
- Leveraged loans
- Commercial and residential mortgages
- Mortgage-backed securities
- Structured credit products
- Private debt

Sources:

Fabozzi-Handbook-9th Ed-Ch 7, 10, 21 – 23

Commentary on Question:

This question tests candidates' understanding of the nature and the variety of asset classes in the fixed income portfolio, along with an application in the portfolio construction to meet a given investment objective.

Solution:

(a) Contrast the risks associated with investing in category A, B, and C securities against U.S. Treasury bonds in the above table.

Commentary on Question:

Candidates performed as expected on this part. Many were able to correctly identify prepayment risk from Agency pass-throughs and default/credit risk of PQR bonds. However, few mentioned sovereign risk.

Agency pass-throughs have uncertain future cash flows due to prepayment.

PQR Coupon bond - default /credit spread risk, company-specific event risk

PQR zero – default / credit spread risk, company-specific event risk

Sovereign risk is associated with Treasury and agency primarily.

1. Continued

(b) Explain which of the four categories of securities in the table is most suitable to support the liability based on the investment guideline.

Commentary on Question:
Candidates performed below expectations. The key was the nature of the liability cash flows:(i) cash flows are non-interest sensitive; (ii) cash flows occur monthly; (iii) cash flow amount varies with time. Partial credit was awarded for those that correctly selected PQR zeros but many candidates provided insufficient support/explanation of the rationale.

PQR zeros are the most suitable assets because

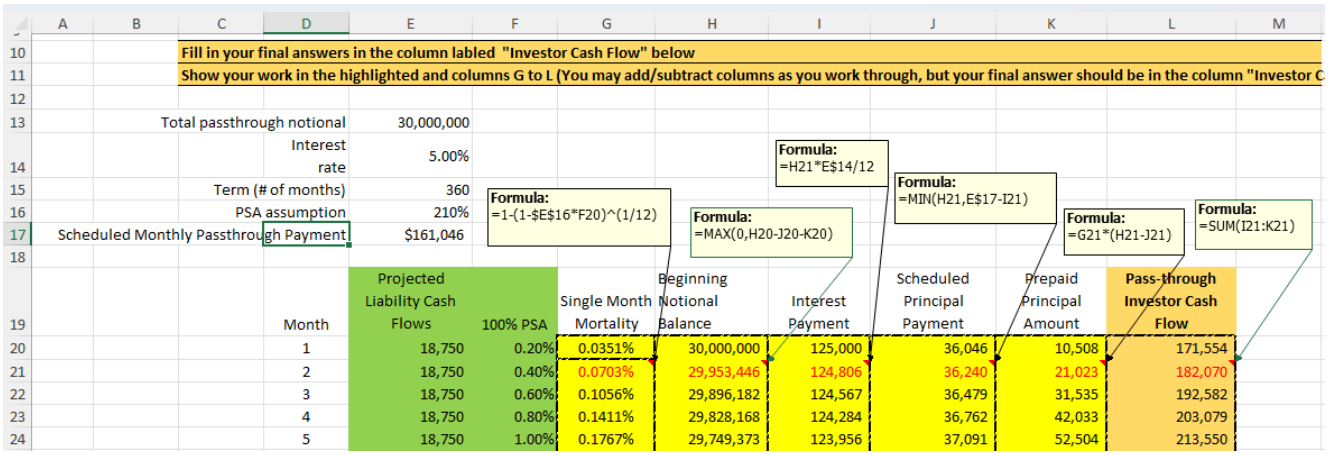
- Even though RMBS provides monthly asset cash flows, the pre-payment risk is likely to lead to those cash flows being unmatched with the fixed (non-interest-sensitive) liability cash flows in the first 36 months.
- Other bonds pay semiannual coupons only, with no monthly cash flow to match the liability needs.
- If Treasury or PQR coupon bonds are selected to back the liability, they must be supplemented with the zero-coupon bonds in order to pay for the liability's monthly cash flows in the months when coupon payments are not available. This kind of asset portfolio (coupon bonds + zeros) will cost more to establish upfront than using zero-coupon bonds alone.

(c) Calculate the projected total cash flows due to the investor in each month using 210% PSA for the agency RMBS pass-throughs.

Commentary on Question:
Candidates performed below expectations due to multiple formula errors in the Excel sheet they constructed. Some erroneously reflected the "projected liability cash flows" column in deriving the "investor cash flows". Partial credit was awarded to those who made less than four formula errors.

1. Continued

See Excel sheet.



Fill in your final answers in the column labled "Investor Cash Flow" below
Show your work in the highlighted and columns G to L (You may add/subtract columns as you work through, but your final answer should be in the column "Investor C

Total passthrough notional	30,000,000
Interest rate	5.00%
Term (# of months)	360
PSA assumption	210%
Scheduled Monthly Passthrough Payment	$161,046

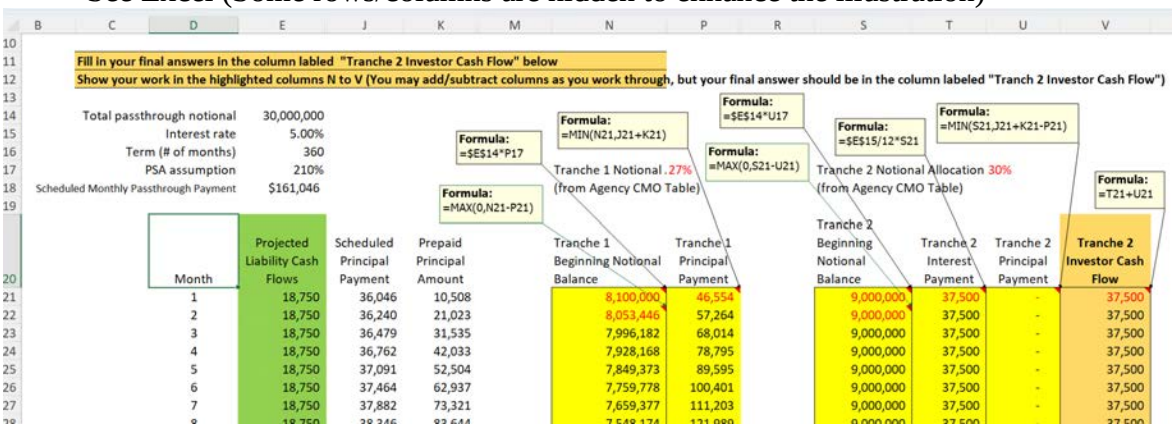
Formula: =1-(1-$E$16*F20)^(1/12)
Formula: =H21*E$14/12
Formula: =MAX(0,H20-J20-K20)
Formula: =MIN(H21,E$17-I21)
Formula: =G21*(H21-J21)
Formula: =SUM(I21:K21)

Month	Projected Liability Cash Flows	100% PSA	Single Month Mortality	Beginning Notional Balance	Interest Payment	Scheduled Principal Payment	Prepaid Principal Amount	Pass-through Investor Cash Flow
1	18,750	0.20%	0.0351%	30,000,000	125,000	36,046	10,508	171,554
2	18,750	0.40%	0.0703%	29,953,446	124,806	36,240	21,023	182,070
3	18,750	0.60%	0.1056%	29,896,182	124,567	36,479	31,535	192,582
4	18,750	0.80%	0.1411%	29,828,168	124,284	36,762	42,033	203,079
5	18,750	1.00%	0.1767%	29,749,373	123,956	37,091	52,504	213,550

(d) Calculate the projected cash flows of Tranche 2 due to the investor each month.

Commentary on Question:
Candidates performed poorly due to blank answers (i.e., skipping the question) or multiple formula errors in the Excel sheet they constructed. Many formula errors appeared indicative of a candidate's incorrect understanding of CMO tranche cash flows. Partial credit was awarded to those who made less than four formula errors

See Excel (Some rows/columns are hidden to enhance the illustration)



Fill in your final answers in the column labled "Tranche 2 Investor Cash Flow" below
Show your work in the highlighted columns N to V (You may add/subtract columns as you work through, but your final answer should be in the column labeled "Tranch 2 Investor Cash Flow")

Total passthrough notional	30,000,000
Interest rate	5.00%
Term (# of months)	360
PSA assumption	210%
Scheduled Monthly Passthrough Payment	$161,046

Formula: =$E$14*P17
Formula: =MAX(0,N21-P21)
Formula: =MIN(N21,J21+K21)
Tranche 1 Notional 27% (from Agency CMO Table)
Formula: =$E$14*U17
Formula: =MAX(0,S21-U21)
Formula: =$E$15/12*S21
Tranche 2 Notional Allocation 30% (from Agency CMO Table)
Formula: =MIN(S21,J21+K21-P21)
Formula: =T21+U21

Month	Projected Liability Cash Flows	Scheduled Principal Payment	Prepaid Principal Amount	Tranche 1 Beginning Notional Balance	Tranche 1 Principal Payment	Tranche 2 Beginning Notional Balance	Tranche 2 Interest Payment	Tranche 2 Principal Payment	Tranche 2 Investor Cash Flow
1	18,750	36,046	10,508	8,100,000	46,554	9,000,000	37,500	-	37,500
2	18,750	36,240	21,023	8,053,446	57,264	9,000,000	37,500	-	37,500
3	18,750	36,479	31,535	7,996,182	68,014	9,000,000	37,500	-	37,500
4	18,750	36,762	42,033	7,928,168	78,795	9,000,000	37,500	-	37,500
5	18,750	37,091	52,504	7,849,373	89,595	9,000,000	37,500	-	37,500
6	18,750	37,464	62,937	7,759,778	100,401	9,000,000	37,500	-	37,500
7	18,750	37,882	73,321	7,659,377	111,203	9,000,000	37,500	-	37,500

(e) Critique your assistant's proposal.

Commentary on Question:
Candidates performed below expectation. Though many disagreed with the proposal, few provided full and correct rationale. Partial credit was awarded for each correct rationale that candidates used in their critique.

1. Continued

Part (d) shows that, when Tranche 2's notional = $9 million, Tranche 2 cash flows = 2 x liability cash flows in each month. Therefore, when Tranche 2's notional = (1/2) * $9 million = $4.5 million, Tranche 2 cash flows = liability cash flows in each month.

The proposal is valid (i.e. meet the investment guidelines) only under the condition that future pre-payment follows 210% PSA and/or Tranche 2's pre-payment exposure is protected by other support bonds.

Since none of the above conditions is likely to be true in reality, Tranche 2's future cash flows are likely to be different from those illustrated in Part (d) when interest rate changes.

Because liability cash flows are non-interest sensitive, Tranche 2 asset does not meet the investment guideline.
Final Note: See the complete Excel sheet solution for Part (c) and (d) below

INV 101 1125 Rubric -1.xlsx

2. Learning Objectives:

1. The candidate will understand the nature and the variety of asset classes that can be used in constructing a portfolio.

Learning Outcomes:

(1b) Demonstrate an understanding of the distinguishing investment characteristics and potential contributions to investment portfolios of various types of equity and alternative investments, including:

- Public Equity
- Private Equity
- Real Estate
- Hedge Funds

Sources:

Commercial Real Estate Analysis and Investments, Miller & Geltner, 3rd Edition, 2014

Commentary on Question:

This question requires candidates to demonstrate understanding of real estate investment valuations and differences between private property markets and the publicly traded REITs.

Solution:

(a) Justify why Company ABC should purchase Property X.

Commentary on Question:

Candidates performed as expected for this section. Credit was given where candidates either described or calculated all valuation components (Investment Value IV, Market Value MV, Net Present Value NPV). There were several cases where candidates described in words but did not perform the actual calculations; in these cases, partial credit was given based on the quality and depth of commentary comparing the IV, MV and NPV.

MV Property X = $125mn (based on second most motivated buyer concept)
IV ABC = $200mn
NPV = 200 – 125 = $75mn
Since the NPV is positive ABC should purchase property X

(b) Calculate REIT Y's Net Asset Value and differential relative to its share price.

2. Continued

Commentary on Question:
Most candidates performed better than expected and had a good understanding of the requirements of this part. There were cases where candidates performed the calculations correctly on a per share basis (dividing NAV or the differential value by 10,000 outstanding shares) and full credit was given in these cases as well. A small number of candidates earned less than full credit due to minor calculation errors

REIT Y NAV = $1.5mn - $1.4mn = $100k
Differential Value = $100k – $15*10,000 = -$50k [or $50k]

(c) Describe three reasons why a differential valuation might exist between the REIT and private property market.

Commentary on Question:
Candidates performed better than expected for this section. The key for this question was to compare the REIT vs. the private property market and to provide reasons for a potential difference in valuation between the two. A good number of candidates provided relevant commentary on one structure (REIT or private property market) without comparison to the other and thus only received partial credit.

- The REIT NAV is based on static portfolio of properties, but REIT share prices can bake in future growth expectations, for example, in this case.
- REIT share prices can be more informationally efficient relative to the private property market
- Differences in future cash flow and OCC expectations

(d) Evaluate the CEO's statement.

Commentary on Question:
Candidates performed better than expected on this section. Most candidates recognized that the CEO's statement was incorrect but some did not explicitly state this in their answer; partial credit was given as long as the commentary implied disagreement with the CEO's statement. The key for this question is recognizing the likely mean reversion for NAV and share prices in the long-run. Partial credit was also given where candidates cited other possible investment behavioral biases (herding bias, overconfidence etc.).

The CEO is incorrect. Because Company ABC is a long-term investor and differences between REIT NAVS and share prices are generally mean reverting over the long run, it is inappropriate to rely on a momentum investing strategy.

2. Continued

(e) Evaluate the CEO's statement.

Commentary on Question:
Candidates performed better than average for this section. Most candidates obtained at least partial credit for either recognizing that the marginal/property level OCC should be used in assessing a new acquisition or for recognizing that the REIT level OCC reflects the risk of its current assets. There were a number of candidates who provided well-rounded answers covering all key supporting justifications to receive full credit.

The CEO is incorrect. The OCC values given reflect the risk of both REITS' current assets. However, for new properties both REITs are likely to face the same future cashflows, thus will have similar investment values on new properties. You cannot look at the REIT level OCC to assess a given REITS' ability to purchase new properties but must examine the property level OCC instead. "The risk resides in the asset not investor".

(f) Recommend in which of the above REITs company ABC should invest.

Commentary on Question:
Candidates performed as expected on this section, with most candidates having a good understanding of the requirements of this part. A number of candidates provided additional commentary tying the risk profile of Company ABC as a long-term, risk averse investor to support their choice of REIT Z which has a lower OCC (lower risk profile).

Company ABC should invest in REIT Z based on the OCC numbers provided. REIT Y has a higher OCC, indicating it invests in potentially riskier properties / new construction.

3. Learning Objectives:

2. The candidate will understand portfolio construction, management, and assessment.

Learning Outcomes:

(2a) Describe the portfolio management process and recommend investment governance structure.

(2b) Develop an investment policy statement (IPS) for an institutional investor.

(2c) Demonstrate an understanding of portfolio construction approaches and techniques for asset allocation, passive/active management and rebalancing.

(2d) Recommend and justify an optimal portfolio allocation in a risk-return framework.

Sources:

Portfolio Management in Practice Vol 1, CFA, ch 5, p.166-168

Portfolio Management in Practice Vol 1, CFA, ch 6, p.213-214, 220-221

Portfolio Management in Practice Vol 1, CFA, ch 7, p.355-357

INV101-103-25: Elements of an Investment Policy Statement for Institutional Investors, p.11-12

Commentary on Question:

This question tested the concept of asset allocation.

Solution:

(a) Explain how the concept of an economic balance sheet differs from a traditional balance sheet, including providing one item that only appears on an economic balance sheet.

Commentary on Question:

The candidates performed as expected on this question. While many candidates were able to describe in some way that the economic balance sheet reflects future expected cashflows, very few were able to mention its inclusion of extended assets and liabilities. On the other hand, most candidates provided valid examples of items only appearing on an economic balance sheet as required.

Traditional Balance Sheet: Lists tangible assets (stocks, bonds, real estate) and recorded liabilities (debt, pension obligations). It does not capture future income streams or non-traditional assets.

3. Continued

Economic Balance Sheet: includes conventional financial assets and liabilities as well as extended assets and liabilities that can be relevant in making asset allocation decisions for an investor's financial portfolio.

Examples of an item that only appears on Economic balance sheet (any item from the list below would suffice for this question):

- Human capital (expected future earnings).
- Present value of pension income
- Present value of expected heritance
- PV of future consumption
- Pension liabilities and social security entitlements (for institutions).
- Present value of intellectual property
- Contingent claims such as insurance payouts or legal liabilities

(b) Calculate the economic net worth for your client

Commentary on Question:
Candidates performed above average for this question. Many candidates demonstrated a good understanding of the concept of economic net worth in their solutions. Common mistakes included misclassifications of items as economic asset and liability, especially for the pension value and the mortgage loan.

Economic Assets	Present Value ($)	Economic Liabilities	Present Value ($)
Stock Portfolio	500,000	Mortgage Loan	2,000,000
Home Value	3,000,000	College Trust Obligation	600,000
Pension Value	1,200,000	Future Consumption	1,500,000
Expected Inheritance	700,000	**Total Economic Liabilities (EL)**	**4,100,000**
Total Economic Assets (EA)	**5,400,000**	**Economic Net Worth (ENW)**	**1,300,000**

(c) Recommend the most appropriate asset allocation using mean-variance optimization.

Commentary on Question:
Candidates performed well in this question. Most candidates were able to provide correct calculations and recommended the appropriate portfolio accordingly. Mistakes made by the candidates include miscalculations or a general misinterpretation of the question.

3. Continued

$U_m = E(R_m) - 0.5\lambda\sigma^2_m$ where $\lambda = 3$

$U_A = 0.12 - 0.5*3*0.25^2 = 2.625\%$
$U_B = 0.8 - 0.5*3*0.20^2 = 2\%$
$U_C = 0.5 - 0.5*3*0.12^2 = 2.84\%$

Portfolio C is most appropriate because it has the highest utility.

(d) Describe two key constraints that would impact your client's asset allocation.

Commentary on Question:
Candidates performed as expected for this question. A majority of the candidates were able to provide valid constraints such as time horizon, liquidity need and tax consideration. However, only a few were able to provide sufficient and accurate description under the context of this question.

Any two of the three key constraints below:

Time horizon for performance evaluation: Your client's portfolio performance should not be judged solely based on just short-term returns. Instead, evaluation points should be aligned with key life milestones: paying the mortgage (stable cash flow), funding the education trust (3 years), receiving the inheritance (10 years), and ensuring retirement income sustainability (long-term horizon).

Liquidity Needs: Your client requires at least $600,000 in three years for the education trust and $1,500,000 in expected lifetime consumption, necessitating a balance between liquid and illiquid investments

Tax Considerations: Your client's investments are in taxable accounts and he is receiving a taxable inheritance in ten years, which means he needs to consider the impact of capital gains taxes and potentially use tax-efficient investment vehicles such as tax-deferred accounts for high-turnover or tax-inefficient assets

4. Learning Objectives:

2. The candidate will understand portfolio construction, management, and assessment.

Learning Outcomes:

(2e) Demonstrate an understanding of common techniques to enhance yield and manage liquidity in fixed income portfolios.

(2f) Construct and manage portfolios of fixed income investments under various strategies, including indexing and target return.

(2g) Construct and manage portfolios of equity under various passive strategies.

Sources:

Portfolio Management in Practice Vol 1, CFA, Ch 9: Overview of Fixed-Income Portfolio Management, p.469-471, 478-479

Portfolio Management in Practice Vol 1, CFA, Ch 10: Liability-Driven and Index-Based Strategies, p.550-551

Portfolio Management in Practice Vol 1, CFA, Ch 12: Passive Equity Investing, p.612

Commentary on Question:

This question tested the concepts of equity and fixed-income portfolio construction and manipulation.

Solution:

(a) Identify two similarities and two differences between the instruments.

Commentary on Question:

Candidates performed below expectations on this question. While many candidates were able to identify the interest rate sensitivities of both instruments, they often struggled to identify other relevant similarities and differences beyond what had already been provided in the question.

Both instruments are similar in that they have leverage embedded in them and would lose value when interest rates rise. However, the IRS is more capital efficient (i.e., doesn't require a large upfront cost) and has higher liquidity compared to inverse floaters.

(b) Explain how both instruments can be used to enhance the yield on the FI portfolio.

4. Continued

Commentary on Question:
Candidates performed as expected on this question. Many candidates were able to relate the additional interest rate sensitivity from the instruments to potential higher yields on the fixed-income portfolio. A few candidates were able to explain how the instruments could also be used to ride the yield curve and further enhance yields on the fixed-income portfolio.

Both instruments can appreciate in value when interest rates decrease, which can be used to supplement the lower yield earned on the FI portfolio (from reinvestment). Both instruments can also ride the yield curve to generate cashflows to supplement the yields on the fixed-income portfolio.

(c) Explain how a passive bond ETF can accomplish this.

Commentary on Question:
Candidates performed as expected on this question. Most candidates were able to explain how the bond ETF's liquidity can be used to support the PRT business. Many candidates alluded to how the bond ETF can be used to reduce the impact of cash drag, however, only a few candidates were able to explain how the bond ETF could be used to facilitate rebalance the fixed-income portfolio.

A bond ETF can be used to better manage the FI portfolio by addressing the Re-balancing, Liquidity, and Cash Drag issues of the current FI portfolio. Namely, with the bond ETF's liquidity and if the ETF is selected s.t it's indexed to the same benchmark as the FI portfolio, then, proceeds from the PRT deal can be quickly invested into the ETF to reduce cash drag and moved out of the ETF once the PM has found good securities for allocation.

(d) Justify appropriate risk factors used in the factor-based strategy.

Commentary on Question:
Candidates performed poorly on this question. While most candidates showed that they understood what an equity factor portfolio is and the factors that are considered, only a few candidates were able to identify and explain the relevant factors in the context of the question.

Due to the relatively high allocation to equities, the factor portfolio is constructed using factors that are focused on meeting the liability's liquidity and low market risk requirements and the business's need for higher returns (even in the face of low interest rates). Value, yield, quality, and volatility are the key factors chosen for the factor portfolio.

4. Continued

The value factor ensures that the portfolio would mainly consist of stocks of mature companies with stable net incomes that can consistently support high dividend yields.

The yield factor ensures that the portfolio would mainly consist of stocks with relatively high dividend yields, thus ensuring that even in a low-interest-rate environment, the portfolio can continue to generate high dividends to supplement the low-interest rate income.

The high-quality factor ensures that the portfolio would mainly consist of stocks that are high-quality (e.g., stocks with consistent earnings and dividend growth and low debt-to-equity ratios), and this ensures that there's minimum volatility in the overall portfolio throughout the various stages of the business cycle.

The low volatility factor ensures that the portfolio would mainly consist of stocks with relatively low volatility, and this is important because in a downturn, they can be sold with minor market losses to meet the liquid claims obligations.

5. Learning Objectives:

2. The candidate will understand portfolio construction, management, and assessment.

Learning Outcomes:

(2g) Construct and manage portfolios of equity under various passive strategies.

(2h) Construct and manage portfolios of equity under various active strategies.

Sources:

Portfolio Management in Practice Vol 1, CFA, Ch 12: Passive Equity Investing, p.630, 632

Portfolio Management in Practice Vol 1, CFA, Ch 13: Active Equity Investing: Strategies, p.678-690

Commentary on Question:

This question tested the concepts of passive and active equity portfolio management strategies.

Solution:

(a) Calculate the EQ portfolio's 5-year annualized tracking error.

Commentary on Question:

Candidates performed very well on this section. This indicates that most candidates had a clear and consistent understanding of the material.

See Excel

(b) Describe three factors that may be driving the tracking error.

Commentary on Question:

Performance on this section was average. Most candidates correctly identified fees (or MER) as the main cause of tracking error, though many failed to identify withdrawals and deposits as a key factor.

The following are the main factors driving the EQ portfolio's tracking error:

- MER – fees are a drag on a portfolio's excess returns; however, there aren't any fees associated with the benchmark index's performance, therefore, there would be a discrepancy in the net returns of the EQ portfolio and the benchmark index. This difference is a major source of tracking error for the EQ portfolio (especially if the MER is quite high).

5. Continued

- Withdrawals – whenever a policyholder lapses or borrows against their policy, YUP's asset manager must liquidate a portion of the portfolio to meet those redemptions. It's rarely the case that the asset manager can liquidate the perfect proportion of securities such that it wouldn't result in deviations in portfolio weights from the benchmark index, hence, these withdrawals would contribute to the EQ portfolio's tracking error.
- Deposits – whenever a policyholder pays their premium, it may not be enough for the asset manager to draw on that deposit and invest it in portfolio assets. As a result, there's cash drag associated with managing the EQ portfolio whereas this doesn't exist for the benchmark index, which exacerbates the portfolio's tracking error.

(c) Explain how activist funds could manipulate a target firm's balance sheet to unlock value for their investors.

Commentary on Question:
Performance on this section was the lowest of the entire question. Many candidates incorrectly discussed "improving efficiency," which is not a balance sheet strategy.

The two most common balance sheet strategies used by activist funds are breaking up conglomerate and restructuring the firm's balance sheet.

- Breaking up a large conglomerate – the individual lines of businesses (in a major conglomerate) could be more valuable as individual pieces than as a group because the heads of the individual lines would have more freedom to pursue value creation than to be hindered by bureaucracy in a conglomerate. By breaking apart the conglomerate, the activist fund can unlock this hidden value in the firm's balance sheet.
- Restructuring the firm's balance sheet to better utilize capital – larger firms tend to operate in a variety of businesses; however, they may not be the best at all those lines of business. This strategy aims to get management to focus on developing the core segments of the business (i.e., the most profitable segments) and selling off the less profitable/useful segments. As a result, the firm would be more efficient in utilizing its capital and can pursue more profitable growth.

(d) Evaluate whether it's appropriate for YUP to allocate a portion of the EQ portfolio to an in-house activist strategy fund.

5. Continued

Commentary on Question:
The results for this section were mixed, with performance splitting into two distinct groups. A large number of candidates struggled, either failing to answer or reaching the wrong conclusion, while another group performed reasonably well. Essentially, candidates either understood the core concept or missed it entirely.

No, YUP shouldn't allocate any of their EQ portfolio to an in-house activist strategy fund due to the following reasons:

- YUP isn't managing enough money to be able to run a well-diversified in-house activist strategy fund. Namely, activist strategies often require the investor to take up to 10% of the target company if they want to have sway with the board. However, even for small cap public companies, a 10% stake can be $25M, which would be half of YUP's EQ portfolio.
- YUP is a relatively young firm and lacks in-house expertise to be able to run an activist strategy well. So, they would need to hire an external portfolio manager specializing in activist strategies, however, given the low allocation that YUP can assign to this manager, it's unlikely that YUP would be able to find a good candidate for the role.

6. Learning Objectives:

2. The candidate will understand portfolio construction, management, and assessment.

Learning Outcomes:

(2i) Apply performance measurement methodologies to various asset portfolios.

(2k) Assess and interpret performance attribution metrics for a given asset or portfolio.

Sources:

Portfolio Management in Practice Vol 1, CFA, Ch 19, p.1133–1135, 1168–1170.

Commentary on Question:

This question tests candidates' understanding of the components of performance attribution versus performance of a benchmark portfolio, and common methods to evaluate portfolio returns in light of risk inherent in the portfolio.

Solution:

(a)

(i) Describe the issue that occurs in the Brinson-Hood-Beebower Model when the benchmark return outperforms the benchmark.

(ii) Describe the improvement made by the Brinson-Fachler model that addresses this issue.

Commentary on Question:

Candidates performed modestly below expectations on this question. Most candidates were able to identify the issue with the Brinson-Hood-Beebower Model and describe the formulas in the Brinson-Fachler model that addressed the issue.

In the Brinson-Hood-Beebower model, the issue is with how the allocation effect for a given sector is calculated. Symbolically, the formula is (wi – Wi) * Bi, where wi is the fund weight for sector i, Wi is the benchmark weight for sector i, and Bi is the overall benchmark return.

If the portfolio weighting for a section is higher than that in the portfolio, and the benchmark return for the sector is negative, then the allocation effect will be negative. However, if the portfolio is overweight in a sector that performed better than the overall benchmark return, then the allocation effect should be positive.

Alternatively:

If the portfolio weighting for a sector is higher than that in the portfolio, and the benchmark return for the sector is positive, then the allocation effect will be positive even if the benchmark return for the sector is positive but less than the overall benchmark return.

6. Continued

Solution for (a)(ii):
The Brinson-Fachler model solves the problem when returns are negative by incorporating the difference between the sector return within the benchmark and the overall benchmark return. This results in a positive allocation effect for a given sector whenever the portfolio is overweighted in that sector and whenever the benchmark return for the sector exceeds the overall benchmark return. Alternatively, a positive allocation effect is also achieved when the portfolio is underweighted in that sector and the benchmark return for the sector underperforms the overall benchmark return.

(b) Calculate X, W, Z, Y and R.

Commentary on Question:
Candidates performed modestly below expectations on this part, with few candidates answering this question correctly. Most candidates received partial credit and there were relatively few candidates obtained the correct value for X.

Note that a cell in the Excel workbook which could be used for the calculations showed the value -0.35% even though the Excel workbook and the Word document showed the value was 0.35. So, candidates who correctly answered this part and all subsequent parts based on either 0.35% or -0.35% were given credit based on the value chosen. No candidate was penalized for using -0.35%.

Under the Brinson-Fachler model:
$S_i = W_i(R_i - B_i)$
$I_i = (w_i - W_i)(R_i - B_i)$
$A_i = (w_i - W_i)(B_i - B)$
Where:
S_i is the seletion effect for sector i
I_i is the interaction effect for sector i
A_i is the allocation effect for sector i
w_i is the weight for sector i in the portfolio
W_i is the weight for sector i in the benchmark portfolio
R_i is the return for sector i within the portfolio
B_i is the return for sector i within the benchmark portfolio
B is the overall return for the benchmark portfolio

Based on the values given and where the allocation effect for fixed income is 0.35%:
$-0.002 = 0.4 * (0.06 - W)$
$-0.001 = (Z - 0.4) * (0.06 - W)$
$0.035 = (0.25 - 0.5) * (X - 0.5X - 0.4W - (0.08)(0.10))$
Solving these equations, we get:
W = 0.065
Z = 0.6
X = 0.04

6. Continued

Since 0.25 + 0.6 + Y = 1, Y = 0.15
Since $(0.25)(0.03) + (0.6)(0.06) + (0.15)(R) = 0.057, R = 0.9$

Based on the values given and where the allocation effect for fixed income is -0.35%: W, Z, Y, and R are the same as when the allocation effect for fixed income in 0.35%.
For X,
$-0.035 = (0.25 - 0.5) * (X - 0.5X - 0.4W - (0.08)(0.10))$
and X = 0.096

(c) Calculate manager A's performance attribution.

Commentary on Question:
Candidates performed as expected on this question. There were a small number of candidates who left this question blank and most of these candidates had also left part (b) blank or calculated only a few of the values that were required.

	Selection	Allocation	Interaction	Total
Fixed Income	-0.005 (2)	0.0035 (Given)	0.0025 (4)	0.0010 (5)
Equity	-0.002 (Given)	0.0022 (3)	-0.001 (Given)	-0.0008 (5)
REIT	0.001 (2)	0.0013 (3)	0.005 (4)	0.0028 (5)
Total	0.006 (2)	0.007 (3)	0.0020 (4)	0.0030 (1)

(1) Calculate the excess return:
The Fund return is 0.057
The Benchmark return is (0.5)(0.04) + (0.4)(0.065) + (0.1)(0.08) = 0.054
Therefore, the excess return is 0.057 – 0.054 = 0.003
(2) Calculate the selection effect:
Fixed income (0.5)(0.03 – 0.04) = -0.005
REIT (0.1)(0.09-0.08) = 0.001
Total -0.005 – 0.002 + 0.001 = 0.006
(3) Calculate the allocation effect:
Equity (0.6 - 0.4)(0.065 – 0.054) = 0.0022
REIT (0.15 - 0.1)(0.08-0.054) = 0.0013
Total 0.0035 + 0.0022 + 0.0013 = 0.0070
(4) Calculate the interaction effect:
Fixed Income (0.25 – 0.5)(0.03 – 0.04) = 0.0025
REIT (0.15 - 0.1)(0.09-0.08) = 0.0005
Total 0.0025 - 0.0010 + 0.0005 = 0.0020
(5) The total for each row is the sum of the values in the row.

6. Continued

Alternative Solution for (c): Based on the allocation effect of -0.35%

	Selection	Allocation	Interaction	Total
Fixed Income	-0.033 (2)	-0.0035 (Given)	0.0165 (4)	-0.02 (5)
Equity	-0.002 (Given)	-0.0034 (3)	-0.001 (Given)	-0.0064 (5)
REIT	0.001 (2)	-0.0001 (3)	0.0005 (4)	0.0014 (5)
Total	-0.034 (2)	-0.007 (3)	0.016 (4)	-0.025 (1)

(1) Calculate the excess return:
The Fund return is 0.082
The Benchmark return is (0.5)(0.096) + (0.4)(0.065) + (0.1)(0.08) = 0.082
Therefore, the excess return is 0.057 – 0.082 = -0.025
(2) Calculate the selection effect:
Fixed income (0.5)(0.03 – 0.096) = -0.033
REIT (0.1)(0.09-0.08) = 0.001
Total -0.033 – 0.002 + 0.001 = -0.034
(3) Calculate the allocation effect:
Equity (0.6 - 0.4)(0.065 – 0.082) = -0.0034
REIT (0.15 - 0.1)(0.08-0.082) = -0.0001
Total -0.0035 -0.0034 - 0.0001 = -0.007
(4) Calculate the interaction effect:
Fixed Income (0.25 – 0.5)(0.03 – 0.096) = 0.0165
REIT (0.15 - 0.1)(0.09-0.08) = 0.0005
Total 0.0165 - 0.0010 + 0.0005 = 0.0016
(5) The total for each row is the sum of the values in the row.

(d) *(1.5 points)* Analyze manager A's performance based on his performance attribution results obtained in (c). (ANSWER IN EXCEL)

Commentary on Question:
Candidates performed worse than expected on this section, with many leaving the answer blank. Those candidates that answered it addressed the key attributes of the analysis, which were an evaluation of the performance as measured by the selection effect and the allocation effect.

Candidates who calculated the performance attribution results using the above mentioned -0.35% as the allocation effect and did the analysis based on it were not penalized as long as their analysis is consistent with the ouput.

6. Continued

- Manager A outperforms the benchmark overall by 0.3%.
- The selection effect produces a return of -0.6%, indicating Manager A has exhibited poor security selection.
    - Particularly, the selection return of -0.5% in Fixed Income drags down the overall selection return.
    - This is because Manager A picked a fixed-income security underperforming its benchmark.
- The allocation effect produces a return of 0.7%, indicating Manager A is very good at allocating asset categories.
    - As positive allocation returns are produced for Fixed Income, Equity and REIT, Manager A overweighted asset categories that outperformed the overall benchmark return and underweighted those categories that underperformed the overall benchmark return.
- The interaction effect is the effect resulting from the interaction of allocation and selection decisions combined and is positive overall.

Alternative solution based on the performance attribution using the -0.35% allocation effect in part (b) and (c).

- Overall speaking, manager A's portfolio underperformed comparing to the benchmark by 2.5%.
- The selection effect produces a return of -3.4%, indicating Manager A has exhibited poor security selection in both Fixed Income and Equity asset classes.
- The allocation effect produces a return of -0.7%, indicating Manager A is not very good at allocating asset categories either.
- The interaction effect is the effect resulting from the interaction of allocation and selection decisions combined and is positive overall.

(e) *(1.5 points)* Recommend a manager based on Sharpe ratio, Treynor ratio and Sortino ratio. (ANSWER IN EXCEL)

Commentary on Question:
Candidates performed as expected for this section. Several candidates did not calculate the values correctly because they did not remember the appropriate denominator for one or more of the ratios that had to be calculated.

Sharpe Ratio = $\frac{Fund\ Return - Risk\ Free\ Rate}{Standard\ Deviation}$

Treynor Ratio = $\frac{Fund\ Return - Risk\ Free\ Rate}{Systematic\ Risk}$

Sortino Ratio = $\frac{Fund\ Return - Target\ Rate\ of\ Return}{Semi{-}Standard\ Deviation}$

6. Continued

For Manager A:

Sharpe Ratio = $\frac{0.057 - 0.015}{0.1} = 0.42$

Treynor Ratio = $\frac{0.057 - 0.015}{1.06} = 0.0396$

Sortino Ratio = $\frac{0.057 - 0.04}{0.025} = 0.68$

For Manager B:

Sharpe Ratio = $\frac{0.057 - 0.015}{0.1193} = 0.46$

Treynor Ratio = $\frac{0.057 - 0.015}{1.37} = 0.040$

Sortino Ratio = $\frac{0.057 - 0.0025}{0.0067} = 1.01$

Each of these measures shows returns per unit of risk, and so the higher the ratio, the more favorable the manager. Because all three ratios are higher for Manager B, Manager B is recommended.

7. Learning Objectives:

3. The candidate will understand the best practices of credit risk management.

Learning Outcomes:

(3b) Demonstrate an understanding of and the ability to apply both the concepts and techniques used in the measurement of default risk of individual securities.

Sources:

The Handbook of Credit Risk Management, Bouteille & Coogan-Pushner, 2nd Edition, 2022, Ch. 4

Commentary on Question:

This question tests candidates' understanding of measuring and monitoring credit risk.

Solution:

(a) Define Gross Exposure, Net Exposure, and Adjusted Exposure.

Commentary on Question:

Candidates performed above average on this question. Many candidates were able to clearly define all three exposure terms. Some candidates did not highlight that the expected usage rate for the adjusted exposure was during a default situation and received partial credit.

Gross Exposure (GE) is the absolute amount at risk, or the worst-case scenario. It represents the amount of money due by the counterparty, therefore the money at risk in case of bankruptcy.

Net Exposure (NE) is defined as GE minus the amount of collateral pledged. A cash or cash equivalent collateral will reduce the credit loss by the collateral's liquid fair value.

Adjusted Exposure is the NE multiplied by the expected usage given default (UGD). UGD captures the expected rate of utilization of a facility in case of bankruptcy.

(b) List the two-step process of determining default probabilities.

Commentary on Question:

Candidates performed as expected on this question. A common error was not stating the need to analyze the financial strength of the company to assign the rating. Some candidates missed using the historic default frequency of entities with the same rating to determine the current default probability.

Since default probabilities are not readily observable, they are typically determined by a two-step process:

1. Analyze its financial strength and assign a rating to it that represents its perceived financial strength
2. Using historical data, observe the default frequency of entities with similar ratings. The observed relative freq. is the estimate of the PD.

7. Continued

(c) Describe three reasons for the nationally recognized statistical ratings organizations (NRSROs) being regulated by the Securities and Exchange Commission (SEC).

Commentary on Question:
Candidates performed below average on this question, with many candidates accurately described at least one reason and received partial credit. Credit was awarded for responses that demonstrated the correct reasons. Many candidates described the 2008 financial crisis exposing inaccurate ratings. Many candidates highlighted that rating agencies were being paid by the companies receiving the rating. Some candidates noted that the SEC introduced a more transparent process.

- Protect users of credit ratings and the public interest
- Promotes rating accuracy
- Ensure that ratings are not unduly influenced by conflicts of interest

(d) Describe the S&P global ratings corporate criteria framework.

Commentary on Question:
Candidates performed poorly on this question. A common error was describing the rating scale, from investment to speculative grade. A few candidates were given partial credit for highlighting some of the correct criteria.

S&P global rating corporate criteria framework anchors on the following two risk profiles:

1. Business risk profile which includes country risk, industry risk, and competitive position
2. Financial risk profile which includes assessment of cash flow and leverage level

The risk anchors are modified by company specific analysis on the following risk factor to arrive at standalone credit profile:

1. Diversification/portfolio effect
2. Capital structure
3. Financial policy
4. Liquidity
5. Management/governance

At last, the standalone credit profile is comparable ratings analysis to arrive at the credit rating for the issuer.

8. Learning Objectives:

3. The candidate will understand the best practices of credit risk management.

Learning Outcomes:

(3c) Understand, evaluate, and apply credit risk modeling techniques.

Sources:

Credit Risk Modeling, Bolder, David, 2018 Chapter 2. (part a, b)

Credit Risk Modeling, Bolder, David, 2018 Chapter 3. (part c)

Credit Risk Modeling, Bolder, David, 2018 Chapter 4. (part d, e)

Commentary on Question:

This question assesses understanding of portfolio-level default risk, including how alternative credit-risk models—binomial, mixture-binomial, and threshold-factor structures—capture dependence, tail behavior, and conditional default dynamics.

Solution:

(a) Calculate $E[D_N]$ and $Var[D_N]$ using the binomial independent-default model.

Commentary on Question:
Candidates performed brilliantly on this question. A few candidates failed to identify correct mean or variance formula.

$$E[D_N] = Np = (1{,}000)(0.01) = 10$$

$$Var[D_N] = Np(1-p) = (1{,}000)(0.01)(1-0.01) = 9.9$$

(b) Identify two additional shortcomings of the model in Part (a) besides the assumption of default independence

Commentary on Question:
Candidates performed as expected on this question. The majority of the candidates were able to correctly identify one additional shortcoming.

The limiting distribution of the binomial distribution converges to the Gaussian law.
The tails of the normal distribution are, in general, relatively thin.
The binomial model has an overly smooth asymptotic behavior.
For sufficiently large N, model behavior is completely described by a single parameter.

8. Continued

(c) Calculate $Var[D_N]$ using the mixture-binomial model.

Commentary on Question:
Candidates performed above average on this question. Most candidates identified correctly the formula of $Var[D_N]$.

$E[Z] = \frac{\alpha}{\alpha+\beta} = \frac{0.2}{20} = 0.01$ (formula 3.21)

$Var[Z] = \frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)} = \frac{3.96}{8400} = 0.000471$ (formula 3.22)

$$E\left[I_{D_n}\right] = E[p(Z)] = E[Z] = \bar{p} = 0.01$$

$E[D_N] = NE[p(Z)]$ = (1,000)(0.01)=10 (formula 3.10)

$Var[D_N] = N\bar{p}(1-\bar{p}) + N(N-1)Var[Z] = (1{,}000)(0.01)(1-0.01) + (1{,}000)(1{,}000-1)(0.000471) = 480.429$ (formula 3.11)

(d) Calculate the "Z-score" that would be required in determining the conditional probability of y_n when G = −2.33. (You do not have to calculate the probability.)

Commentary on Question:
Candidates performed above average on this question. The majority of candidates correctly identified the formula of the conditional default probability. Some candidates failed to calculate correctly the conditional mean and variance of y_n.

$$c = \Phi^{-1}(0.01) = -2.326$$
$$E[y_n|G] = \sqrt{0.2}\,G = \sqrt{0.2}(-2.33) = -1.042$$
$$1 - p = 0.8$$

Conditional default probability: (formula 4.18)

$$\Phi\left(\frac{c - E[y_n|G]}{\sqrt{1-p}}\right) = \Phi\left(\frac{-2.326-(-1.042)}{\sqrt{0.8}}\right) \approx \Phi(-1.435), \qquad Zscore = -1.435$$

Note: The conditional default probability is $\Phi(-1.435) = 0.0756$.

(e) Critique your manager's claim.

Commentary on Question:
Candidates performed as expected on this question. Many candidates failed to recognize that the Gaussian threshold model also has heavy tail, and what makes the t-distribution preferable is its ability to model tail dependence.

8. Continued

Your manager is wrong.
The loss distribution in the one-factor Gaussian threshold model is, for positive values of the parameter ρ, both highly skewed and leptokurtotic.
A rather more compelling reason for moving away from the Gaussian distribution relates to the notion of tail dependence. The tail-dependence coefficient tends to zero for the Gaussian distribution.
For the t-distribution, tail dependence does not disappear as we move arbitrarily far into the tails of the joint distribution.