****BEGINNING OF EXAMINATION****
INVESTMENT
MORNING SESSION

Questions 1-4 pertain to the Case Study

1. *(6 points)*

(a) Assess the consistency of the definition of a derivative in LifeCo's operational guidelines with the definition under US GAAP.

(b) Describe how LifeCo's Derivative Policy addresses operational and legal risks.

(c) Recommend additional controls to better address these risks.

Questions 1-4 pertain to the Case Study

2. *(5 points)* A new actuarial student at LifeCo is very excited about the "profit" your portfolio is generating with MBS. He views "profit" on an MBS bond as the difference between OAS and the liability required interest spread over Treasuries.

(a) Explain why "profit" may not equal the difference between OAS and the required interest spread with a Jump Z-bond.

(b) Explain why "profit" may not equal the difference between OAS and the required interest spread for more general securities.

The student recommends that LifeCo could be more profitable and better duration-matched by replacing the current MBS within the Traditional Life portfolio with Z-bonds. Z-bonds, the student argues, have a higher OAS, higher duration, and lower convexity than the current MBS.

(c) Evaluate this recommendation.

Questions 1-4 pertain to the Case Study

3. *(13 points)* LifeCo's management is concerned by the losses arising from the dynamic hedging of the options embedded in its variable annuities. An external report highlighted that the target delta is currently based on a lognormal distribution with the volatility equal to the sample standard deviation of the fund investment return over the past 12 months.

(a) Describe the options embedded in the variable annuity product.

(b) Describe and compare the following models used to estimate the volatility from past data
   (i) sample standard deviation
   (ii) exponentially weighted moving average model
   (iii) generalized auto-regressive conditional heteroscedasticity

(c) Recommend ways to improve the dynamic hedging program.

(d) Describe strategies that can be used to minimize the model risk.

LifeCo is considering whether to continue its current dynamic hedging program or pursue another risk management strategy.

(e) Review alternative strategies for managing the embedded option exposure.

(f) Recommend which of these strategies would be most appropriate if the dynamic hedging strategy is discontinued. Justify your recommendation.

Questions 1-4 pertain to the Case Study

4. *(10 points)* You have recently been promoted to Chief ALM Officer at LifeCo. The CEO has called a meeting with you and the pricing actuary to discuss the launch of a new universal life product.

(a) *(2 points)* The CEO, an accountant by training, emphasizes the importance of statutory and GAAP measures to determine the economic value of the insurer. Critique this standpoint.

(b) *(4 points)* Explain how to coordinate LifeCo's investment and product management strategies for future retentions for this new product to protect LifeCo's shareholder value from interest rate risk.

(c) *(1 point)* The pricing actuary expects to increase future credited rates as interest rates rise. Explain how LifeCo's investment strategy should be adjusted to protect shareholder value from interest rate risk.

(d) *(1 point)* LifeCo's key competitors keep credited rates unchanged regardless of changes in interest rates. Assess how their approach could affect your strategy in part (c).

(e) *(2 points)* Propose a method for LifeCo to implement the changes in parts (c) and (d) that would minimize transaction costs.

5. *(7 points)* The table below has the 10 largest capital requirements at issue from 100 scenarios for a variable annuity with a GMDB of a return of premium. Requirements are given for the real world and risk-neutral approaches. A negative value indicates a surplus.

Approach										
Real World	-0.35%	-0.30%	-0.25%	-0.10%	-0.10%	-0.10%	-0.10%	0.40%	1.10%	2.70%
Risk-Neutral	-0.30%	-0.28%	-0.26%	-0.24%	-0.21%	-0.17%	-0.10%	0.00%	0.20%	0.40%

Based on this data, the CEO suggests allocating capital based on the real world approach at a quantile of 91% but if the market performs poorly to switch to the risk-neutral approach with a CTE at 95%.

(a) Define the quantile risk measure.

(b) Calculate the 91% and 95% quantile measures for each approach.

(c) Define the CTE risk measure.

(d) Calculate the 91% and 95% CTE measures for each approach.

(e) Calculate the standard error for a 64% confidence interval for the 95% quantile risk measure under the actuarial approach.

(f) Appraise the CEO's suggested mix strategy

6. *(4 points)* You have been given the following assumptions for one of AnnuityCo's fixed-income asset portfolios:

Obligor (A)	Loss Given Default (LGD_A)	Expected Loss Over the Next Year (EL_A)
1	165,000	660
2	235,000	940
3	700,000	1,050
4	900,000	1,800
Total	2,000,000	-

Unit of exposure for banding L = 100,000

One-year risk-free rate r = 3%

(a) Using the Actuarial Approach (CreditRisk+) to measuring credit risk, calculate the probability that the loss occurring over the next year is 300,000 or less.

(b) A colleague has suggested that the CreditRisk+ approach avoids the limitations of the CreditMetrics and KMV approaches. Evaluate this comment.

7. *(4 points)* You are on assignment with the portfolio management team that has been investing in equities primarily in the USA. The team is interested in implementing an expanded international equity strategy.

Identify the issues you should consider prior to investing in countries or markets with which you are not familiar.

8. *(6 points)* You are given the following securities for a 1-year period:

Security	Price	Payoff in "Up" State	Payoff in "Down" State
A	1	1.5	0.7
B	15/11	2	1
C	?	1.8	0.85

Calculate the price of Security C.

9. *(5 points)* CMP Life's marketing group is introducing a new product that allows the policyholder to allocate premiums between an accumulation fund and a payout annuity.

Premium inflow	$20 million per month
Accumulation fund	35% investment grade convertible bonds
	65% investment grade corporate bonds
Payout annuity	20 year certain, level payments

(a) List the assumptions you would need from the pricing actuaries to help you construct investment guidelines for the investment managers.

(b) Describe the information you will provide to the investment managers on an on-going basis.

(c) Explain whether a benchmark of the universe of all convertible securities (including both investment and non-investment grade) would be appropriate for the accumulation portion of the portfolio.

(d) Describe the considerations you would have to make when instructing the asset managers if CMP Life stops selling this product after 10 years and there are no additional premiums.

****END OF EXAMINATION****
MORNING SESSION

****BEGINNING OF EXAMINATION****
INVESTMENT
AFTERNOON SESSION
Beginning With Question 10

10. *(7 points)* You are the Chief Risk Officer for a US life insurance company which owns a portfolio of corporate bonds. The ALM committee has proposed a reduction in the credit exposure of their portfolio through the use of derivatives. You have been asked to analyze 4 potential solutions:

(i) Asset Swaps
(ii) Single Name Default Swaps
(iii) Basket Default Swaps
(iv) Portfolio Default Swaps

(a) *(5 points)* Describe each derivative and the advantages and disadvantages of each.

(b) *(2 points)* Assuming you decide to recommend a default swap, outline the accounting considerations.

11. *(6 points)* Over the past several days, ABC Corporation's stock has been trading around $25.50.

You are given the following financial information for ABC Corporation.

Net Income	250,000
Goodwill Amortization	40,000
Interest Expense	45,000
Capital Expenditures	30,000
Tax Rate	35%
Company Beta	1.2
Risk-Free Rate	6.0%
Market Risk Premium	5.0%
Market Value of Debt	2,000,000
Pre-Tax Cost of Debt	10.0%
Estimated Perpetual Growth Rate of Cashflows	4.0%
Number of Shares Outstanding	100,000

ABC's capital structure is 20% debt and 80% equity.

Use the economic model approach to calculate ABC's market value per share and determine whether or not the share price is currently over- or under-valued.

12. *(4 points)* You are given the projected liability cash flows of a company and decide to use the direct method to calculate its fair value. The discount rate used in your initial calculation was determined as the risk-free rate plus the credit spread corresponding to the company's rating.

(a) Analyze the arguments for and against adding the firm's credit spread to the risk-free rate in calculating fair value of liabilities.

(b) Explain how the indirect method of estimating insurance liabilities can be linked to the Modigliani and Miller proposition and put-call parity.

13. *(4 points)* Your company enters into a one year forward contract to sell 100 U.S. dollars for 130 Euro in New York.

You are given the following:

- contract is initially at-the-money
- one year dollar risk-free rate of interest is 5% per annum
- one year dollar rate of interest at which the counterparty can borrow is 5.5% per annum
- exchange rate volatility is 12% per annum
- defaults are recognized only at the end of the life of the contract
- recovery rate is zero when default occurs

(a) Calculate the percentage loss from defaults during the life of the contract.

(b) Calculate the value of an at-the-money call option to buy 130 Euro in one year.

(c) Estimate the present value of the cost of defaults on the forward contract.

14. *(6 points)*

(a) Explain the difference between the net present value approach and the risk-neutral valuation approach for valuing a capital investment project.

(b) List the advantages of the risk-neutral valuation approach for valuing real options.

(c) Describe the impact on the expected return and volatility in moving from real world to risk-neutral world.

(d) Distinguish between the real world and the risk-neutral approaches of valuing a derivative.

(e) Describe the conditions under which both approaches in (d) give the same value of a derivative.

15. *(4 points)* A one-step binomial tree is used to model the impact of an important announcement on the stock price of Company XYZ. There is a 50% chance that the announcement will be positive for the company. The Company does not pay dividends.

Current stock price =	\$20
Stock price after good news =	\$30
Stock price after bad news =	\$15
Time period =	3 months
Risk-free rate (continuous compounding) =	5 %

(a) Calculate the price of a 3-month call option on the Company stock with strike price equal to \$22.

(b) The call writer decides to dynamically delta-gamma hedge the option based on a standard lognormal model. Evaluate the effectiveness of this approach in this context.

16. *(8 points)* You are consulting to a P&C company regarding the fair value of their insurance liabilities. You are examining a single one-year policy with an uncertain claim payment payable at the end of the year. Your analysis determines the following:

- The expected claim payment is $2,000.
- The expected annual return of the asset portfolio backing the liability is 7%.
- The one-year risk-free rate is 5%.
- The company's tax rate is 35%.
- The ratio of equity to liabilities for similar products in the marketplace is 20%.
- The return on equity for similar products in the marketplace is 15%.

(a) Calculate the fair value of the liability at the beginning of the policy year using the cost-of-capital approach.

(b) Calculate the Market Value Margin that will produce the same fair value when discounting at the risk-free rate.

(c) Identify the assumptions underlying perfect markets that may not hold in the real world with respect to insurance risks.

(d) List two reasons why U.S. Treasury securities may not be appropriate as the risk-free rate for fair valuation.

17. *(7 points)* You have been asked to apply the Excess Spread approach to evaluate the static credited rate reset strategy and the dynamic reset strategy.

(a) Define Excess Spread and Required Spread on Assets (RSA).

(b) List the risks associated with an SPDA policy.

(c) List the steps when measuring interest rate risk with the Excess Spread approach.

(d) Calculate the Excess Spreads of the following two strategies:

- The static credited rate reset strategy:
  RSA=80 bp
  Spread on assets is 150 bp, credit risk is 5 bp, and expense is 15 bp.

- The dynamic reset strategy:
  RSA=70 bp
  Spread on assets is 160 bp, credit risk is 10 bp, and expense is 20 bp.

(e) Appraise the use of each of the two strategies for setting the SPDA credited rates.

18. *(4 points)* You are performing an actuarial valuation of a defined benefit pension plan. Your results are showing the plan to be under-funded, with a funding ratio of 70%. The plan sponsor wishes to find an asset portfolio using the surplus frontier approach that will correct the problem.

You are given the following:

- Liability beta = 0.8
- Risk-free rate = 4.0%
- Market portfolio excess return over risk-free rate = 8%
- Alpha = 0

(a) Explain the Minimum Surplus Variance Portfolio.

(b) Compute the minimum asset beta required to give a positive surplus return.

(c) Assess the appropriateness of this strategy.

19. *(7 points)* You work for a publicly traded company with a defined-benefit pension plan. Your CFO read recently that shifting pension assets from stocks to 100% bonds reduces risk, and creates a tax arbitrage, resulting in gains to shareholders. You are given the following:

Current pension assets =	$10,000,000
Current pension liabilities =	$10,000,000
Current pension asset allocation:	60% stocks, 40% bonds
Corporate tax rate =	35%
Personal tax rate on stocks =	18%
Personal tax rate on bonds =	28%
Estimated stock return =	11%
Estimated bond return =	7%

(a) Compare the Tepper arbitrage and the Black arbitrage.

(b) Compute the theoretical shareholder gain using both methods.

(c) Outline the challenges and arguments your CFO may face in moving to 100% bonds.

20. *(3 points)* As the CFO of your life insurance company, you have been asked to provide a single measure of risk associated with a portfolio of whole life insurance products.

The current value of the portfolio is $61,125,856. Most of the value of the portfolio can be explained by a set of monthly observable independent variables.

The 95% confidence level of VaR for the portfolio value over a two-year time horizon is $30,170,914.

Critique this approach as a measure of portfolio risk.

****END OF EXAMINATION****
AFTERNOON SESSION