SOCIETY OF ACTUARIES
Advanced Portfolio Management

Exam APMV

AFTERNOON SESSION

Date: Friday, April 30, 2010
Time: 1:30 p.m. – 4:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 11 questions numbered 13 through 23 for a total of 60 points. The points for each question are indicated at the beginning of the question. There are no questions that pertain to the Case Study in the afternoon session.

2. Failure to stop writing after time is called will result in the disqualification of your answers or further disciplinary action.

3. While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions on the exam booklet.

Written-Answer Instructions

1. Write your candidate number at the top of each sheet. Your name must not appear.

2. Write on only one side of a sheet. Start each question on a fresh sheet. On each sheet, write the number of the question that you are answering. Do not answer more than one question on a single sheet.

3. The answer should be confined to the question as set.

4. When you are asked to calculate, show all your work including any applicable formulas.

5. When you finish, insert all your written-answer sheets into the Essay Answer Envelope. Be sure to hand in all your answer sheets since they cannot be accepted later. Seal the envelope and write your candidate number in the space provided on the outside of the envelope. Check the appropriate box to indicate morning or afternoon session for Exam APMV.

6. Be sure your written-answer envelope is signed because if it is not, your examination will not be graded.

Tournez le cahier d'examen pour la version française.

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Exam APMV-Front Cover

****BEGINNING OF EXAMINATION****
AFTERNOON SESSION
Beginning with Question 13

13. (*4 points*) Zim-Zam is an actuarial software company with two main units. Both units are successful and profitable. Zim-Zam does not feel its stock price fully recognizes the value of both units. To unleash the true value of its units, Zim-Zam has recently completed an equity carve out of its Smart Applications unit. The new company created from the equity carve out is called Apps for Actuaries, Inc.

Five percent (5%) of Apps for Actuaries was sold to individual investors and one percent (1%) to institutional investors. A spin-off will take place in four months where each shareholder of Zim-Zam will receive 1.25 shares of Apps for Actuaries for each share of Zim-Zam they hold.

Apps for Actuaries is currently trading at $60/share and Zim-Zam is trading at $45/share.

(a) (*0.5 points*) Describe what is meant by the "stub value" of Zim-Zam.

(b) (*0.5 points*) Calculate the implied share price of the stub value of Zim-Zam.

(c) (*1 point*) Determine what arbitrage opportunities exist between Zim-Zam and Apps for Actuaries share prices.

(d) (*1 point*) Identify any behavioral factors that may have created this situation and identify what market understandings they might be inconsistent with.

(e) (*1 point*) Explain why any arbitrage opportunities might not be able to be realized.

14. (*5 points*) Annuities-R-Us Insurance Company has recently entered a new market providing immediate annuities with a nonforfeiture provision to individuals. Under the contract, the policyholder has a right to surrender the annuity and get a lump sum. The lump sum will be calculated as the present value of future annuity cash flows discounted at the Treasury curve + 3%. The pricing actuary indicated that this product should be invested in higher-quality assets with spreads to Treasuries of 1.5% on average.

An actuarial student proposed investing the assets into longer duration BB zero-coupon bonds yielding a spread to Treasuries of 3% on average. The student's rationale is a steeply sloped yield curve and the potential for maximizing profits.

(a) (*1 point*) Define Liquidity, Market and Liquidation Risks.

(b) (*2 points*) Critique the actuarial student's suggested investment strategy.

(c) (*1 point*) Recommend the best of the following bond investment strategies for this product and justify your recommendation.

(i) Bullet

(ii) Barbell

(iii) Laddered Maturity

(d) (*1 point*) List strategic and operational considerations of liquidity risk management for Annuities-R-Us.

15. (*5 points*) You are given the following one-period, two-state, model.

	Asset A (Equity)	Asset B (Risk Free)	Probability
Market Price	100	100	
Feast State Payout	120	105	0.5
Famine State Payout	95	105	0.5

(a) (*2 points*)

(i) Calculate the market price of the state price securities.

(ii) Calculate the risk neutral probabilities for the two states.

(b) (*1.5 points*) Describe the intuition behind the formula relating state deflators and state marginal utility when an individual is invested optimally.

You are advising the participants of a pension plan with the following investment options with assets from (a).

Option 1	All assets in Asset A
Option 2	All assets in Asset B
Option 3	50% in A, and 50% in B

The plan has a current value of 95. One time period from now, the participants will be paid the smaller of 110 or the total value of the plan. This will be the only plan payment.

(c) (*1.5 points*) Recommend the best investment option for the plan participants, assuming the following plan participant utility function, where x is the value of the payout at the end of the period, $u(x) = x^{\frac{1}{2}}$.

16. (*5 points*) ABC Life company is pricing an SPDA product. The crediting rate is reset each year based on the average A-rated corporate bond yield less the target spread subject to minimum crediting rates.

Assume the rates below:

Rates	Current	One year forward
Treasury (1 year maturity)	3.5%	4.5% (based on forward)
A-rated Corporate (Composite)	5%	5.5% (based on forward)
Target Credited Spread	2%	2%
Current Crediting Rate	3%	TBD (3.5% based on forward)
Minimum Crediting Rate	2%	2%

Traditional Accounting Balance Sheet – ABC Life, End of Period (EOP) Year 1			
Corporate Bond	1,000	SPDA Liability	1,000
Net working capital	5	Shareholder equity	5

Risk-Capital Balance Sheet – ABC Life, End of Period (EOP) Year 1			
Corporate Bond	1,000	SPDA Liability	1,000
Asset Insurance	10		
Interest Rate Floor	5	Shareholder equity	15

Hedging Cost:
Asset Insurance for default and corporate spread changes = 10
Interest Rate Floor @ 4% on Corporate Bond = 5

(a) (*1 point*) List the components of Standard & Poor's Financial Product Company (FPC) model and associate them with the risk embedded in this product.

(b) (*1 point*) Calculate ROE ignoring risk capital, assuming the forward interest rates are realized as actual rates in year 2 and 35 bps of EOP 1 SPDA liability as expenses.

(c) (*1 point*) Calculate ROE reflecting risk capital, assuming the forward interest rates are realized as actual rates in year 2.

(d) (*1 point*) Identify inaccuracies from ignoring risk capital when calculating ROE.

(e) (*1 point*) Discuss how hedging can affect the amount of risk capital and ROE reflecting risk capital.

17. (*7 points*) You are an investment manager for Wat-A-Life Insurance Company. The company currently holds $10 million worth of Whizbang stock at a current value of $100; it is obligated to hold this stock for a period of 5 years. Whizbang stock has a beta of 1.1 relative to the S&P 500 index. The S&P 500 index futures contract has a contract size of 250 times the index, and a beta of 1 relative to the index. The current market value of the S&P 500 index is 1000. You observe the following market option prices for Whizbang:

(Each option covers 100 shares of the underlying stock)

Option Type	Term (years)	Strike	Price of Option
Call	5	125	29
Put	5	125	25
Call	5	130	26
Put	5	130	28
Call	5	145	24
Put	5	145	36
Call	5	150	23
Put	5	150	38

Consider the following independent goals:

(i) at the end of 5 years, the change in the hedged portfolio value will be 20% of the change in the S&P 500 index.

(ii) at the end of 5 years, the hedged portfolio value, net of the hedging cost, will be no less than $10 million.

(iii) at the end of 5 years, the hedged portfolio value, net of the hedging cost, lies between $12.5 million and $14.5 million.

(a) (*1 point*) Identify the type of derivative(s) that should be used for each goal.

(b) (*3 points*) Determine the position(s) that should be taken to achieve each goal

(c) (*2 points*) Calculate the initial outlay of each hedging strategy.

An analyst from CrystalBall Bank has advised you that Whizbang stock will likely fall more than 10% in the next five years.

(d) (*1 point*) Select which of the above strategies you would implement if you believe the analyst's outlook to be correct.

18. (*6 points*) Worst's Rating Agency is using the Contingent Claim Approach to measure the credit risk of H & M Company. H & M has a single debt obligation, which is held by BigBucks Bank.

H & M Company – capital structure

Risky assets $= V_0 = 130$	Debt* $= B_0 = 95$
	Equity $= S_0 = 35$

*The single debt obligation has a face value of F, maturing at time T with a current market value of B_0.

(a) (*1 point*) Describe when BigBucks is exposed to the credit risk from H & M, considering H & M's capital structure provided in the table above.

(b) (*2 points*) Explain how the bank can eliminate credit risk, and show the hedge payoff structure (from the bank perspective) at time 0 and time T (symbols only, no calculations required).

Additional Information	
Debt Face Value	$F_T = 100$
Time	$T = 1$
Risk-free rate	$r = 5.0\%$
Volatility of risky assets	$\sigma = 20\%$
$N(-d_1)$	$N(-d_1) \approx 0.0483$
$N(-d_2)$	$N(-d_2) \approx 0.0719$

(c) (*2 points*) Calculate the risk-neutral probability of default, and expected severity of loss given default, as well as the cost to BigBucks of eliminating the credit risk, using the Merton model and the data above.

As an analyst with Worst's Rating Agency, you had made a credit rating decision based on the analysis from (c). You learn that the volatility of risky assets has increased to 40% with no change in the risk-free rate.

(d) (*1 point*) Explain the potential impact on your recommended credit rating given this new information.

19. (*5 points*) You are given the following information:

- Bond A: 2% annual coupon, three-year bond
- Bond B: 15% annual coupon, three-year bond
- Both bonds have a Z-spread of 7%
- Both bonds have a face value of 100 and are option-free
- Risk-free rate is 5% annual effective
- Running spread on CDS is 5%
- Investors can borrow at the risk-free rate

(a) (*1 point*) Compute the price of each bond.

(b) (*1.5 points*) Describe each of the following bond-CDS trading strategies:

(i) Lock-in risk-free spread

(ii) Trade the basis

(iii) Profit from default

(c) (*2.5 points*) Determine the amount and timing of cash flows for each of the following strategies, given that Bond A does not default but Bond B defaults at the second coupon date with a recovery rate of 60%:

(i) Buy Bond A and buy CDS protection with 3-year maturity under the lock-in the risk-free spread strategy.

(ii) Buy Bond B and buy CDS protection with 2-year maturity under the profit from default strategy.

20. (*7 points*) You are working on a synthetic CDO deal to help free up capital for a bank. The investor would receive a spread annually for 3 years. The underlying collateral is 100 million of credit default swaps (CDS) with 3 year maturities. You are currently assuming a default correlation of 0.3.

Tranche	Attachment point (%)	Notional amount ($ millions)	Par spread (basis point)	Expected Loss ($ millions)	Unexpected Loss ($ millions)
Equity	0 – 3	30	1507	15.3	27.6
Mezzanine	3 – 10	70	?	10.5	31.5
Senior	10 – 100	900	7	3.4	22.1
Entire portfolio	0 – 100	1000			

Unexpected loss = a level of loss due to default that is one standard deviation above the tranche's expected loss.

EL_i = Expected Loss of Mezzanine tranche up to and including Payment Date T_i

T_i	EL_i (in millions)
1	2
2	4
3	10.5

(a) (*2.5 points*) Calculate the par spread on the Mezzanine tranche. Assume the discount rate is 5% compounded continuously.

(b) (*1.5 points*) Calculate the leverage of the Mezzanine tranche using the expected loss and unexpected loss for the Mezzanine tranche.

(c) (*1.5 points*) Explain how the following factors would impact the leverage and the expected loss of the Mezzanine tranche.

(i) An increase in the credit spread of the underlying portfolio given the high credit enhancement of the Mezzanine tranche.

(ii) An increase in the Mezzanine tranche credit enhancement.

(d) (*1.5 points*) Explain the impact on the value of each tranche if the market assumed a default correlation of 0.7.

21. (*7 points*) PAP Life, a small insurer with a low risk tolerance, would like to enhance the risk-adjusted performance of its investment portfolio. PAP Life requires a minimum return of 0.5% per quarter, which is the risk-free rate. The company is considering investing in Duichong Hedge Fund, established in 1998, with returns data available from 2001. The fund reports returns quarterly. The fund strategy is to go long the stock of the company being acquired and short the stock of the acquirer to earn the spread difference.

The Lehman Sisters Global Macro Hedge Fund (LSGMHF) Index is comprised of 50 funds at the start of the year and 25 funds at year end. The index return is the weighted average of the performance of the constituent funds by asset value. The index relies on hedge fund managers with a track record longer than 3 years to report to Lehman Sisters.

Quarter	LSGMHF Index return (%) (Quarterly)	Duichong Hedge Fund return (%) (Quarterly)
Q1	−3	8
Q2	−1	24
Q3	3	−7
Q4	8	−15

(a) (*2 points*) Critique the use of the LSGMHF Index to assess the Duichong Hedge Fund returns.

(b) (*1 points*) Compute the annualized downside deviation of the Duichong Hedge Fund returns relative to the PAP minimum rate of return of 0.5% per quarter.

(c) (*1 points*) Calculate the annualized Sharpe Ratio and the Sortino Ratio of the Duichong Hedge Fund.

(d) (*2 points*) Compare and contrast the use of the measures in (c) by PAP Life to evaluate the hedge fund relative to the company investment objectives.

The company is also considering an alternative, the HighReturn hedge fund, which has a Sharpe ratio of 0.0012 and a Sortino ratio of 0.001 for 2009.

(e) (*1 point*) Recommend which of the two hedge funds would offer the best option for PAP Life.

22. (*5 points*) You are a consultant to a defined benefit pension plan. The plan's most recent actuarial valuation revealed the following:

Assets ($ millions)	350
Liabilities ($ millions)	
Active members	100
Retired members	300

A student actuary has been asked to discuss steps in developing a strategic asset allocation for the plan. She makes the following observations:

(i) The key decision points are:
- The bond/equity split
- The allocation to alternative asset classes

(ii) The relevant asset classes to consider are:
- Bonds
- Public equities
- Private equities
- Hedge funds

(iii) Assumptions determined based on historical data over the last 10 years will be used to find an efficient frontier.

(iv) The allocation that maximizes the Sharpe ratio will be selected.

(a) (*3.5 points*) Assess each statement above separately, and propose adjustments as necessary.

(b) (*1.5 points*) Recommend approaches that will improve the strategic asset allocation process for the pension plan.

23. (*4 points*) You are currently using a static model to manage a portfolio of Agency Mortgage Backed Securities (Agency MBS). However, you are considering upgrading to a single-period, stochastic model.

(a) (*1 point*) Explain the information provided to investors by the following Agency MBS metrics:

(i) Weighted-average coupon

(ii) Weighted-average maturity & weighted-average loan age

(b) (*1 point*) Describe the major drivers of prepayments for Agency MBS.

(c) (*2 points*) Compare and contrast features and limitations of:

(i) a static model,

(ii) a single-period, stochastic model,

(iii) and a multi-period model.

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