
SOCIETY OF ACTUARIES
Advanced Portfolio Management

Exam APMV

MORNING SESSION

Date: Friday, May 1, 2009

Time: 8:30 a.m. – 11:45 a.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This examination has a total of 120 points. It consists of a morning session (worth 60 points) and an afternoon session (worth 60 points).
 - a) The morning session consists of 10 questions numbered 1 through 10.
 - b) The afternoon session consists of 10 questions numbered 11 through 20.

The points for each question are indicated at the beginning of the question. Questions 1 through 4 pertain to the Case Study, which is enclosed inside the front cover of this exam booklet.

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.
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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.

CASE STUDY INSTRUCTIONS

The case study will be used as a basis for some examination questions. Be sure to answer the question asked by referring to the case study. For example, when asked for advantages of a particular plan design to a company referenced in the case study, your response should be limited to that company. Other advantages should not be listed, as they are extraneous to the question and will result in no additional credit. Further, if they conflict with the applicable advantages, no credit will be given.

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

Questions 1 – 4 pertain to the case study

- 1.** (6 points) LifeCo management is concerned about the dollar duration mismatch in the traditional line of business. It has been suggested that the company increase its exposure to non-agency Collateralized Mortgage Obligations (CMO) as a means of closing the duration gap. You have been assigned to study this strategy.
- (a) Describe non-agency CMOs.
 - (b) Compare agency and non-agency CMOs.
 - (c) Assess the appropriateness of this new investment strategy.
 - (d) Determine whether this strategy complies with LifeCo's investment policy for the traditional line.

Questions 1 – 4 pertain to the case study

2. (8 points) As the Chief Investment Officer for LifeCo, you are looking to implement benchmarks for the fixed income portfolios.

- (a) List and describe the basic steps in developing quantitative portfolio management techniques relative to an index.

In order to better analyze and manage the portfolio risk and performance of LifeCo’s fixed income assets backing the \$1.5 billion of accumulation annuities, you are reviewing the following XYZ Index:

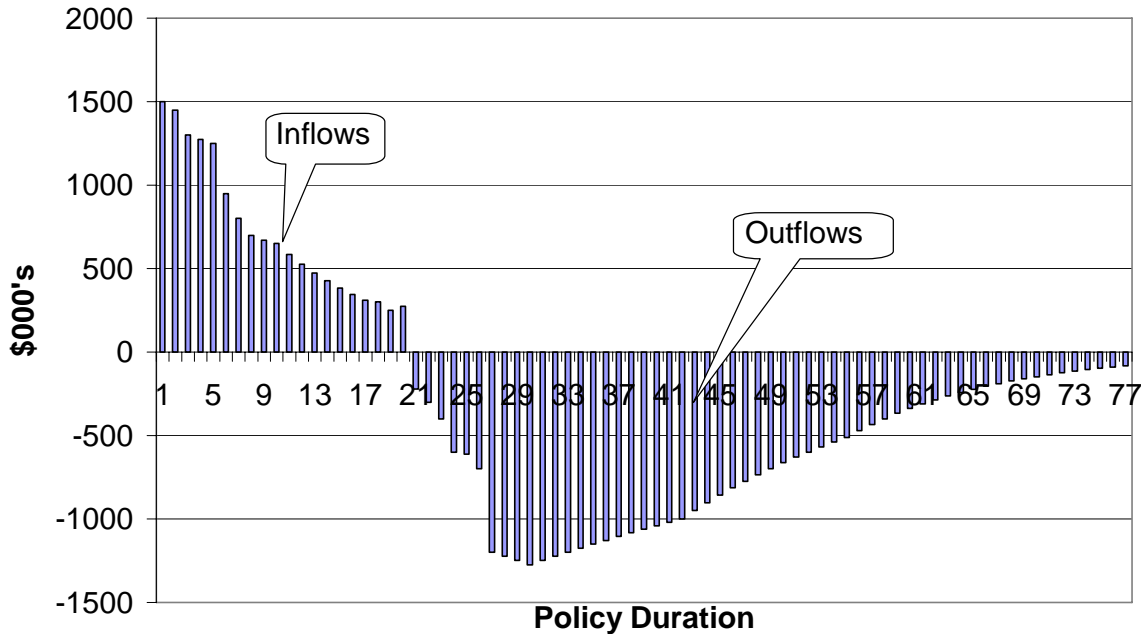
XYZ Index Composition	% in Index	Effective Duration
Investment Grade AA	15%	6.0
Investment Grade A	32%	7.0
Below Investment Grade BB	5%	6.0
Below Investment Grade B	3%	4.0
Mortgage Products (including structured)	25%	7.0
Equity	20%	6.0
Total	100%	6.5

- (b) Compare the XYZ Index to the ALM guidelines in Section V of LifeCo’s ALM Policy Statement.
- (c) Evaluate the appropriateness of the XYZ index, given LifeCo's investment constraints:
- (i) With respect to the current asset composition.
 - (ii) As a benchmark.
- (d) Describe the complexities arising as a result of the fact that, in general, fixed income benchmarks are capitalization weighted and all-inclusive.

Questions 1 – 4 pertain to the case study

- 3.** (7 points) LifeCo wishes to enter the long term care (LTC) market but is concerned about the investment risk associated with this type of product. The chart below shows the typical LTC product's early cash inflows vs. later cash outflows by policy duration.

LTC Liability Cashflows



- (a) Describe the key components of an investment policy statement for this new line of business.

LifeCo management does not want to create a separate segment for this block and is considering combining the LTC block of business with a segment backing one of the existing blocks of business:

- (1) Closed block of traditional life business
 - (2) UL block
 - (3) Accumulation annuity block
- (b) Analyze the appropriateness of each of these three possibilities with respect to investment strategy.
- (c) Describe the investment strategy considerations that must be addressed for a separate segment for LTC.

Questions 1 – 4 pertain to the case study

- 4.** (8 points) LifeCo is considering entering into the credit default swap (CDS) below to generate additional income and to enhance its risk management. LifeCo management does not want to have more than 19% of the Non-Traditional Life segment invested in below investment grade bonds. The CDS protects the purchaser against a rating downgrade to below investment grade.

Equivalent Annual Premium	130bps
Notional	\$10 million
Asset-Backed Securities	Residential Mortgages

- (a) List and describe the key components of the derivative policy for this initiative.
- (b) Describe how LifeCo could use this CDS to increase the yield on assets.
- (c) Calculate the amount of the CDS needed to increase the segment yield to 7.25% to support crediting rates in its Non-Traditional Life segment.
- (d) Describe the losses that the LifeCo's Non-Traditional Life segment may realize from the arrangement described in (c) due to recent downgrades in the mortgage sector.
- (e) Explain whether this strategy is consistent with LifeCo management's fiduciary obligations.

5. (9 points) Due to a recent credit market crash, JAR Insurance would like to enhance its credit risk management. The details of JAR's bond portfolio are described below:

Company	Exposure	Band	Default probability
A	250,000	3	0.02%
B	620,000	6	0.12%
C	323,000	3	0.50%
D	643,000	6	0.09%
X	120,000	1	1.20%

Company X's asset value follows Brownian motion with the following data:

Asset(V_0):	120,000
volatility of asset (σ):	30%
mean(μ):	15%
risk free rate:	4%
company debt:	
short term	120,000
long term	0

Assume all bonds are short term with one year maturity.

- Calculate the real world and the risk neutral default probabilities of company X using the KMV approach.
- Calculate the expected recovery and the expected loss given default for company X using the KMV approach in a risk neutral world.
- Calculate the expected number of defaults in band 6 using the CreditRisk+ model. Assume that an exposure unit equals \$100,000 and the recovery rate is 0%.
- Compare and contrast the KMV approach and the CreditRisk+ model.

6. (4 points)

- (a) Describe the risks embedded in Collateralized Mortgage Obligations.
- (b) Describe the special considerations of mortgage passthroughs with coupons above current market rates.
- (c) Recommend approaches to hedge each risk identified in (a).

7. (5 points) A portfolio has the following credit rating profile:

Rating	Percentage
Aaa	5%
Aa	10%
A	30%
Baa	50%
Ba	5%

Given the following 12 month credit transition frequency matrix:

Initial Rating	12 Month Transition (percent)							
	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default
Aaa	85	10	5					
Aa		80	10	5	5			
A			75	10	10	5		
Baa				75	10	10	5	
Ba				5	65	15	10	5
B					5	60	20	15
Caa-C						10	65	25

- (a) Calculate the expected credit rating profile of the portfolio at the end of 12 months.
- (b) Describe how a credit default swap (CDS) works.
- (c) Assess how CDS can be used to hedge credit risk in the portfolio.

8. (5 points) You are using the mean variance approach for asset allocation optimization.

- (a) Describe the reverse optimization procedure for setting inputs.
- (b) Explain the motivations for using the reverse optimization procedure.
- (c) Calculate the expected return for each asset using the reverse optimization procedure. Assume that:

- the current riskless rate of interest is 3%;
- the market risk premium is 4%;
- the relative values for the assets are as follows:

Cash	10%
Bonds	40%
Stocks	50%

- the covariance matrix is:

	Cash	Bonds	Stocks
Cash	0	0	0
Bonds	0	0.003	0.006
Stocks	0	0.006	0.031

9. (4 points) Behavioral biases among different group dynamics can impact the overall investment performance of a corporation.

- (a) Discuss the different behavioral biases facing investors today.
- (b) Explain how these biases are impacted by different social groups.
- (c) Describe the impact this can have on the Efficient Market Hypothesis.

- 10.** (4 points) You manage an equity portfolio that is benchmarked to the Mud & Poors 500 index (M&P 500). You are concerned about downside market volatility and want to maintain past gains achieved by the portfolio. You also want to ensure that you will be able to keep some future appreciation in the index, although you do not expect large (in excess of 10%) increases in the value of the index over the next 30 days.

You have been presented with the following statistics on two M&P 500 European options:

	Call Option	Put Option
Strike	920	835
Price	61.00	122.00
Delta	0.42	-0.51
Option Expiration	30 days	30 days

The current level of the M&P 500 is 875.

- Recommend a costless option strategy that can be implemented to address your concerns, given your expectations.
- Describe the total payoffs of your recommended option strategy stated in (a).
- Calculate the index level at which the portfolio (including option positions) would experience losses.

Assume there are no transaction costs.

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

SOCIETY OF ACTUARIES
Exam AFE
Advanced Finance/ERM

Exam AFE
AFTERNOON SESSION

Date: Friday, May 1, 2009

Time: 1:30 p.m. – 4:45 p.m.

INSTRUCTIONS TO CANDIDATES

General Instructions

1. This afternoon session consists of 6 questions numbered 6 through 11 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.
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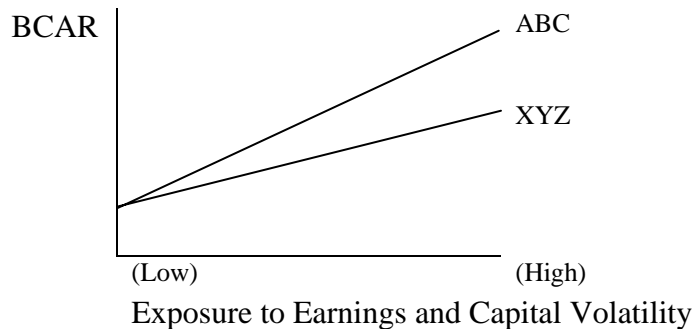
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****BEGINNING OF EXAMINATION****
AFTERNOON SESSION

- 6.** (5 points) You are a rating analyst at A.M. Best. You will be taking responsibility for rating two companies, ABC and XYZ, which are both medium-sized insurance companies with nearly identical lines of business, assets, and liabilities. You are given the graph below of ABC's and XYZ's Best's Capital Adequacy Ratio (BCAR).



- (a) Describe the BCAR tool and identify its strengths and weaknesses.
- (b) Indicate the conclusions you can draw regarding the relative risk management practices and the relative A.M. Best ratings for ABC and XYZ based on their respective BCAR graphs.
- (c) Describe the key risks A.M. Best expects companies to assess through an effective ERM program.
- (d) Identify five future external events and trends that could affect a company's ERM strategy.

7. (14 points) You are employed by Marlin Life, a financial services company that sells traditional life products. Financial reporting at Marlin has been based on US GAAP accounting standards. Recently, there has been some concern expressed by senior management at Marlin about having to “report all liabilities at fair value because of SFAS157”.

You have compiled information for one of the products sold by Marlin Life, a 3-year single premium term life product that is priced to provide a level 12% return on equity. The product has the following expected cash flows:

3-Year Single Premium Term Life Cash Flows

	$t = 0$	$t = 1$	$t = 2$	$t = 3$
Gross Premium	250	-	-	-
Expenses & Commissions	70	5	5	5
Claims	0	60	60	60

- (a) (1 point) Provide an overview for the financial reporting team explaining the difference between fair value and US GAAP accounting (prior to the introduction of SFAS157) for the products offered by Marlin.
- (b) (1 point) Explain to senior management the motivation behind SFAS157, including a description of the reporting impact for the types of products sold by Marlin.
- (c) (5 points) In order to report on a fair value basis, Marlin must decide the following:
- (i) a fair value methodology;
 - (ii) a methodology for the calibration for risk adjustment to the market;
 - (iii) whether to reflect own credit risk.

For each of (i), (ii), and (iii), explain the decision that needs to be made, identify available alternatives and outline the considerations in making the decision.

7. Continued

(d) (5 points) You have decided to use the cost of capital approach in computing fair value and to reflect the market price of risk using the following assumptions:

- The ratio of equity to liabilities is 7%
- There are no taxes
- Return on assets is 5%

Compute the following quantities for the 3-year term product described above:

- (i) Fair Value of Liability;
- (ii) Net Operating Gain.

Show your work.

(e) (2 points) Marlin is also considering using Embedded Value as a basis for senior management performance-based compensation.

Compare the advantages and disadvantages of using an Embedded Value approach as opposed to either GAAP or Fair Value based measures. Recommend one of these three approaches for Marlin.

- 8.** (14 points) Adventure Life has recently acquired a bank subsidiary, Adventure Life Bank (ALB). You are the Risk Manager evaluating ALB's risk management practices.

Currently, ALB's derivatives risk management practices include the following:

- ALB has legally enforceable netting arrangements with each of its current counterparties.
- ALB uses a lognormal diffusion process in its Monte Carlo simulation model to estimate its exposures to derivatives.
- ALB imposes a current limit of \$10 million at the 99% Potential Future Exposure (PFE) level for each counterparty.

You have gathered the following data on ALB's current derivative holdings:

Transaction	Counterparty	Derivative Type	Residual Maturity	Notional Amount (millions)	Current Mark-to-Market (millions)	Add-on Factors (%)	Risk Weight
T1	JPO	US Interest Rate Swap	5 years	50	-2.0	0.5	20%
T2	JPO	US Equity Index Put Option	1 year	20	1.1	6.0	20%
T3	MN	USD/CAD FX Swap	2 years	20	2.1	5.0	20%
T4	MN	Emerging Market FX Swap	3 months	10	-1.5	1.0	20%
T5	GT	US Interest Rate Futures	6 months	20	1.7	0.0	50%

- (a) Calculate the potential benefit to ALB of having enforceable netting arrangements in its derivative holdings. Show your work.
- (b) Other than netting arrangements, identify other counterparty credit risk mitigants that ALB could employ to manage its derivative exposure.
- (c) Describe the G-30 best-practice risk management recommendations for end-users of derivatives with respect to each of the following:
 - (i) Mark-to-Market Process
 - (ii) Credit Exposure and Aggregation
 - (iii) Credit Enhancement

8. Continued

- (d) Assess the suitability or the shortcomings of ALB's simulation model as compared to other possible models for determining the PFE for each of ALB's derivative positions.
- (e) Detail the steps involved in calculating the original BIS (Bank for International Settlements) risk-weighted amounts for derivatives, which ignores netting.
- (f) Calculate the original BIS risk-weighted amount for ALB's derivative book, ignoring netting. Show your work.
- (g) ALB's derivatives team has proposed another transaction with the counterparty JPO. A simulation of 1000 scenarios performed on total JPO counterparty exposure that included the proposed transaction produced the following partial results:

	1	2	3	4	5	6	7	8	9	10	11	12
Ordered PFEs	15.2	14.5	14.2	13.9	13.6	13.1	12.7	12.0	11.2	10.4	9.9	9.7

Assess whether the proposed transaction with JPO will fall within ALB's stated counterparty risk limits. Show your work.

- (h) Identify and explain four major components in the G-12 Recommendations for the Improvement of Counterparty Risk Management Practices that should be incorporated in ALB's derivative risk management practices.

9. (14 points) As the product development actuary for Arsenal Life, you are proposing the addition of GMDB and GMAB features to make Arsenal's single premium variable annuity (SPVA) more attractive.

You are given the following additional information:

- The SPVA does not offer a fixed account investment option.
- The GMAB feature allows the annuitant to renew the contract at maturity with a guarantee value equal to 100% of the premium.
- The GMDB feature provides payment of a death benefit equal to 90% of the premium.
- Management Expense Ratio (MER) = 125 bp per annum (applied at the beginning of the year).
- $S_0 = 1$
- Risk free rate = 6%
- $\sigma = 10\%$
- $BSP_0(t)$ is the cost at issue of a put option that matures in t years
- $BSP(t) = Ge^{-rt}\Phi(-d_2) - S_0(1-m)^t\Phi(-d_1)$

t	$BSP_0(t)$	$q_{x+[t-1]}$
1	0.001882	0.1
2	0.002976	0.2
3	$BSP_0(3)$	0.3
4	0.002871	1.0

x	$\Phi(x)$
0.80	0.788
0.85	0.802
0.90	0.816
0.95	0.829
1.00	0.841
1.05	0.853
1.10	0.864
1.15	0.875
1.20	0.885
1.25	0.894
1.30	0.903

x	$\Phi(x)$
1.35	0.911
1.40	0.919
1.45	0.926
1.50	0.933
1.55	0.939
1.60	0.945
1.65	0.951
1.70	0.955
1.75	0.960
1.80	0.964
1.85	0.968

9. Continued

- (a) (5 points) You are considering the following potential approaches to managing the risks associated with the GMDB and GMAB:
- Funding the benefits using the actuarial method
 - Dynamic hedging of the benefits
 - Reinsuring the GMDB on a YRT basis
 - Coinsuring 50% of the benefits only, where benefit charges and claims are shared proportionately with the reinsurer.
- (i) Describe each of the approaches, and evaluate the strengths and weaknesses of each.
- (ii) Recommend and justify the use of one of these approaches.
- (b) (2 points) You are considering incorporating a voluntary reset feature for the GMAB.
- (i) Provide arguments for including this feature.
- (ii) Explain the effect of this feature on the risk profile and risk management of the SPVA product line.
- (c) (7 points) Arsenal has decided to proceed with the GMDB only and to price for this benefit using the margin offset approach. Using the assumptions provided, calculate:
- (i) $BSP_0(3)$, the value at issue of a three-year put option using Black-Scholes.
- (ii) The annual margin offset rate to be assessed to policy holders that compensates Arsenal for offering the GMDB.

Show your work.

- 10.** (7 points) You are an analyst for a credit rating agency reporting on Sunshine Life Co. (SLC). SLC has announced plans to demutualize and anticipates increased scrutiny of its corporate governance from shareholders. In response, SLC plans to introduce a number of organizational changes with respect to the Board of Directors and senior management compensation.
- (a) Identify common governance strengths that are typically observable in U.S. insurance companies.
 - (b) Identify the advantages, from a ratings standpoint, of demutualizing.
 - (c) Outline and explain the key characteristics that should be considered when building a strong Board of Directors.
 - (d) Provide arguments for and against including each of these individuals on the Board of Directors:
 - (i) A policyholder representative
 - (ii) A retired, former senior executive of SLC
 - (iii) A senior executive of another life insurance company
 - (iv) An agent representative with an equity stake in the company
 - (v) An agent representative without an equity stake in the company.
 - (e) Identify the positive and negative consequences of using significant amounts of stock-based compensation to attract and retain senior management for a demutualized SLC.

11. (6 points) You are the head of a newly formed ERM department at Gator Life, a small life insurance company which sells a wide range of insurance products. Gator currently uses factor-based, deterministic methods to model risks. Gator does not have a hedging program and none of Gator's employees have expertise in the use of hedging to control risks.

You have proposed adopting an Economic Capital (EC) framework for the entire company as part of your risk management process.

- (a) You have identified three major risks for Gator: equity risk, mortality risk, and credit risk. For each of these risks:
 - (i) Explain the nature of the risk in a company such as Gator with a broad product line and describe any particular features of the risk that Gator should consider.
 - (ii) Explain how each of these risks could be modeled within an EC framework.
- (b) Two popular EC methodologies are the liability runoff approach and the one-year mark-to-market approach.
 - (i) Define and compare the advantages and disadvantages of these two approaches.
 - (ii) Recommend one of these approaches for Gator. Justify your recommendation.
- (c) Identify five potential uses for EC in Gator's operations and briefly describe the requirements for implementing EC in each case.

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