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**SOCIETY OF ACTUARIES**  
**Life Finance & Valuation – U.S.**

# Exam ILALFVU

## MORNING SESSION

**Date:** Thursday, April 27, 2017

**Time:** 8:30 a.m. – 11:45 a.m.

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### INSTRUCTIONS TO CANDIDATES

#### General Instructions

1. This examination has a total of 100 points. It consists of a morning session (worth 60 points) and an afternoon session (worth 40 points).
  - a) The morning session consists of 6 questions numbered 1 through 6.
  - b) The afternoon session consists of 4 questions numbered 7 through 10.

The points for each question are indicated at the beginning of the question.
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 because 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 ILALFVU.
6. Be sure your essay answer envelope is signed because if it is not, your examination will not be graded.





**\*\*BEGINNING OF EXAMINATION\*\***  
**Morning Session**

- 1.** (9 points) XYZ is a holding company that owns two subsidiaries. Subsidiary B exclusively conducts banking activities, whereas Subsidiary L predominantly conducts life insurance activities. Each subsidiary prepares its own financial statements.
- (a) (2 points) Management is concerned about potential financial statement volatility between the effective dates of IFRS 9 (effective January 1, 2018) and IFRS 4 (effective January 1, 2020 at the earliest). The IASB has developed proposals for dealing with this potential volatility.
- Recommend a course of action for each subsidiary based upon these proposals.  
Justify your response.
- (b) (2 points) For Subsidiary L's variable annuity portfolio, a consultant suggests using the replicating portfolio technique to determine the fulfillment of cash flows under IFRS 4.
- (i) Describe the replicating portfolio technique.
- (ii) Assess the appropriateness of using the replicating portfolio technique for a variable annuity portfolio.

# 1. Continued

- (c) (5 points) You are provided the following information for Subsidiary L's non-participating 3-year term life portfolio:

| (in millions)          | Year 1 | Year 2 | Year 3 |
|------------------------|--------|--------|--------|
| Best Estimate Premium  | 100    | 100    | 100    |
| Best Estimate Claims   | 70     | 75     | 80     |
| Required Capital       | 320    | 280    | 220    |
| Actual Claims Incurred | 80     | 90     | 65     |

Assume:

- There are no expenses
- Discount rate = 0%
- Risk free rate = 0%
- The cost of capital methodology is used to measure the uncertainty of the amount and timing of cash flows
- Cost of capital = 6%
- The contractual service margin is amortized linearly
- No interest is accrued on the contractual service margin
- The measurement model uses the building block approach under the IFRS 4 Revised Exposure Draft

Calculate the following:

- (i) Best estimate liability at inception
- (ii) Risk adjustment (or margin for uncertainties) at inception
- (iii) Contractual service margin at inception
- (iv) Insurance contract revenue for year 1
- (v) Underwriting results for year 1

Show all work.

**2.** (10 points)

- (a) (4 points) Compare and contrast the following measures used to determine the value of a block of life insurance:
- Embedded Value (EV);
  - Market Consistent Embedded Value (MCEV); and
  - Actuarial Appraisal Value (AAV)
- (b) (3 points) ABC, a European multi-line insurance company, is purchasing DEF Life, a small privately held U.S. life insurer with Universal Life, Term Life, Fixed Deferred Annuities, and Variable Deferred Annuities.

ABC uses MCEV to evaluate its own financial performance.

Critique the following statements made by the CEO of ABC about valuing DEF's business:

- A. *The MCEV earnings for Fixed Deferred Annuities will look horrible, since a risk-free rate must be used for discounting and projecting investment income.*
- B. *Since our incentive compensation is based on operating MCEV earnings, we're taking a big gamble that interest rates will increase in the short term.*
- C. *MCEV doesn't do a great job incorporating cost of capital for the Term Insurance block.*
- D. *The AAV may overstate the value of the Variable Annuity block.*

## 2. Continued

- (c) (3 points) You are given the following information for DEF's in-force business on December 31, 2017 and expected new business for 2018:

| Values as of December 31, 2017                     | Business Inforce On December 31, 2017 | Expected New Business Sold in 2018 |
|--|---------------------------------------|------------------------------------|
| PV of Premiums                                     | 160                                   | 20                                 |
| PV of Benefits and Expenses                        | 140                                   | 15                                 |
| PV of Investment Income on Assets Backing Reserves | 50                                    | 10                                 |
| Initial Required Capital                           | 30                                    | 5                                  |
| PV of Investment Income on Required Capital        | 10                                    | 4                                  |
| Initial Free Surplus                               | 25                                    | N/A                                |
| PV of Investment Income on Free Surplus            | 5                                     | 2                                  |
| Sum of Discounted Required Capital at each EOY     | 200                                   | 40                                 |

Assume:

- Additional sales occur in 2019 and 2020, which are identical to the sales in 2018
- No sales are assumed to occur after 2020
- Risk-free rate = 3%
- Pre-tax Cost of Capital Rate = 15%
- After-tax Cost of Capital Rate = 10%

Calculate the Actuarial Appraisal Value on December 31, 2017. Show all work.

3. (10 points) You are given the following for a 3-year single premium deferred annuity (SPDA).

| Policy Year                  | 1                | 2     | 3     |
|------------------------------|------------------|-------|-------|
| Estimated Gross Profit (EGP) | To be calculated | 3,000 | 2,800 |
| Surrender Charge (% of AV)   | 5%               | 2%    | 1%    |

- Earned Rate = 6%
- Credited Rate = 3%
- Surrender Rate = 6%
- Front-end load (% of premium) = 2%
- Commission (% of premium) = 4%
- Statutory Interest = 4.5%
- Single Premium = 100,000
- Initial Acquisition Expenses = 250
- Annual Maintenance Expenses = 50
- Maintenance expenses and surrenders occur at the end of the policy year

- (a) (5 points)
- (i) Calculate the Deferred Acquisition Cost (DAC) at the end of the first policy year. Show your work.
  - (ii) Calculate the Unearned Revenue Liability (URL) at the end of the first policy year. Show your work.
- (b) (2 points) Explain the differences between loss recognition testing and recoverability analysis for SPDAs.
- (c) (2 points)
- (i) Calculate the reserve at issue using the Commissioner's Annuity Reserve Valuation Method (CARVM). Assume full surrenders are the only benefit stream.
  - (ii) Explain how the calculation would be different if there were other benefit streams.
- (d) (1 point) Actuarial Guideline XXXIII classifies possible annuity benefit streams into two categories: non-elective benefits and elective benefits.

Define these categories and list two examples of each.



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**4.** (12 points) You are the Appointed Actuary of VDL Life Insurance Company, a U.S. based insurance company, which has recently launched an Indexed Universal Life (IUL) product.

(a) (2 points) Contrast the following methods of valuation:

- Implied Guaranteed Rate Method (IGRM)
- CRVM with Updated Market Value (UMV)

(b) (5 points) You are given the following assumptions regarding a sample IUL policy issued by VDL, which is being valued according to the IGRM method:

|                          |        |
|--------------------------|--------|
| Valuation Rate           | 4%     |
| Guaranteed Rate (GR)     | 1%     |
| Participation Rate       | 30%    |
| Cap Rate                 | 10%    |
| Index-based Benefit Term | 1 Year |

|  | <b>At Issue</b> | <b>End of Year</b> |
|--|-----------------|--------------------|
| Policy Value                                 | 2,000           | 2,150              |
| Option Value (current)                       | 80              | 70                 |
| Option Value (12mo. average)                 | 65              |                    |
| Option Value ( 36mo. average)                | 50              |                    |
| Option Value (60mo. average)                 | 40              |                    |
| Option Value (120mo. average)                | 30              |                    |
| Guaranteed Maturity Fund (GMF)               |                 | 2,300              |
| PV of Guaranteed Maturity Premiums (GMPs)    | 15,000          | 14,000             |
| PV Guaranteed Death Benefits with Implied GR | 5,600           | 5,500              |
| PV Guaranteed Death Benefits with GR         | 5,100           | 5,000              |
| Unamortized Expense Allowance                |                 | 200                |

- (i) Determine the Implied Guaranteed Rate in the current term, as of the issue date.
- (ii) Determine the Implied Guaranteed Rate for terms after the first, as of the issue date.
- (iii) Calculate the statutory reserve at the end of Year 1 for this policy.

Show all work.

#### 4. Continued

- (c) (5 points) Critique the following email based on the requirements of Actuarial Guideline 36 (AG 36):

*From : Valuation Actuary  
To : Chief Actuary  
Subject : IUL Hedging Strategy and Reserving Implications*

*After performing the analysis we discussed, I am pleased to confirm our hedging program will qualify under the “Hedged as Required” criteria. Therefore, we will qualify to use the CRVM with UVM method.*

*Here are some highlights of our hedging program:*

- *Hedging effectively covers 80% – 90% of the reserve equity exposure in any given period*
- *We have a system in place to monitor effectiveness*
- *If the difference between performance and expectations is ever above 25%, we must notify the commissioner that we are no longer “Hedged as Required”*

*Relying on CRVM with UVM under Option Replication Hedging is considered a Type 2a computational method. Once we establish this reserving choice, we may later decide to move to a Type 1 method, but the reverse movement is not possible.*

*Compared to our basic UL reserving, AG 36 provides several differences:*

- *AG 36 for IUL does not reference any Cash Surrender Value floor*
- *When determining the moving average volatility for reserving purposes, our capital markets team will use market data without any conservatism*
- *IUL is exempt from Asset Adequacy testing as long as we remain “Hedged As Required”*

5. (9 points) SJG Life is changing the tax reserve method for a block of individual life insurance. You are given:

- No contracts are issued in 2016
- The statute of limitations precludes any changes from being made on the 2015 tax return
- The new method is yet to be categorized
- Tax reserve balances on the old and new methods are as follows:

| (millions)        | Old Method | New Method |
|-------------------|------------|------------|
| January 1, 2016   | 120.0      | 118.5      |
| December 31, 2016 | 126.0      | 123.0      |

Evaluate each statement below:

- A. *The opening reserve at January 1, 2017 is 123.0 million no matter how the new method is categorized.*
- B. *If the new method is determined to be a change in basis under Section 807(f):*
- (i) *2016 tax deduction is 3.0 million*
  - (ii) *3.0 million is spread into taxable income over 10 years*
- C. *If the new method is determined to be a correction of a mathematical or posting error:*
- (i) *2016 tax deduction is 4.5 million*
  - (ii) *1.5 million is spread into taxable income over 10 years*
- D. *If the new method is determined to be a change in facts or change in estimate, the 2016 tax deduction is 3.0 million.*
- E. *If the new method is determined to be a change in method of accounting governed by Section 446:*
- (i) *2016 tax deduction is 3.0 million*
  - (ii) *1.5 million is permanently excluded from taxable income*

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6. (10 points) The following are QRS Life's financial results:

|                    | 2015   | 2016   |
|--------------------|--------|--------|
| Gross Premium      | 58,100 | 55,700 |
| Net Premium        | 55,200 | 53,000 |
| Interest           | 25,200 | 25,400 |
| Death Claims       | 5,100  | 4,100  |
| Surrenders         | 17,200 | 20,800 |
| Change in Reserves | 43,500 | 41,000 |
| Expenses           | 15,200 | 14,900 |
| Earnings           | 2,300  | 300    |

|                             | 2015      | 2016      |
|-----------------------------|-----------|-----------|
| Cash Surrender Value at EOY | 1,055,000 | 1,095,100 |
| Reserves at EOY             | 975,875   | 1,016,875 |

|                       | 2015   | 2016   |
|-----------------------|--------|--------|
| Expected Interest     | 23,200 | 25,700 |
| Expected Death Claims | 3,600  | 3,400  |
| Expected Surrenders   | 21,200 | 25,000 |
| Expected Expenses     | 13,800 | 13,200 |

- (a) (8 points)
- (i) (2 points) Describe the key types of drivers that can cause profit to emerge differently than anticipated in a Source of Earnings analysis.
- (ii) (6 points) Assess each of the following statements using a Source of Earnings analysis. Justify your answer.
- A. *Premiums were a key driver in the decline in earnings.*
  - B. *Stable investment income had a minimal impact on earnings.*
  - C. *Mortality experience had a favorable impact on earnings.*
  - D. *Surrender experience can be summarized by combining the impact from surrenders and change in reserves. Total surrender experience had an unfavorable impact on earnings.*
  - E. *Persistency was worse than expected, fueling the decline in premiums.*
  - F. *Stable expenses had a minimal impact on earnings.*

**6. Continued**

(b) (2 points) Evaluate which of the following reinsurance arrangements would have been most advantageous for QRS Life over the past two years of financials. Justify your answer.

- Coinsurance
- Yearly Renewable Term

**\*\*END OF EXAMINATION\*\***  
**Morning Session**

**USE THIS PAGE FOR YOUR SCRATCH WORK**