CSP-IU Model Solutions
Fall 2012

1. Learning Objectives:

5. The candidate will understand the Risk Based Capital (RBC) regulatory framework and the principles underlying the determination of Regulatory RBC and Economic Capital.

Learning Outcomes:

(5a) Describe the MCCSR/RBC regulatory framework and the principles underlying the determination of Regulatory RBC.

(5c) Explain and apply the concepts, approaches and methods for determining Economic Capital.

Sources:

Valuation of Liabilities, Chapter 16 (Risk Based Capital)

Economic Capital for Life Insurance Companies, SOA Research Paper, Feb 2008

ILA-C121-08: Economic Capital Modeling: Practical Considerations, Milliman White Paper

Commentary on Question:

The question combined retrieval of information (i.e. provide the definition of EC vs. RBC), comprehension and analysis. The cognitive level was relatively easy. Most students were able to answer part (a), which was pure memorization.

Solution:

(a) Compare the U.S. regulatory Risk Based Capital (RBC) factor-based methodology to the Economic Capital methodology of setting capital levels for life insurance companies.

RBC:

- Factor based model
- Contains 4 risk categories:
  - C1 – assets: affiliates, bonds, mortgages, preferred and common stocks, real estate
  - C2 – insurance risk: factors based on NAAR
  - C3 – interest rate/market risk: 3 categories of low, medium, high, depending on the different kinds of reserves
  - C4 – general business risk: fraud, mismanagement, litigation

1. Continued

- Includes covariance adjustment
- RBC ratio = total adjusted capital / authorized control level RBC
- Authorized control level RBC = = C0 + C4a + SQRT((C1a+C3a)^2 + C1cs^2 + C2^2)
- Regulatory action level triggered depending on RBC ratio

Economic Capital:

- EC is an internal calculation of the capital required, based on company's view of risk, with calculations based on economic principles.
- Risk factors include: market risk, credit risk, insurance risk, operational risk, liquidity risk
- 2 main approaches used: liability runoff, and 1 year mark-to-market

(b) List the products for which U.S. Life Insurance companies currently do not calculate RBC using a factor-based methodology, and briefly describe the methodology used instead.

Annuities and Single Premium Life

- RBC C3 Phase 1:
  - Used the same model as asset adequacy analysis
  - Run either 12 or 50 scenarios
  - For each scenario, find the worst-case PV of stat surplus
  - Discount using 105% of 1 yr treasury rate
  - Take weighted average of the ranked scenarios
  - May be exempted by C-3 significance test and C-3 stress test

Variable Products with guarantees

- C3 Phase 2
  - Calculate the Total Asset requirement (TAR)
  - Assumptions are prudent estimates
  - Find required capital for each scenario as highest PV of negative accumulated surplus
  - Additional asset requirement (AAR) = CTE90 of the above scenario amounts
  - TAR = AAR + total assets
  - RBC requirement = TAR + stat reserves

(c) Company HJR owns a closed block of universal life insurance policies with a minimum credited interest rate guarantee. Briefly explain how a low interest-rate environment would affect HJR's capital levels on this block of business under each of the following capital models. Justify your answer.

(i) U.S. Risk Based Capital (RBC) model

(ii) Economic Capital model

1. Continued

RBC:

- C3 interest risk based on UL reserve - considered low risk, not much capital change in a low interest environment
- Possible increase in capital due to CFT result because assets are not earning as much investment income (reinvestment risk)

EC:

- EC associated interest rate risk is often significant for companies with UL products with interest rate guarantees
- Changes in persistency due to market-linked events are generally reflected explicitly in EC - persistency is likely to increase when UL product has interest rate guarantees while alternative investments offer low yield

2. Learning Objectives:

7. The candidate will be able to evaluate risks faced by a Company by virtue of the Company's products, assets and management strategies and practices and be able to evaluate the appropriateness of various methods of risk mitigation.

Learning Outcomes:

(7c) Describe and evaluate the other risks an insurance company faces including operational, marketplace and expense risks.

(7e) Describe and apply methods of risk mitigation and hedging and to understand the limitations of such methods.

Sources:

ILA-C116-07: Mapping of Life Insurance Risks, AAA Report to NAIC

ILA-C125-10: Insurance Risk Management Response to the Financial Crisis, CRO Forum, April 2009

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) BL's management sets its capital at 200% of the AA rating requirement as per a major rating agency. Management's main concerns are liquidity and value creation, and believe this formula gives BL the strong capital position it needs to keep borrowing costs down and satisfy its equity investors.

Evaluate whether setting the capital at this level is sufficient to address management's concerns. Justify your answer.

Commentary on Question:

This question tests candidates' understanding of the limitations of a high amount of capital. Actuaries often focus on liabilities and forget a balance sheet always has two sides.

Candidates also needed to understand the difference between risk control and risk optimization, and why a high amount of capital may actually hurt the company.

Candidates who did not do well failed to consider what capital means to liquidity and value creation, and instead believed holding a high enough amount of capital per rating agency and/or regulatory specified rules is sufficient.

2. Continued

Amount of capital alone is not enough to address management's concerns.

Liquidity

- A high amount of capital alone does not necessarily mean sufficient liquidity.
- Liquidity needs are sudden, and even valuable assets can become illiquid quickly.
- Management needs to make sure capital is invested in assets that can be readily converted to cash in a time of need.

Value Creation

- Holding a high amount of capital does tend to reduce borrowing costs, but also increase frictional costs.
- Opportunity costs: there may well have been other more efficient uses of capital, like investing in new products.
- Management needs to go through risk optimization and consider other methods of capital calculations to account for company-specific risks, for example economic capital models.

(b) BL entered into an index swap with the largest U.S. investment bank, Gator Mallory (GM), in an attempt to hedge its separate account guarantees. Discuss the potential risks associated with this deal, using the Federal Reserve Risk Categories and associated Elements of Insurance Risks as a guide.

Commentary on Question

BL is attempting to hedge its equity market exposure, but no risk management program is perfect and this question is testing candidates' ability to identify the potential risks these programs introduce.

Note that to help candidates the question tried to describe the swap in more detail, but made a mistake in describing the floating leg which should have been max(0,strike/current-1). This was taken into account in grading but generally did not have a material impact on candidates' scores.

For a fixed fee, BL will receive payments when market drops more than 10%. These payments will help offset BL's loss from VA guarantees.

The Model Solution provides an answer that earns full credit, but is certainly not an exhaustive list. Credits were also given to other valid answers.

Candidates who did not do well only listed general risks, instead of discussing risks specifically associated with this deal.

2. Continued

- **Credit / Counterparty:** Daily settlements and GM being the largest IB both serve to reduce the risk, but GM may still fail to pay on a daily basis or default altogether.

- **Concentration:** BL is hedging the entire VA block with 1 counterparty.

- **Net Retention / Policyholder Behavior:** this is not a full reinsurance. With a fixed notional, if policyholder behaviors materially defer from model assumptions BL will be exposed to additional risks from this deal.

- **Basis:** S&P500 is unlikely to track the underlying VA perfectly even when all other model assumptions match actual experience. Strike price may also not match the VA guarantees which were sold at various points in time, i.e. entered when the market was at different levels.

- **Operational:** sufficient expertise, system and internal controls are necessary to handle the execution of this deal.

- **Pricing / Underwriting:** BL may not have priced the swap right, i.e. paying too much on the fixed leg.

- **Liquidity:** BL may have trouble with paying daily settlements.

- **Political / Legal:** changes in government policies and regulations regarding hedging programs and derivatives may affect the deal.

3. Learning Objectives:

7. The candidate will be able to evaluate risks faced by a Company by virtue of the Company's products, assets and management strategies and practices and be able to evaluate the appropriateness of various methods of risk mitigation.

Learning Outcomes:

(7e) Describe and apply methods of risk mitigation and hedging and to understand the limitations of such methods.

Sources:

ILA-C807-09: Market Value Margins for Insurance Liabilities in Financial Reporting and Solvency Applications, E&Y, October 2007

Commentary on Question:

This question tests candidates' understanding of market value margins for insurance liabilities.

The cognitive level of this question is a combination of retrieval and knowledge utilization.

An important concept to remember for this question is that MVM at model start date (t = 0) is the sum of PV (annual costs), where the annual costs are projected all the way out to the end of the projection period. Some candidates only calculated the annual costs for the first year and missed out the last two years.

Most candidates got the three key components of risk margins correct. The area where many candidates lost points on is the BEL calculation, where they failed to use the given BEL(1) value to calculate the BEL(0) value. Most candidates did the DB calculation for year one correctly, however.

Solution:

(a) List and explain the three key components in establishing risk margins under this methodology.

Commentary on Question

Most candidates got the three main points but not necessarily all the sub-bullet points.

1. Capital base
   The first step is to access the degree of risk in the underlying claim and benefit payments.
   From this, determine how much capital is needed to support the risk that these claim and benefit payments exceed their expected values.

3. Continued

2. Time horizon for capital commitment
   The next step is to determine the period over which the capital must be committed and hence the capital base in each period until the final claim liability is paid
   In the case when actual claim and benefit experience emerges as expected, capital intended to support the risk of deviations in these amounts from their expected value can gradually be released.
3. Required rate of return on capital per period
   Finally, for each period during which the capital is held to support the risk associated with the unpaid claims and benefits, the providers of that capital will require an appropriate rate of return.
   Part of that return will be earned through the investment of the capital itself in marketable securities, so the rate of return used for this purpose need only reflect the spread over the risk-free return.
   The spread should reflect the amount of risk and may also include other "frictional costs" associated with holding capital, if any.

(b)

(i) Calculate the best estimate liability (BEL) at the model start date. Show all work.

(ii) Calculate the market value margin (MVM) for this block of business using a one-year exposure horizon. Show all work.

Commentary on Question
For the BEL calculation, most candidates did well on the DB calculation. Some candidates used the wrong formula for the BEL(0) calculation.

For the MVM calculation, the common mistake was using the wrong discount rate and calculating only the first year's values.

Note that there was a printing error in the Issue Date of the policies which caused the policies to be out of force at 1/1/2014, while the grid of BEL values showed policies in force at this date. The issue date should have been one year earlier. While the issue date was not critical for answering the question, full marks were given if the incorrect date lead to an incorrect numerical answer, but most candidates demonstrated an understanding of the underlying formulas and concepts.

Calculate BEL
At end of first policy year:
# of deaths(1) = mortality rate x # of lives(0)
= 3% x 2,000 =60

3. Continued

DB paid(1) = # of deaths(1) x DB amount
= 60 x 100,000 =6,000,000
PVDB(1) = DB paid(1)/(1 + interest rate)
= 6,000,000/(1.04) = 5,769,231
BEL (0) = PV DB Year 1 + BEL (1) / (1 + interest rate)
= 5,769,231 + 16169000 / 1.04 = 21,316,346

Calculate MVM
At time t = 1:
Capital base = BEL(ds) – BEL
= 17,985,000 - 16,169,000 = 1,816,000
Annual cost = capital base x cost of capital
= 1,816,000 x 7% = 127,120
At time t = 2:
Capital base = BEL(ds) – BEL
= 12,627,000 - 10,816,000 = 1,811,000
Annual cost = capital base x cost of capital
= 1,811,000 x 7% = 126,770
At time t = 3:
Capital base = BEL(ds) – BEL
= 7,238,000 - 5,428,000 = 1,810,000
Annual cost = capital base x cost of capital
= 1,810,000 x 7% = 126,700
MVM = sum of PV(annual costs)
= 127,120 / (1.04) +126,770 / (1.04)^2 + 126,700 / (1.04)^3 = 352,073

4. Learning Objectives:

6. The candidate will be able to integrate data from various sources into model office and asset/liability models.

7. The candidate will be able to evaluate risks faced by a Company by virtue of the Company's products, assets and management strategies and practices and be able to evaluate the appropriateness of various methods of risk mitigation.

Learning Outcomes:

(6a) For an ALM model:
- (i) Select appropriate assumptions and scenarios
- (ii) Model dynamic behavior of both assets and liabilities
- (iii) Model and explain various strategies, including hedging
- (iv) Analyze and evaluate results
- (v) Recommend appropriate strategies

(6b) Apply a model office process and make appropriate recommendations.

(7a) Identify, categorize and evaluate potential sources of risk in products including but not limited to mortality, morbidity and lapse.

Sources:

Life Insurance Products and Finance, Ch 14 Financial Modeling

ILA-C116-07: Mapping of Life Insurance Risks, AAA Report to NAIC Multi-Stakeholder Approach to Capital Adequacy (excluding Appendix), Conning Research

Commentary on Question:

The concept in (a) was to ask a specific question on an ALM topic, attempting to elicit the right specific information. It was deliberate that there were no specific products or company situations mentioned. The concept in (b) was to determine whether candidates know how to use memorized formulas in simplified applications.

The question was approximately 1/3 Comprehension and 2/3 Knowledge Utilization.

Candidates generally performed relatively well on section (b)(i), about average on section (b)(ii) and less well on section (a). Section (a) answers frequently did not describe any form of interaction between assets and liabilities (the essence of ALM) and sometimes were less robust than desired. See further commentary by section.

Solution:

(a) With respect to the disintermediation and reinvestment risks:
- (i) Define each of these risks.
- (ii) Explain how duration may be used to manage each of these risks.
- (iii) Explain the impact of changes in both the yields and yield curve shape on these two risks.

4. Continued

Commentary on Question:
For section (a) disintermediation, many candidates did not reflect that the company always has an expectation of when the policyholder will want funds and invests accordingly (most surrenders are not surprises, and invested assets do not automatically have to be sold in a properly managed portfolio holding cash) or that disintermediation may happen for reasons other than earnings available in alternatives (ratings downgrade or run-on-the-bank due to solvency concerns).

For section (a) reinvestment, some candidates did not reflect that earnings rate may also decrease due to asset cash flows (calls and prepayments) or the policyholder may pay additional premium when lower earning investments are available (situation companies face when insufficient spread is available compared to guaranteed minimum interest rate).

(i)

Disintermediation:

- Risk that policyholders make earlier than expected withdrawals.
- Unexpected timing or amounts of cash needs may require asset sales at loses.
- Risk that actual cash flows or liquidation asset values do no coincide with cash flow obligations.
- May also occur due to solvency concerns or ratings downgrade.

Reinvestment:

- Risk that company is not able to earn at least the current interest rates on future positive cash flows.
- Risk that rates will fall causing cash flows from an investment, upon reinvestment to earn less than original underlying asset.
- Risk that yields on investments of varying credit quality, liquidity, or maturity do not move in the same direction or magnitude as liabilities backed by those investments.
- Interest rate fluctuations may affect assets and liabilities differently, which may expose the company to statutory insolvency.
- Policyholders may be more likely to increase premium payments when earnings rates are low in flexible premium policies – still earn guaranteed minimum.

(ii)

- If asset and liability durations have been matched then small changes in interest rates will have approximately same effect on assets and liabilities.
- If duration matched, assets & liabilities will move together - offsetting effect.

4. Continued

- Need to rebalance asset portfolio periodically to maintain duration matching, due to (among others):
  - Changes in interest rates,
  - Changes in assets due to sales, defaults, calls and prepayments,
  - Emerging differences between expected and actual cash flows.
- Duration measures include: Macaulay duration, Modified duration

Disintermediation Risk:

- If most significant risk, maintain asset duration < liability duration.
- Provides earlier than needed asset cash flows to help offset unexpected liability cash flows that might result from an increase in interest rates or inaccuracy in duration matching.

Reinvestment Risk:

- If most significant risk, maintain asset duration = liability duration

(iii)

Lower yields decrease risk of disintermediation and increase reinvestment risk.

- Spread compression or even negative spread between earned and credited interest rates are possible.
- Lower yields tend to increase duration.

Higher yields increase risk of disintermediation and decrease reinvestment risk.

- Spreads may expand beyond target level.
- Higher yields tend to decrease duration.

Disintermediation Risk under various yield curves:

- Steepening – tends toward higher potential.
- Flattening – tends toward medium/low potential.
- Inversion – high yield with short maturity has very high potential.

Reinvestment Risk under various yield curves:

- Steepening – tends toward medium/low potential.
- Flattening – low yield has higher potential.
- Inversion – low investment earnings cost to shorten asset duration.

(b) Given assumptions and information provided in the body of the question:

(i) Calculate the portfolio of bonds and its cost under the cash flow matching strategy. Show all work.

(ii) Calculate the portfolio of bonds under the duration matching strategy using Macaulay duration at 5%. Show all work.

4. Continued

Commentary on Question:
For section (b) some candidates mixed concepts, attempting in a cash flow matching strategy to use discounting to determine the bond portfolio composition or not realizing for the Macaulay duration matching strategy that the liability and each bond separately has its own Macaulay duration. For section (b)(i), some candidates doubled the coupon payment or didn't calculate the matching portfolio cost.

(i) *Cash flow matching strategy*

Coupon Payment for semi-annual coupon = ½ * Annual Coupon Rate * Par Value
Cash flow at maturity = Coupon Payment + Par Value

Bond A: Matures at t=0.5
Coupon Payment (t=0.5) = 10 = ½ * 2.00% * 1,000
Cash flow (t=0.5) = 1,010 = 10 + 1,000

Bond B: Matures at t=1.0
Coupon Payment (t=0.5 & t=1.0) = 30 = ½ * 6.00% * 1,000
Cash flow (t=0.5) = 30
Cash flow (t=1.0) = 1,030 = 30 + 1,000

Liability requirement (t=1.0) = 2,060
Liability requirement (t=0.5) = 3,090

Work backwards from end to beginning, t=1.0 first:
t=1.0: 2,060 = B * 1,030 B = 2 = 2,060/1,030
With two of bond B there is also a coupon payment at t=0.5 of 60 = 2 * 30
Remaining liability requirement (t=0.5) = 3,030 = 3,090 - 60
t=0.5: 3,030 = A * 1,010 A = 3 = 3,030/1,010
Portfolio of bonds for exact cash flow match is 3 Bond A and 2 Bond B.

Price = PV (Cash flows discounted at Yield to Maturity)
Bond A Price = $1{,}004.99 = 1{,}010 / (1 + .010)^{0.5}$
Bond B Price = $1{,}017.79 = 30 / (1 + .012)^{0.5} + 1{,}030 / (1+ .012)^{1.0}$
Check: Yield to Maturity < Coupon rate, therefore, Price > Par value.

Portfolio cost = 3 * 1,004.99 + 2 * 1,017.79 = 5,110.18

(ii) *Macaulay duration matching strategy*

Macaulay Duration = $_{t = 0 \text{ to } n}\sum t\, v^t\, CF_t \,/\, _{t = 0 \text{ to } n}\sum v^t\, CF_t$
Macauley duration for one cash flow = t, the time of that cash flow.

4. Continued

Separate Macaulay duration each for the liabilities, for Bond A and for Bond B.

Mac. Dur. (Liability) = 0.697 = $\frac{0.5*(1/1.05)^{0.5} * 3{,}090 + 1.0*(1/1.05)^{1.0} * 2{,}060}{(1/1.05)^{0.5} * 3{,}090 + (1/1.05)^{1.0} * 2{,}060}$

Mac. Dur. (Bond A) = 0.500 = $\frac{0.5*(1/1.05)^{0.5} * 1{,}010}{(1/1.05)^{0.5} * 1{,}010}$

Mac. Dur. (Bond B) = 0.986 = $\frac{0.5*(1/1.05)^{0.5} * 30 + 1.0*(1/1.05)^{1.0} * 1{,}030}{(1/1.05)^{0.5} * 30 + (1/1.05)^{1.0} * 1{,}030}$

Check: Bond A duration should be 0.5 because that is the only cash flow.
Bond B duration should be less than 1 as a small cash flow is earlier.
Liability duration should be closer to 0.5 than to 1.0.

We only have Bond A and Bond B in which to invest:
Bond A% + Bond B% = 1, or use x for Bond A% and (1 - x) for Bond B%,

Duration of Liabilities = x * Bond A Duration + (1 - x) * Bond B Duration
0.697 = x * 0.5 + (1 - x) * 0.986
0.697 = x * (0.5 – 0.986) + 0.986
-0.289 = x * - 0.486
x = 0.595

To match Macaulay duration, we need 0.595 of Bond A and 0.405 of Bond B.

5. Learning Objectives:

3. The candidate will be able to evaluate various forms of reinsurance, what the financial impact is of each form and describe the circumstances that would make each type of reinsurance appropriate.

6. The candidate will be able to integrate data from various sources into model office and asset/liability models.

Learning Outcomes:

(3a) For traditional and financial reinsurance, explain the consequences and evaluate the effect on both ceding and assuming companies with respect to:
- (i) Risk transfer
- (ii) Cash flow
- (iii) Financial statement presentation
- (iv) Tax impact, and
- (v) Reserve credit requirements.

(3b) Describe the considerations and evaluate the appropriate reinsurance form from the ceding and assuming company perspectives.

(6c) Explain limitations of models and possible sources of error:
- (i) Quality of data
- (ii) Granularity of the model

Sources:

Life & Health Reinsurance – Chapters 4 & 5

ASOP #23 Data Quality

Commentary on Question:

The question tested the candidate knowledge and understanding of various reinsurance arrangements and their impacts.
The question was approximately 40% comprehension and retrieval and 60% knowledge utilization.
Most candidates demonstrated a good level of knowledge on this topic. Note that part (a) also asked for recommendation on the type of reinsurance used, candidates therefore should attempt to make a recommendation in order to get full credit.

Solution:

(a) Explain the two types of reinsurance offered by ABC. Recommend the type of reinsurance which would be most suitable for XYZ.

YRT

- Reinsurance premium is not directly related to the product premium.
- The amount reinsured is based on the Net Amount of Risk.

5. Continued

- The ceding company is responsible for establishing reserves and paying all benefits.
- YRT transfers mortality and morbidity risk only.
- YRT is easy to administer.

Coinsurance

- The reinsurance policy is in the same format as that of the direct company.
- The reinsurance company receives a proportionate share of the direct premiums, and establishes its proportionate share of the reserves.
- All risks are shared.
- The ceding company receives an expense allowance from the reinsurer to cover expenses and commissions.
- The reinsurer shares in the surplus strain of new issues.

Recommendation: XYZ should use coinsurance since the block of business is term insurance and there is a limited surplus amount. Coinsurance will also reduce income volatility.

(b) Calculate the change in XYZ's free surplus at the end of the year under YRT and coinsurance.

Commentary on Question:
Many candidates were able to calculate income under both reinsurance agreements. However, a common mistake among candidates was neglecting to perform the additional calculations to determine free surplus. In order to receive full credit, the candidate should have calculated the EOY Asset, EOY Reserves, and EOY Required Surplus in order to determine the EOY free surplus.

Calculate before tax income before reinsurance, in order to get the tax rate.
Before tax income = Premium + Investment Income – Death Claims – Expenses – Increase in Reserves = 7,200

Free Surplus = Assets – Reserves – Required Surplus
Free surplus before reinsurance = 64,500 – 20,000 – 40,000 = 4,500

YRT
Net premium = 100,000 – 40,000 = 60,000
Investment income = 2,000 (given)
Net claims = 50,000 – 0.75*50,000 = 12,500
Expenses = 25,000
Increase in reserves = 20,000 (since no reserve credit)
Before tax income net of reinsurance = 4,500

5. Continued

After tax income net of reinsurance = Before tax income net of reinsurance * (after tax income before reinsurance/before tax income before reinsurance) = 4,500*(4,500/7,200) = 2,813

EOY Asset = BOY Asset + Premium + Investment Income – Claims – Expenses – Tax = 40,000 + 60,000 + 2,000 – 12,500 – 25,000 – (4,500 – 2,813) = 62,813
EOY Reserves = 20,000
EOY Required Surplus = Required Surplus before reinsurance*(0.5*net face amt/gross face amt + 0.5*net reserve/gross reserve) =
40,000*(0.5*0.25 + 0.5*1) = 25,000
Free surplus net of reinsurance = 62,813 – 20,000 – 25,000 = 17,813
Change in free surplus = 17,813 – 4,500 = 13,313

Coinsurance
Net premium = 100,000 – 0.75*100,000 = 25,000
Investment income = 2,000 (given)
Net claims = 50,000 – 0.75*50,000 = 12,500
Expenses = Expenses – Expense Allowance =
25,000 – 0.25*(0.75*100,000) = 6,250
Increase in reserves = 20,000 – 0.75*20,000 = 5,000
Before tax income net of reinsurance = 3,250
After tax income net of reinsurance = 3,250*(4,500/7,200) = 2031

EOY Asset = 40,000 + 25,000 + 2,000 – 12,500 – 6,250 – (3,250 – 2,031) = 47,031
EOY Reserves = 5,000
EOY Required Surplus = 40,000*(0.5*0.25 + 0.5*0.25) = 10,000
Free surplus net of reinsurance = 47,031 – 5,000 – 10,000 = 32,031
Change in free surplus = 32,031 – 4,500 = 27,531

(c) Explain the responsibilities of ABC's actuary under ASOP #23 with respect to false data and incomplete or inconsistent data.

Commentary on Question:
Most candidates understood that the actuary should review the data but is not required to audit the data or determine if it has been intentionally falsified. Candidates who received full credit were those who wrote a thorough response and hit most of the major details in the solution.

5. Continued

Completely accurate and comprehensive data is never available. The actuary is not required to determine if data is falsified. The actuary is not required to audit the data or perform additional data compilations for the sole purpose of finding questionable data. The actuary should disclose reliance on information supplied by XYZ.

The actuary should review the data provided by XYZ to determine if it is sufficient for performing cash flow testing, if more review is needed, and to check for consistency. Since the XYZ business is so small, there is unlikely to be another source of data. The actuary should disclose any potential existence of uncertainty or bias in the data. If the lack of data quality issue cannot be rectified, the ABC actuary can refuse to sign the opinion.

6. Learning Objectives:

1. The candidate will understand basic financial statements and reports of Can. life insurance companies and be able to analyze the data in them.

Learning Outcomes:

(1e) Describe and critique the framework and principles used in the calculation of reserves under a Fair Value approach.

(1f) Describe emerging developments impacting U.S. GAAP and International Reporting frameworks and assess their impact on the valuation of reserves.

Sources:

ILA-C127-11 July 2010 Exposure Draft - Insurance Contracts, IASB, pages 19 to 84

Commentary on Question:

The question tested candidates' understanding of the proposed valuation model under IFRS 4, and verify that understanding with a numerical example.
The cognitive level is: retrieval for part (a), analysis for part (b), and knowledge utilization for part (c).
To receive maximum points, the candidates needed to be able to define the initial measurement under IFRS 4, with sufficient details on each of the key components, as well as provide an appropriate solution to the numerical part of the question.
Most candidates were able to answer at least part of the question, but few provided a good answer to all parts. The numerical portion in part (c) was generally well answered, while the description of the process to use for a reinsured portfolio was generally poor. Specific comments for each part are provided below.

Solution:

(a)

Commentary on Question:

The description of the initial measurement varied in the level of detail and quality. Many candidates simply listed the building blocks, which was not sufficient given the candidates were asked to define these items. Most candidates understood the purpose of the residual margin. It was not as clear with the risk adjustment, which some candidates considered to be outside of the PV of fulfillment cash flows. Less candidates were able to provide appropriate considerations for the discount rate.

(i) Define the Initial Measurement and its key components.

The initial measurement of an insurance contract is equal to the sum of the PV of fulfillment cash flows and the residual margin.

6. Continued

The PV of the fulfillment cash flows is comprised of:

- An explicit, unbiased and probability-weighted estimate of future cash outflows less future cash inflows
- A discount rate that adjusts the cash flows for the time value of money
- The risk adjustment, which is an explicit estimate of the effects of uncertainty about the amount and timing of the future cash flows
- Only incremental acquisition costs are included in the cash flows

The residual margin eliminates any gain at inception of the contract. It is needed when the expected present value of the future cash outflows plus the risk adjustment is less than the expected present value of the future cash inflows (i.e. when the PV of fulfilment CFs is negative).

(ii) List the considerations in determining the discount rate used in the calculations of the Initial Measurement.

The discount rate should:

- Be consistent with observable current market prices for instruments with cash flows whose characteristics reflect those of the insurance contract liability
- Exclude any factors that influence the observed rates but are not relevant to the insurance contract liability

If the cash flows of an insurance contract do not depend on the performance of specific assets, the discount rate shall reflect the risk free yield curve in the appropriate currency of the instruments with an adjustment for illiquidity.

If the amount, timing, or uncertainty of the cash flows depend on the performance of specific assets, the measurement of the insurance contract shall reflect that dependence.

(b)

Commentary on Question:
Many candidates were able to say whether the statements are true or false, but the corrected false statements were often not fully accurate. Only a small number of candidates were able to explain the process if the portfolio is reinsured. Many candidates simply wrote that net cash flows are used, which is not right as the direct and ceded cash flows are looked at separately, using the same principles.

(i) Assess whether the following statements are true or false. If false, correct the statement to ensure it is true:

6. Continued

1. In order for the embedded derivative (ED) to be separated from its host contract under IAS 39, the ED's economic characteristics should be closely related to its host contract.

2. If separated, the embedded derivative should be measured at fair value under IAS 39.

3. The risk adjustment shall be the chief actuary's best estimate of provision for adverse deviation for the insurance contract.

Statement 1 is false. The ED should be separated from the host contract if the economic characteristics of the ED are not closely related to the host contract, and if a separate instrument with the same terms as the ED would meet the definition of a derivative and be within the scope of IAS 39.

Statement 2 is true.

Statement 3 is false. The risk adjustment is the maximum amount the insurer would rationally pay to be relieved of the risk that the ultimate fulfillment cash flows exceed those expected.

(ii) Explain the process used to determine the present value of the cash flows if the insurance portfolio is reinsured.

The ceding company measures the reinsurance contract at initial recognition as the sum of the PV of fulfilment cash flows plus the residual margin.

The ceding company estimates the PV of the fulfillment cash flows of the reinsurance contract in the same manner as the corresponding part of the PV of the fulfilment cash flows for the underlying insurance contracts.

The ceding company would consider the risk of non-performance by the reinsurer.

The residual margin cannot be negative.

(c) Calculate the insurance liability, under International Financial Reporting Standards (IFRS):

6. Continued

Commentary on Question:
This part was generally well answered by candidates. One common mistake was to use all acquisition costs rather than only using incremental acquisition costs.

Several candidates assumed that the initial annual premium was not included in the expected present value of premiums. No points were lost for this.

(i) At initial recognition, and

EPV of Cash Outflows = EPV of Claims + Incremental Acquisition Costs
= 2,500 + 60 = 2,560

EPV of Cash Inflows = EPV of Premiums = 3,000

PV of Fulfilment CFs = EPV of Cash Outflows + Risk Adjustment
- EPV of Cash Inflows
= 2,560 + 150 - 3,000 = -290

PV of Fulfilment CFs is negative, so need to set-up a residual margin to eliminate the gain at inception

Residual Margin = - PV of Fulfilment CFs = 290

Insurance Liability = PV of Fulfilment CFs + Residual Margin
= -290 + 290 = 0

(ii) Immediately after initial recognition under IFRS.

The initial premium and acquisition costs have been paid and are no longer part of the liability.

EPV of Cash Outflows = EPV of Claims = 2,500

EPV of Cash Inflows = EPV of Premiums - Initial Annual Premium
= 3,000 - 200 = 2,800

Insurance Liability = EPV of Cash Outflows + Risk Adjustment
- EPV of Cash Inflows + Residual Margin
= 2,500 + 150 - 2,800 + 290 = 140

7. Learning Objectives:

4. The candidate will be able to explain and apply the basic methods, approaches and tools of financial management and value creation in a life insurance company context.

8. The candidate will understand the professional standards addressing financial reporting and valuation.

Learning Outcomes:

(4c) Explain and create a product line "gains by source" analysis.

(8c) Identify and apply actuarial standards of practice relevant to financial reporting and valuation.

(8d) Explain the actuary's professional responsibilities to stakeholders including obligations under Sarbanes-Oxley.

Sources:

Actuarial Aspects of SOX 404, Financial Reporter, Dec 2004

Valuation of Life Insurance Liabilities, Ch 15 The Valuation Actuary in the US

1996 Val Act Symposium pages 147-162

Commentary on Question:

Commentary listed underneath each question component.

Solution:

(a) List the key steps a process owner needs to do in order to test an identified control, according to Section 404 of the Sarbanes-Oxley Act.

Commentary on Question:

This part of the question examined the candidates' knowledge regarding the key steps for testing an internal financial reporting control under SOX 404. There are six key steps, listed on page 15 of the Financial Reporter source. Few candidates received full credit for their answer. Many candidates received no credit because they either wrote down another list from the Financial Reporter source or they wrote down nothing at all.

- Determine what actions are necessary to define the effectiveness of the control.
- Add and/or change test steps as needed.
- Execute the test.
- Document the test results.
- Determine if compensating controls exist that would be effective if the control is not effective.

7. Continued

- Prepare a remediation plan for the control if it is determined to not be effective.

(b) An actuarial opinion and memorandum prepared by the Appointed Actuary for ABC Life includes the following statements or practices:

- Cash flow testing is always performed.
- The liability section includes a summary of the reserves held for ABC Life's major products only along with the policy reserve valuation methods used.
- One or more paragraphs to qualify their opinion which discloses any inconsistencies and the release of additional reserves established in a prior opinion including a brief description of any assumptions on which the opinion is based.
- A Source of Earnings statement is included.

Assess the appropriateness of each of the above statements or practices as per Sections 6 & 7 of the Actuarial Opinion and Memorandum Model Regulation and Actuarial Standards of Practice No. 22 and what changes, if any, must be incorporated to ensure the Appointed Actuary complies with these regulations and standards of practice. Justify your answer.

Commentary on Question:
This part of the question examined the candidates' knowledge regarding the required content of an asset adequacy opinion and supporting memorandum. The candidate was asked to assess four specific statements or practices. Many candidates strayed from the scope of the question and discussed (sometimes at length) other aspects of the opinion and memorandum which the question did not inquire about; no credit was given for this extraneous information. Following is specific commentary relative to the four statements or practices that the question inquired about:

- Most candidates realized that cash flow testing is not always necessary and gave an example of a situation where it might not be required. Few candidates mentioned the judgment that ASOP 22 gives to the actuary when deciding whether or not to perform cash flow testing.
- Most candidates realized that the liability section is incomplete and listed some of the missing items. Few candidates listed all of the missing items.
- Most candidates realized the appropriateness of including the paragraph(s) to qualify the opinion.
- Most candidates realized that a Source of Earnings statement is not required.

7. Continued

Firstly, while it is never inappropriate to perform cash flow testing, ASOP 22 allows the actuary to exercise considerable judgment when deciding whether or not cash flow testing is necessary. A key consideration is the sensitivity of cash flows to changing economic conditions. Products where cash flows are relatively insensitive to changes in economic conditions due to design or investment strategy may not require cash flow testing.

Secondly, the liability section is not compliant with Sections 6 & 7 of the model regulation. Section 6 requires a summary of the reserves held for all products, not just the major products. In addition, Section 7 requires product descriptions along with documentation of the following:

- Valuation assumptions
- Source for the liabilities in force
- Investment reserves
- Reinsurance arrangements
- Any guarantees made by the general account in support of benefits provided through a separate account
- Assumptions used in the asset adequacy analysis

Thirdly, under Section 6 of the model regulation, including the paragraph(s) to qualify the opinion is required if in fact the opinion needs to be qualified.

Finally, while it may be helpful to include a Source of Earnings statement to highlight areas where actual experience has deviated from expected experience, neither ASOP 22 nor the model regulation require the statement.

8. Learning Objectives:

8. The candidate will understand the professional standards addressing financial reporting and valuation.

Learning Outcomes:

(8c) Identify and apply actuarial standards of practice relevant to financial reporting and valuation.

Sources:

ASOP 21 – Responding to the Auditor (exc. Transmittal Memo and Appendices)

ASOP 41 – Actuarial Communication (exc. Transmittal Memo and Appendices)

Commentary on Question:

Commentary listed underneath each question component.

Solution:

(a) Explain where the memo does not comply with ASOP 21 – Responding to the Auditor, and ASOP 41 – Actuarial Communication.

Commentary on Question:

Most candidates were able to list out the key objectives and purpose of the two ASOP's. To get full credits, candidates should list out the ASOPs, the recommended practices as per the ASOP and include a discussion of how/where the guidelines are violated. Some candidates did not discuss the violations, while other candidates did not answer the question in respect to the two ASOP's. Some candidates confused the "student" in the question as the "responding actuary."

21-3.1.3. Responding actuary should be appropriately responsive to the auditor's or examiner's reasonable requests.

- Nine weeks after request is not appropriately responsive

21-3.1.2 Responding actuary should be prepared to discuss with the auditor known circumstances that have a significant effect.

- Circumstances include: Changes in operating environment; Trends in experience; Product or plan changes and changes in product mix or demographic mix; Changes in the entity's methods, policies, or procedures, or in statutory valuation bases; Compliance with relevant new or revised accounting rules, laws, and regulations
- Responding actuary here is not prepared to discuss operating environment
- Responding actuary here is blaming consultant or key person that left or lack of resource.

8. Continued

21-3.1.1 Responding actuary should be prepared to discuss with the auditor data items based on documentation:

- Data used
- Source of prescribed assumption and basis for assumptions that are not prescribed assumptions
- Methods used
- Responding actuary here has not prepared adequate data to share with auditor
- Responding actuary has not collected adequate data from consultant or key person that has now left
- Responding actuary did not conduct parallel testing to ensure reserves are appropriately calculated

21-3.2.2 In addition to ASOP 41 documentation requirements, reviewing actuary's documentation should include:

- Evidence the reviewing actuary's procedures have been planned and coordinated with the auditor
- Summary description of the items subject to the reviewing actuary's audit or examination procedures
- Responding actuary shows no evidence of planning, coordination, or preparation of summary descriptions

41-3.1.4 The actuary issuing an actuarial communication should ensure that the actuarial communication clearly identifies the actuary as being responsible

- No identification of responding actuary in proposed memo

41-3.1.6 An actuary who makes an actuarial communication assumes responsibility for it except to the extent that actuary disclaims responsibility by stating reliance on other sources.

- Reliance on others is fine as long as it is reasonable to rely upon them

41-3.5.1 An actuarial communication may be used in a way that may influence persons who are not part of the intended audience.

- Included language in the actuarial communication, which may limit its distribution to other users.
- No language in memo limits the audience to desired

8. Continued

(b) Recommend changes, if any, in company policy and process regarding ASOP 21 and ASOP 41.

Commentary on Question:
Candidates should be aware that the question is asking for improvements specifically related to the ASOPs for responding to the auditors. Many candidates wrote about general improvements for the company, such as process/system improvements.

21-3.1.3 Respond within a reasonable time of any auditor request
41-2.1.3 Respond with recent data properly summarized and described
21-3.1.2 Respond with appropriate discussion of changes in operating environment
21-3.1.1 Respond with data that is documented
21-3.2.2 Demonstrate planning and coordination with auditor
41-3.1.4 Clearly identify the responding actuary
41-3.1.6 Properly rely on others for information
41-3.5.1 Properly limit the audience to avoid any misuse of information

9. Learning Objectives:

1. The candidate will understand basic financial statements and reports of U.S. life insurance companies and be able to analyze the data in them.

2. The candidate will be able to understand and apply valuation principles of individual life insurance and annuity products issued by U.S. life insurance companies.

Learning Outcomes:

(1e) Describe and critique the framework and principles used in the calculation of reserves under a Fair Value approach.

(2b) Recommend appropriate valuation under the following standards:
- (i) U.S. Statutory
- (ii) U.S. GAAP
- (iii) U.S. Tax
- (iv) Fair Value Accounting

Sources:

SFAS 157 Fair Value Measurements, paragraphs 1-30

"An Approach for Measurement of the Fair Value of Insurance Contracts", Actuarial Practice Forum, May 2007

ILA-C810-09: AAA Practice Note: Draft Notes on FAS 157 and 159

FAS 157 Staff Position Paper, pp. 1-8

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Define the following as they relate to the determination of fair value of insurance liabilities:

(i) Principal Market

(ii) Most Advantageous Market

Principal market is the market in which the reporting entity would sell the asset and transfer the liability with greatest volume and level of activity (primary market).
Fair value or exit price shall represent the price in principal market.

9. Continued

Most Advantageous market is the market in which the reporting entity would sell the asset or transfer the liability with the price that maximizes the amount received for the asset or minimize the amount paid to transfer the liability. Shall only be considered in the absence of a principal market.

(b) Describe the limitations of the following potential markets in consideration of determining the fair value of life insurance products:

(i) Life insurance company market

(ii) Reinsurance market

(iii) Capital markets

The life insurance company market

- Market between insurers
- Fair value based on price that the insurance company would have to pay another operating in the same insurance market to take on the obligations and associated revenues of life insurance contracts
- Market prices not readily observable
  - Low transaction volume
  - Uniqueness of company's liabilities
  - Deals may combine a basket of products and intangibles

The reinsurance market

- Market in which the insurer could transfer the risks associated with the contract or embedded derivative in a reinsurance transaction
- Reinsurance may not represent full transfer of the liability
- Counterparty risk remains
- Reinsurance deals are generally unique
- May not be possible to get directly observable market prices
- Quotes may, however, provide useful market data for the determination of fair value

Capital markets

- Market in which the insurer could transfer certain risks associated with contracts that contain capital market risks
- Capital market solutions available for insurance do not represent a full transfer of the liability
- Counterparty risk remains

9. Continued

- Capital market transactions do not involve a transfer of all risks
  - Policyholder behavior risk, mortality risk, basis risk, and model risk not transferred

(c) Identify when and why a customer consideration model could serve as a substitute to an exit price model in the determination of fair value.

Commentary on Question:
Understanding of exit and entry price concepts is important. Demonstrate the ability to relate the concepts to insurance market is critical to earn points.

Why:
A customer consideration model is an entry price model
It uses observed transaction prices from the retail or business-to-consumer market. An exit price model uses observed transaction prices from the wholesale or business-to-business market.
Business-to-business transaction prices represent an estimate of the price that market participants would demand to settle a liability.
Therefore, conceptually an exit price model is more consistent with fair value concepts.

If an exit price model is available, a customer consideration model should not be considered to determine fair value.

However,
- There is no active business-to-business reference market for insurance contracts
- Limited breadth, liquidity, and frequency of observable prices in this market make it a challenge to develop reliable info
- Large markets transactions are impacted by entity-specific and strategic considerations
-

Therefore, we consider to use customer consider model because the only current market where insurance liabilities are frequently traded with minimal transaction-specific distortion is the business-to-consumer market.

When:
The customer consideration model would produce a value equivalent to the exit value when:
- Entity-specific values eliminated are eliminated from the exit price model
- Unit of account is the individual insurance contract

9. Continued

In a customer consideration model, a market participant would be indifferent between receiving the same amount of money from the transferring entity or the insured

From the POV of a market participant, the return would be the same.

A significant difference between estimates based on exit value and a customer consideration model relates to the different use of the unit of account between the portfolio and the individual contract, respectively.

(d) ABC recently acquired a large block of term policies from XYZ Insurance Company, another subsidiary of MegaConglomorate, after XYZ exited the term market. Your boss, the Chief Actuary, recommends reporting the fair value as the transaction price, based on it being the most recently observable price for the block and the fact that ABC intends to hold the liability on the books until maturity.

Commentary on Question:
Demonstrate the ability to distinguish the transaction price (entry price) and fair value (exit price) is critical. Also important to understand that fair value is market based and is between independent parties.

The transaction price:
- Is an entry price
- Represents the price paid to assume the liability

The fair value:
- Is an exit price
- Should represent the price received to transfer the liability

So fundamentally, the transaction price is not a good measure of fair value because it is an entry price.
In many cases, however, the entry price (transaction price) will equal the exit price.

This is NOT the case in the example because:
- The transaction is between related parties.
- That is, the price is NOT indicative of how market participants would value the business under current market conditions.
- ABC's intention to hold the liability is not relevant in estimating fair value.
- FV is market-based; ABC's intentions are entity-based.

10. Learning Objectives:

2. The candidate will be able to understand and apply valuation principles of individual life insurance and annuity products issued by U.S. life insurance companies.

Learning Outcomes:

(2c) Calculate liabilities under U.S. statutory, U.S. tax, U.S. GAAP, and DAC assets under U.S. GAAP for the following products:
- (i) Traditional life insurance
- (ii) Term life insurance
- (iii) Universal life insurance
- (iv) Universal life insurance with secondary guarantees
- (v) Deferred annuity
- (vi) Payout annuity
- (vii) Variable annuity with guaranteed minimum death benefits
- (viii) Variable annuity with guaranteed living benefits
- (ix) Equity-indexed annuities
- (x) Equity-indexed life insurance
- (xi) Variable life insurance with guaranteed minimum death benefits
- (xii) Riders

Sources:

Valuation of Life Insurance Liabilities, Chapter 10 Deferred Annuities

Commentary on Question:

This question tested the candidates' understanding of the CARVM reserve calculations. To receive maximum credit, candidates need to show the impact of partial withdrawals on the CARVM calculation.

Most candidates did well on this problem. Some struggled with the calculation of the partial withdrawal.

Solution:

Calculate the CARVM reserve, as described in *Valuation of Life Insurance Liabilities*, for Mr. Vandelay's contract at issue. Show all work.

Intuitively by looking at the assumptions, the worst-case present value of benefits will occur in a pattern that has taken the maximum partial withdrawals to date. However, because of the interaction of the credited rate, surrender charge rate and valuation rate, it is not intuitively clear at what year-end the worst case PV will occur. Thus it is necessary to test the PV of benefits if Mr. Vandelay were to take the maximum partial withdrawals and lapse at each year end. To be rigorous, I could also test the PV assuming no withdrawals or a pattern of some years with withdrawals and some without, but I know that it will not find the worst case PV

10. Continued

Year 1:

Fund at end of Year 1 before withdrawal = 50000 * 1.032 = 51600
Max partial withdrawal for year 1 = 51600 * .025 = 1290
Fund at end of Year 1 with max withdrawal taken = 51600 – 1290 = 50310

CSV With Partial Withdrawal = 50310 * .95 = 47794.50
PV Benefits = 47794.50 / 1.04 + 1290 / 1.04 = 47196.63

Year 2:

Fund at end of Year 2 before Year 2 withdrawal = 50310 * 1.032 = 51919.92
Max partial withdrawal for year 2 = 52951.92 * .025 = 1298.00
Fund at end of Year 2 with max withdrawal taken = 51919.92 – 1298.00 = 50621.92

CSV with Partial Withdrawals = 50621.92 * .98 = 49609.48
PV Benefits = 49609.48 / 1.04^2 + 1298.00 / 1.04^2 + 1290 / 1.04 = 48307.21

Year 3:

Fund at end of Year 3 before Year 3 withdrawal = 50621.92 * 1.015 = 51381.25
Because there is no surrender charge at the end of year 3, no need to calculate the free partial withdrawal since it is all free
PV Benefits = 51381.25 / 1.04^3 + 1298.00 / 1.04^2 + 1290 / 1.04 = 48307.21 = 48118.20

Worst case PV assumes Vandelay lapses at the end of year 2. Thus CARVM reserve at issue = $48,307.21

Year 2:
Largest partial withdrawal = 50,000(1.032)(1.032)(0.025) = 1,331.28
CSV without partial withdrawal = 50,000(1.032)(1.032)(0.98) = 52,186.18
CSV with 1 partial withdrawal = 50,000(1.032)(1.032)(0.98)(0.975) = 50,881.52
CSV with 2 partial withdrawals = 50,000(1.032)(1.032)(0.98)(0.975)(0.975) = 49,609.48
PV of maximum benefit = PV of CSV without partial withdrawal = 52,186.18/[(1.04)(1.04)] = 48,249.06

Year 3:
Largest partial withdrawal = 0.025(50,000)(1.032)(1.032)(1.015) = 1,351.25
CSV without partial withdrawal = 50,000(1.032)(1.032)(1.015) = 54,049.97
CSV with 1 partial withdrawal = 50,000(1.032)(1.032)(1.015)(0.975) = 52,698.72

10. Continued

CSV with 2 partial withdrawals = 50,000(1.032)(1.032)(1.015)(0.975)(0.975) = 51,381.25
CSV with 3 partial withdrawals = 50,000(1.032)(1.032)(1.015)(0.975)(0.975)(0.975) = 50,096.72
PV of maximum benefit = PV of CSV without partial withdrawal = 54,049.97/[(1.04)(1.04)(1.04)] = 48,050.22

CARVM Reserve = Greatest Present Value = 48,249.06

11. Learning Objectives:

2. The candidate will be able to understand and apply valuation principles of individual life insurance and annuity products issued by U.S. life insurance companies.

Learning Outcomes:

(2c) Calculate liabilities under U.S. statutory, U.S. tax, U.S. GAAP, and DAC assets under U.S. GAAP for the following products:

- (i) Traditional life insurance
- (ii) Term life insurance
- (iii) Universal life insurance
- (iv) Universal life insurance with secondary guarantees
- (v) Deferred annuity
- (vi) Payout annuity
- (vii) Variable annuity with guaranteed minimum death benefits
- (viii) Variable annuity with guaranteed living benefits
- (ix) Equity-indexed annuities
- (x) Equity-indexed life insurance
- (xi) Variable life insurance with guaranteed minimum death benefits
- (xii) Riders

Sources:

Valuation of Life Insurance Liabilities, Chapter 5 Valuation Methodologies and Approximations

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Calculate both the mean and terminal reserves at valuation date using the Net Level premium method assuming the death benefits are paid at the end of the policy year (curtate). Show all work.

Commentary on Question:

- Candidates on the whole did very well on this part of the question.
- Question is testing knowledge and utilization of reserve calculation.
- It is important to note that the term "Mid-Terminal" reserves applies only when $h = 0.5$. In this case the calculation calls for $h = 0.75$, so the correct terminology is interpolated "Terminal" reserves, but the formula remains the same.
- Recursive formulas for reserves and PV(Death Benefit) were accepted in place of above formulas if they were correct. Many candidates omitted the denominator and did not receive full credit.
- Constant percentage of gross premiums method was accepted in lieu of above NLP formula.

11. Continued

Need to calculate reserves at time 0 (V_0) and at time 1 (V_1), then calculate interpolated mean and terminal reserves at time h=0.75.

- *Net Level Premium Reserve Formula:*
  $Reserve_t = PV(Future\ benefits)_t - PV(Future\ Premiums)_t$
  ${}^{m}{}_{t}VB_{x:n} = AB_{x+t:n-t} - ({}_{m}NLP_{x:n})(\ddot{a}_{x+t:m-t})$
- $AB_{45:4} = 2136.93$ (stated in problem, no credit awarded for recalculating this)
- $\ddot{a}_{45:3} = 1 + vp_{45} + v^2p_{45}p_{46} = 1 + (1.035)^{-1}(1-.00694) + (1.035)^{-2}(1-1.00694)(1-.00753) = 2.8795$
- *Net Level Premium Formula:*
  ${}_{m}NLP_{x:n} = AB_{x:n} \div \ddot{a}_{x:m}$
  $NLP = AB_{45:4} \div \ddot{a}_{45:3} = 2136.93 \div 2.8795 = 742.12$
- $VB_0 = 0$ (definition of NLP reserves)
- $\ddot{a}_{46:2} = 1 + vp_{46} = 1 + (1.035)^{-1}(1-.00753) = 1.9589$
- $AB_{46:3} = DB\ (vq_{46}+v^2p_{46}q_{47}+v^3p_{46}+p_{47}q_{48})$
  $= (75000)[(1.035^{-1})(.00753)+(1.035^{-2})(1-.00753)(.00805)+(1.035^{-3})(1-.00753)(1-.00805)(.00898)] = 1703.05$
- $VB_{46:3} = AB_{46:3}-(NLP)(\ddot{a}_{46:2}) = 1703.05-(742.12)(1.95895) = 249.31$
- $h = 9\ months \div 12\ months = 0.75$
- *Mean Reserve Formula* $= (1-h)({}_{t}V_{x:n}+NLP_{x+t:n}) + (h)({}_{t+1}V_{x:n})$
  $=(1-.75)({}_{0}VB_{45:4}+NLP_{45:4}) + (.75)({}_{1}VB_{45:4}) = (.25)(0+742.12)+(.75)(249.31) = 372.51$
- *Terminal Reserve Formula* $= (1-h)({}_{t}V_{x:n}) + (h)({}_{t+1}V_{x:n})$
  $=(1-.75)({}_{0}VB_{45:4}) + (.75)({}_{1}VB_{45:4}) = (.25)(0)+(.75)(249.31) = 186.98$

(b) Describe, in words, the changes needed to convert reserves calculated on a curtate basis to the following continuous bases.

(i) Semi-Continuous Reserves

(ii) Fully Continuous Reserves

(iii) Discounted Continuous Reserves

Commentary on Question:

- Overall, candidates did not do well on this question.
- This question tests candidates' comprehension of non-curtate reserve methodology.
- The question states "in words," so no credit was given for use or presentation of formulas.

11. Continued

- The question is looking for characteristics that differ from curtate methods. Many candidates wrote "Net premiums are payable annually at beginning of year" for section (i):Semi-Continuous. While this is true, it does not differ from curtate methods in that respect. This response received no additional credit.

(i) Semi-Continuous Reserves
- Death benefits are payable at the moment of death
- Eliminates the needs for immediate payment of claims reserves
- A deferred premium asset is calculated if the mode is other than annual
- Expense allowance is larger if not using net level premium method

(ii) Fully Continuous Reserves
- Death benefits are payable at the moment of death.
- Premiums are payable continuously throughout the year.
- Eliminates the needs for immediate payment of claims reserves.
- Reserve factors are mid-terminals (Mean reserves are not used).
- Unearned premium reserve must be set up for net premiums paid beyond the valuation date.

(iii) Discounted Continuous Reserves
- Death benefits are payable at the moment of death.
- Net Premiums are payable annually at the beginning of the year with a refund of the unearned portion of the current year's premium at death.
- Mean reserves are calculated assuming an annual net premium equal to the continuous net premium discounted with interest only.
- A deferred premium asset is calculated if the mode is other than annual.
- Expense allowance is larger if not using net level premium method.
- No refund or nondeduction reserve held.

12. Learning Objectives:

2. The candidate will be able to understand and apply valuation principles of individual life insurance and annuity products issued by U.S. life insurance companies.

4. The candidate will be able to explain and apply the basic methods, approaches and tools of financial management and value creation in a life insurance company context.

Learning Outcomes:

(2c) Calculate liabilities under U.S. statutory, U.S. tax, U.S. GAAP, and DAC assets under U.S. GAAP for the following products:
- (i) Traditional life insurance
- (ii) Term life insurance
- (iii) Universal life insurance
- (iv) Universal life insurance with secondary guarantees
- (v) Deferred annuity
- (vi) Payout annuity
- (vii) Variable annuity with guaranteed minimum death benefits
- (viii) Variable annuity with guaranteed living benefits
- (ix) Equity-indexed annuities
- (x) Equity-indexed life insurance
- (xi) Variable life insurance with guaranteed minimum death benefits
- (xii) Riders

(4c) Explain and create a product line "gains by source" analysis.

(4d) Apply methods of valuation to business and asset acquisitions and sales including explaining and applying the methods and principles of embedded value.

Sources:

US GAAP For Life Insurers, Chapter 4 Traditional Life Insurance (SFAS 60 & 97)

Embedded Value: Practice and Theory, Actuarial Practice Forum, March 2009

1996 Valuation Actuary Symposium (pages 147-162)

Embedded Value: Practice and Theory, Actuarial Practice Forum, March 2009

Life Insurance Products and Finance, Chapter 16 Financial Management

12. Continued

Commentary on Question:
Parts (a) and (b) of the question test the candidates' understanding of the differences in the determination of earnings on a GAAP basis and a Statutory basis as well the relationship between Statutory Earnings and Distributable Earnings as well as the sources of earnings involved in Statutory Earnings.

Part(c) of the question tests the candidates' understanding of how Embedded Value relates to the minimum assets needed to sell a block of business.

Solution:
(a)

(i) Determine the earnings of XYZ on a GAAP and Statutory Basis for both 2010 and 2011.
(ii) Determine the Distributable earnings for both 2010 and 2011.

Show all work.

(i) GAAP Earnings = Premium + Interest – Deaths – Surrenders – Non-deferrable Expenses – Maintenance Expenses – DAC Amortization – Change in GAAP Reserves

2010= 160 + 80 -16 -45 – 25 – 10 -15 – (180-107) = 56
2011= 140 + 70 -13 -60 – 25 – 15 -14 – (210-180) = 53

Statutory Earnings = Premium + Interest – Deaths – Surrenders – (Deferrable Expenses +Non-deferrable Expenses + Maintenance Expenses) – Change in Statutory Reserves

2010= 160 + 80 -16 -45 – 10 – 25 – 10 – (190-110) = 54
2011= 140 + 70 -13 -60 – 8 – 25 – 15 – (220-190) = 59

(ii) Distributable Earnings = Statutory Earnings – Tax + Investment Income on Beginning of Year Required Capital – Change in Required Capital

2010 = 54 – 20 + .05*10 – (19-10) = 25.5
2011 = 59 – 21 + .045*19 – (26-19) = 31.855

(b)

(i) Perform a Source of Earnings analysis based on Statutory Earnings.
(ii) Evaluate whether the actuarial student's statement is correct based on your Source of Earnings analysis.

Premium Loading = Gross Premium – Net Premium = GP - NP
2010 = 160-115=45

12. Continued

2011 = 140-109=31
Variance = 31 – 45 = -14

Interest = Actual i*(Beginning Reserve + GP – Actual Expenses)
Minus Planned i*(Beginning Reserve + NP – Planned Expenses)
2010 = .05*(110+160-(10+25+10) - .06*(110+115-50) = .75
2011 = .045*(190+140-(8+25+15) - .055*(190+109-60) = -.455
Variance = – .455 - .75 = -1.205

Deaths = (Planned q – Actual q)*(Death Benefit – End of Year Reserve)
2010 = (.002-.0016)*(10,000-190) = 3.92
2011 = (.003-.0013)*(10,000-220) = 16.63
Variance = 16.63 – 3.92 = 12.71

Surrenders = (Planned qw – Actual qw)*(Cash Surrender Value– End of Year Reserve)
2010 = (.1-.12)*(190-190) = 0.00
2011 = (.11-.13)*(220-220) = 0.00
Variance = 0.00 – 0.00 = 0.00

Expenses = Planned Expenses – Actual Expenses
2010 = 50 – (10+25+10) = 5
2011 = 60 – (8+25+15) = 12
Variance = 12 – 5 = 7

Statutory Source of Earnings = Premium Loading + Interest + Deaths + Surrenders + Expenses
2010 = 45 +.75 +3.92 +0.00 + 5 = 54.7
2011 = 31 - .455 + 16.63 + 0.00 + 12 = 59.2
Variance = 59.2 – 54.7 = 4.5

The actuarial student's analysis is correct for premiums, but not surrenders. Deaths are a significant source of earnings as are expenses.

12. Continued

(c)

(i) Define Embedded Value.

(ii) Determine the minimum assets that must be transferred at year end 2011 in order to sell the block of business given the Embedded Value at year end 2011 is 50.2M, ignoring transaction costs and taxes. Show all work.

Embedded Value is a means of measuring the value of business at any point in time and of assessing the financial performance of the business over time.

Minimum Assets = Solvency Reserve + Required Capital – Embedded Value

$= 220 + 26 – 50.2 = 195.8$

13. Learning Objectives:

1. The candidate will understand basic financial statements and reports of U.S. life insurance companies and be able to analyze the data in them.

2. The candidate will be able to understand and apply valuation principles of individual life insurance and annuity products issued by U.S. life insurance companies.

Learning Outcomes:

(1a) Construct the basic financial statements for a life insurance company under U.S. GAAP and Statutory accounting methods and principles.

(2c) Calculate liabilities under U.S. statutory, U.S. tax, U.S. GAAP, and DAC assets under U.S. GAAP for the following products:
- (i) Traditional life insurance
- (ii) Term life insurance
- (iii) Universal life insurance
- (iv) Universal life insurance with secondary guarantees
- (v) Deferred annuity
- (vi) Payout annuity
- (vii) Variable annuity with guaranteed minimum death benefits
- (viii) Variable annuity with guaranteed living benefits
- (ix) Equity-indexed annuities
- (x) Equity-indexed life insurance
- (xi) Variable life insurance with guaranteed minimum death benefits
- (xii) Riders

Sources:

US GAAP for Life Insurers, Second Edition, Chapters 7 (Deferred Annuities) and 14 (Shadow Adjustments)

Commentary on Question:

Solution:

(a) Discuss the rationale behind including shadow DAC adjustments in U.S. GAAP Accounting.

SFAS 115 requires assets classified as "available for sale" (AFS) are reported at fair value, where the market value/book value (unrealized holding gains and losses – UHG&Ls) difference are credited to a separate component of shareholder equity. Thus assets are held at fair value, but liabilities are not. That leads to volatilities in the separate component of shareholder equity.

13. Continued

Shadow adjustments are to offset the gross UHG&Ls, and reduce the volatilities. Assume AFS assets are sold on the valuation date, it will have impact on liability side too. When the unrealized gains are realized, that would increase the EGP in the current period and possibly lower EGP in future periods. So the immediate realization of unrealized gain would cause greater DAC amortization during the current period. The "new" DAC, calculated assuming all UHG&Ls are realized, minus the original DAC, is the shadow DAC adjustment.

(b) Calculate the 12/31/2011 DAC asset prior to the shadow DAC adjustment, and the SFAS 115 shadow DAC adjustment for this block of business.
Show all work.

CALCLUATE DAC

PV at time zero of Capitalized Acquisition costs:
= 500 + 300 / 1.04 + 100 / 1.04^2 + 100 / 1.04^3
= 969.82

PV at time zero of EGPs
= 300 / 1.04 + 1800 / 1.04^2 + 1700 / 1.04^3 + 1200 / 1.04^4 + 800 / 1.04^5
= 5147.26

k = 969.82 / 5147.26 = 18.84%

DAC = k * PV of future EGP - PV future def costs
= 18.84% * (1200 / 1.04 + 800 /1.04^2) - 100
= 256.73

CALCULATE SHADOW DAC ADJUSTMENT

UHG&L
= Market Value of Available For Sale - Reported Value of Available for Sale
= 3400 - 3000 = 400

Shadow DAC Adjustment
= -k * UhG&L
= -18.84% * 400
= -75.36

13. Continued

(c) You have just been notified that a large last-minute maintenance expense is being booked against this line of business for the 2011 financials. Predict how this will affect DAC amortization in calendar year 2011. Justify your answer.

Maintenance expense is not deferrable, so DAE and DAC are not affected.
But EGPs in 2011 is reduced. Less EGPs in 2011 will decrease PV(EGP) at time of issue, and will increase the k-factor.
DAC_2011 = k * PV of future EGP - PV future def costs
Higher k-factor will result in higher DAC balance at end of 2011, which means less DAC amortization in 2011.