ILA LFVC Model Solutions
Fall 2017

1. Learning Objectives:

3. The candidate will understand and apply emerging financial and valuation standards, principles and methodologies.

Learning Outcomes:

(3a) Describe, evaluate and calculate the impact on reserves, income, capital, and processes of emerging developments in Statutory and U.S. GAAP reporting, International Financial Reporting Standards, and Solvency Modernization.

Sources:

LFV-134-16: IFRS PWC Ready or Not, October 2014

LFV-132-14: Practical Guide to IFRS, PwC (July 2013)

IFRS 4 Phase II: Illustrative Example of Life Contract Without Participation Features, EY June 2015

Commentary on Question:

This question tested the candidates' understanding of emerging standards of practice under IFRS17 and how various balance sheet and income items are calculated.

Solution:

(a)

(i) Calculate the Contractual Service Margin (CSM) at issue. Show all work.

(ii) You are given the following at the end of policy year 1:

- Best estimate liability: -7.92
- Risk adjustment: 5.48

Calculate the CSM at the end of policy year 1, assuming no changes in assumptions. Show all work.

1. Continued

Commentary on Question:
Candidates were generally able to earn partial credit for their responses. There were two common errors. First, the equation 0 = BEL + RA + CSM is not correct as it ignores the fact the CSM cannot be negative. Second, most candidates struggled on part (ii) attempting to calculate the CSM using the BEL and RA at time 1 instead of amortizing the time zero CSM using a metric they deemed appropriate.

(i) BEL = (0.2% * 25,000) + (0.3% * 20,000) + (6.5% * -20) + (53% * -50) + (40% * -243) = -15

CSM = Max(0,- (BEL + RA)) = Max(0,-(-15+11) = Max(0,4) = **4**

(ii) The CSM is amortized over the coverage period in a systemic way that best reflects the remaining service

The CSM is adjusted for changes in cash flows related to future service, but not for current and past coverage

As assumptions about the future have not changed:

$CSM_1 = CSM_0$ * Amortization Factor

For short duration term, a straight-line method is reasonable for amortizing the CSM:

$CSM_1 = CSM_0 * (1/2) = 4 * 0.5 =$ **2**

Note - Other Amortization patterns (claims, BEL, etc) were appropriate and able to earn full credit providing the candidate justified their approach

(b) Determine the direction of each event's impact, if any, on the following policy year 1 financial results:

(i) the underwriting result on the income statement

(ii) the investment result on the income statement

(iii) other comprehensive income

Justify your responses.

1. Continued

Commentary on Question:
*Candidates were generally able earn partial credit for their responses. A common error was that candidates assumed the impact of discount rate changes must flow through OCI. This is incorrect, since IFRS17 allows an entity the option of recognizing the impact of discount rate changes in **either** P&L or OCI. To receive full credit, the candidate needed to identify the earnings emergence under both options.*

A – The probability of converting is increased

(i) Underwriting Result – Assumption changes unlock the CSM. Thus, there is no impact to the UW result unless the value of the assumption change exceeds the remaining CSM.

(ii) Investment Results – No impact as changes in policyholder behavior are recognized in Underwriting Results

(iii) OCI – No impact as changes in policyholder behavior are recognized in Underwriting Results

B – The discount rate is increased

(i) Underwriting Result – No impact as changes in discount rate are recognized in either Investment Income or OCI

Under IFRS 17 and entity has the option of reflecting changes in discount rate in either Investment Income or OCI. If the entity has chosen to recognize discount rate changes in Investment Income:

(ii) Investment Results – Positive Impact due to a lower liability

(iii) OCI – No impact

If the entity has chosen to recognize discount rate changes in OCI:

(ii) Investment Results – No impact

(iii) OCI - Positive Impact due to a lower liability

1. **Continued**

C – The policyholder does not die

(i) Underwriting Result – Positive impact as claims paid are less than expected

(ii) Investment Results – No impact as demographic experience is recognized in Underwriting Results

(iii) OCI – No impact as demographic experience is recognized in underwriting Results

D – The policyholder does not lapse

(i) Underwriting Result – Positive impact as persistency improves and more premium is collected than expected

Note - Stating this had a negative impact to underwriting results was also appropriate as the direction of the change was ambiguous

(ii) Investment Results – No impact as demographic experience is recognized in Underwriting Results

(iii) OCI – No impact as demographic experience is recognized in Underwriting Results

2. Learning Objectives:

5. The candidate will understand the nature and uses of basic reinsurance arrangements used by life insurance companies.

Learning Outcomes:

(5a) The candidate will understand the various forms of reinsurance, and be able to, with respect to both the ceding and assuming parties, analyze and evaluate:
- (i) Risk transfer considerations
- (ii) Cash flow mechanics
- (iii) Accounting and financial statement impacts
- (iv) Reserve credit considerations

Sources:

Life, Health & Annuity Reinsurance, Tiller, 4th Edition

Commentary on Question:

This question tested the candidates' knowledge of quota share reinsurance.

Solution:

(a) Explain the advantages and disadvantages of coinsurance to reinsure an inforce block of business.

Commentary on Question:

Candidates generally did well on this part of the question.

Advantages:

- Coinsurance is relatively simple to administer
- Fewer questions regarding the transfer of risk from the regulator point of view.

Disadvantages:

- Need to transfer assets equal to the initial reserves less allowance
- For interest sensitive or par products the reinsurer may want effective control or veto power over the dividend or interest rate determination
- Coinsurance requires the reinsurer to manage the assets and subjects the reinsurer to investment risk
- If reinsurance is terminated, assets equal to the reserves less any termination fee must be transferred to the ceding company
- If the reinsurer does not meet required standards the ceding company may be unable to take credit in its statutory statements for the reserves held by the reinsurer
- Coinsurance subjects the ceding company to additional credit risk

2. Continued

(b) Calculate the gain from operations for each company in year t. Show all work.

Commentary on Question:
This part of the question tested candidates' understanding of reinsurance on a quota share basis and excess loss basis. Most candidates did well at working out the financials for quota share reinsurance, but only a few got the excess loss basis right.

A common mistake was on the reserve calculation. Since death benefits are assumed to incur at the end of the year, the ending reserve should be calculated using number of lives after decrement. Most candidates did not consider decrements in the reserve calculation.

Another common mistake was that many candidates did not include the investment income on net premium.

GHI
Reinsurance Amount per life for GHI for each cohort = $(DB*Quota\ Share\%\_DEF) - 500$
Reinsurance % for GHI = $(Reins\ Amt)/(Total\ DB)$ *Since all lives are identical*
$GHIReins\%\_1 = Max(((1500*0.6)-500)/1500,0) = 26.7\%$
$GHIReins\%\_2 = Max(((800*0.6)-500)/800,0) = 0\%$
GHI Premium = $\sum Prem\_i * \#Lives\_i * Reins\%\_i$
$DEFReins\%\_i = 100\% - ABCIns\% - GHIReins\%\_i$
$DEFReins\%\_1 = 33.3\%$
$DEFReins\%\_2 = 60.0\%$
$Claims = Total\ Claims * Reins\%$
$ReserveIncrease\_i$ = $(Reserve\_t$ * $\#Lives$ EOY$_i$ - $Reserve\_(t-1)$ * $\#Lives$ BOY$_i)$ * $Reins\%\_i$

2. Continued

Company	Invested assets	Operating expenses
ABC	1750	100
DEF	3000	50
GHI	500	25

Cohort	Face Amount per Policy	Reserve(t-1)	Reserve(t)	Annual Premium / Policy	Number of lives (BOY)	Total Claims
1	1,500	3.50	3.75	9.00	200	1500
2	800	4.30	4.45	5.40	400	2400

Quota Share %	0.6	Retained amount	500
Return on Inv	0.035		
GHIReins%1	26.7%		
GHIReins%2	0.0%		
ABCIns%	40%		
DEFReins%1	33.3%		
DEFReins%2	60.0%		
Reserve increase1	50	46.25	less expected deaths
Reserve increase2	60	46.65	less expected deaths

	ABC	DEF	GHI
Revenue			
Premiums			
Gross	3,960	2,376	480
Ceded	2,376	480	
Net	1,584	1,896	480
Investment Income	117	171	34
Total Revenue	**1,701**	**2,067**	**514**
Benefits			
Claims			
Gross	3,900	2,340	400
Ceded	2,340	400	
Net	1,560	1,940	400
Reserve Increase			
Gross	93	56	12
Ceded	56	12	
Net	37	43	12
Total Benefits	**1,597**	**1,983**	**412**
Expenses			
Operating	100	50	25
Total Expenses	**100**	**50**	**25**
Gain from Operations	**4**	**34**	**77**

2. Continued

(c) Recommend whether company ABC Life should recapture the business. Justify your answer.

Commentary on Question:
Most candidates did poorly on this part of the question. Candidates should analyze the Net and Gross profit to support the correct recommendation. Many candidates made the recommendation solely based on net profits calculated in part (b), which could lead to the incorrect recommendation.

Consider the profit from operations with and without reinsurance:

- Net of reinsurance result =4,000
- Gross of reinsurance result = 3960 + 200 (inv inc) - 3900 - 93 - 100 = 67,000
- Since gross profit is higher than net profit, ABC operating result will improve if recapture the business

Other considerations for recapture:

- recapture fee: financial analysis on whether or not to recapture should also take into consideration of recapture fee, if any. This is the compensation the insurer has to pay the reinsurer in order to recapture the business
- should consider the net of reinsurance vs gross of reinsurance results for all projection years rather than just based on year t result.

3. Learning Objectives:

4. The candidate will understand basic financial management, capital management and value creation principles and methods in a life insurance company context.

Learning Outcomes:

(4a) Assess financial performance, including analyzing and interpreting the financial performance of a product line or company.

(4c) Explain and apply methods in determining risk based capital and economic capital.

Sources:

"Strategic Management of Life Insurance Company Surplus," TSA XXXVIII (pages 105-116)

LFV-137-16: Kraus 2011 – EVARAROC vs. MCEV Earnings – A Unification Approach

Commentary on Question:

This question tested candidates' understanding of basic capital management and value creation principles. Candidates were required to perform the calculation of various return measures and then make an assessment or recommendation using those returns. In general, candidates did a good job on the calculations of the return measures but struggled with their assessments and recommendations.

Solution:

(a) Assess the equity allocation in the five-year financial plan based on cost of capital. Show all work.

Commentary on Question:

Candidates generally did well in calculating the cost of capital and equity growth rates for each individual profit center. Most candidates were able to draw the correct conclusions regarding the impact of each profit center on economic value and free cash flow. However, only few candidates were able to correctly draw these conclusions for the overall plan at an aggregate level.

Cost of Capital

- Cost of equity: 7%+6% = 13%
- After tax cost of debt: 14%*(1-35%) = 9.1%
- Cost of capital = 50%*(13%+9.1%) = 11.05%

3. Continued

Equity Growth Rates

- Traditional: (70/50)^1/5-1 = 6.96%
- Non-traditional: (450/230)^(1/5)-1 = 14.37%

- Non-insurance: (340/120)^(1/5)-1 = 23.16%
- Total company: [(70+450+340)/(50+230+120)]^(1/5)-1 = 16.54%

- Total company ROE =
  (17%*70+8%*450+12%*340)/(70+450+340) = 10.31%

Observations and Assessment

- Traditional
  - creating economic value (trad ROE > cost of capital)
  - generating free cash flow (trad equity growth rate < total company ROE)
- Nontraditional
  - destroying economic value (non-trad ROE < cost of capital)
  - consuming free cash flow (non-trad equity growth rate > total company ROE)
- Noninsurance
  - creating economic value (non-ins ROE > cost of capital)
  - consuming free cash flow (non-ins equity growth rate > total company ROE)
- Aggregate
  - destroying economic value (total company ROE < cost of capital)
  - consuming free cash flow (total company equity growth rate > total company ROE)
  - plan could be improved by allocating more capital to traditional and less to nontraditional

(b)

(i) Calculate the return on capital assuming the cost of capital is 10%. Show all work.

(ii) Recommend whether WXY should launch the term product given the economic capital requirement on a risk adjusted basis. Show all work.

3. Continued

Commentary on Question:
In part (i), most candidates were able to perform the calculation of ROC. However, many candidates failed to calculate the correct pre-tax income. Some candidates missed the interest on required capital piece in their formulas.
In part (ii), most candidates did well in choosing the correct economic capital. However, few candidates calculated the correct RAROC and compared it to the hurdle rate to make the recommendation.

Part (i)

- Interest on required capital = 10%*250 = 25
- Pre-tax income: Premium & fees + inv income + interest on req required capital - expenses - benefits = 650+25+25-120-525 = 55
- After tax income = 55*(1-0.35) = 35.75
- ROC = after tax income/ required capital = 35.75/250 = 14.3%

Part (ii)

Calculations:

- Choose Economic Capital (EC) of 625K (99.5% percentile for the 1-in-200 loss)
- Interest on EC = 10%*625 = 62.50
- Pre-tax income = 650+25+62.50-120-525 = 92.50
- After tax income = 92.50*(1-0.35) = 60.13
- RAROC = after tax income/EC = 60.13/625 = 9.62%

Analysis and Recommendation:
Since the RAROC is less than the hurdle rate (cost of capital = 10%), this product does not add value to the company. The launching of this product is therefore not recommended.

4. Learning Objectives:

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

Learning Outcomes:

(2b) Evaluate, calculate, and interpret liabilities.

Sources:

CIA Ed Note – Investment Return Assumptions for Non-Fixed Income Assets for Life Insurers

CIA Ed Note – Investment Assumptions used in the Valuation of Life and Health Insurance Contracts

Commentary on Question:

This question tested candidates' knowledge of valuation requirements around investment assumptions.

Solution:

(a) Calculate the maximum amount of the non-fixed income asset permitted at time 0 and time 20. Show all work.

Commentary on Question:

Most candidates understood that the 20-20-75 rule applied. Many candidates did not get the adjustment required to calculate at time 20, i.e., that the factor was 20% and not 75%. Some candidates did not floor cash flows at zero. Some candidates incorrectly included investment expenses in calculating the cash flows.

Most candidates applied the reduction of investment expense to the expected growth rate, but did not apply the MfAD or the market value adjustment of 30%.

Only half the candidates did not check their calculation against the 35% limit rule.

Only include positive cashflows: those being 22,000-2,000 in year 10 and year 30. All other years are negative so disregard.

Only the net outflows from year 10 and 30 are required.
All other years are negative
Year 10 = 20,000
Year 30 = 36,000

4. Continued

Develop discount rate for NFI calculation
Discount rate is BE less investment expenses less MFAD

Equity growth rate (BE) = 10% (given)
Use an MFAD of 20% per CSOP

Investment expense = 0.50% (given)
Low and high margins are 2.5% and 10%, respectively
Use midpoint of 6.25%.
Note, candidates can recommend any MfAD in the range. Since there is no information in the question that would help determine the appropriate MfAD, any MfAD that falls in the range is acceptable.

Discount rate = 10% * (1-20%) - 0.50% * (1 + 6.25%)= 7.47%

Market shift assumption
Since volatility of asset class is 100% correlated with Canadian equities, use 30% per the standards

PV at time 0 = (20% * 20,000 / 1.0747^10 + 75% * 36,000 / 1.0747^30) / (1-30%)
= 7,223
Assets at time zero = 15,000 (given)
Investment strategy caps assets at investment strategy of 35% = 5,250
Thus time zero assets are 5,250

PV at time 20 = (20% * 36,000 / 1.0747^10) / (1-30%)
= 5,005
Assets at time zero = 20,000 (given)
Investment strategy caps assets at investment strategy of 35% = 7,000
Thus time zero assets are 5,005

(b) Recommend the best estimate assumption and margin for adverse deviation for Naboo's:

(i) growth rate

(ii) dividend rate

Show all work.

4. Continued

Commentary on Question:
Generally, this part of the question was not well answered. The theoretically correct answer was based on an illustration shown in the appendix of the CIA Educational Note: Investment Returns for non-fixed income returns for assets. Only a few candidates understood that the growth rate was equal to the sum of a risk free plus a risk premium rate, where the risk premium rate was limited to a maximum of the Canadian risk premium. Most candidates analyzed the information and came up with a general recommendation based on their reasoning.

Canadian Net Premium
The implied net risk premium assumed by the actuary, reduced by the chosen MfAD, would not exceed the equivalent result assumed for equities in (i) the same jurisdiction when appropriate benchmarks are available, or (ii) Canada, when appropriate benchmarks are not available in the same jurisdiction.
Use the mean duration of the liability cash flows for the base scenario for the projection period.

Canadian Net Risk Premium
MfAD for equity growth is 20% per standards

Net return = 8% * (1 -20%) + 2% * (1 - 90%) = 8.2%
Total return = (1 + 8.2%) ^ 14 * (1 - 30%) - 1 = 111.00%
Annualized return = (1 + 111.00%) ^ (1/14) -1 = 5.48%
Net risk premium = 5.48% - 2% = 3.48%

Naboo Net Risk Premium
MfAD for equity growth is 20% per standards
MfAD for dividend is 20%.
Market shock is 40%

Net return = 15% * (1 -20%) + 3% * (1 - 80%) = 14.4%
Total return = (1 + 14.4%) ^ 14 * (1 - 40%) - 1 = 294.56%
Annualized return = (1 + 294.56%) ^ (1/14) -1 = 10.3%
Net risk premium = 10.3% - 4.5% = 5.8%

Must cap Naboo's net risk premium at the Canadian net risk premium
Reduce growth rate
(Candidates may also reduce dividend rate)

4. Continued

Solve for
$(1 + X) ^ 14 * (1 - 40\%) = (1 + 3.48\% + 4.5\%) ^ 14$
where X = net return
X = 11.99%

$11.99\% = E * (1 - 20\%) + 3\% * (1 - 20\%)$
where E = equity growth rate
E = 11.99%

Recommend
best estimate equity growth rate of 11.99%
MfAD of 20% on equity growth
Best estimate dividend of 3%
MfAD of 20% on dividend

5. Learning Objectives:

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

Learning Outcomes:

(2a) Compare and apply methods for life and annuity product liabilities.

Sources:

LFV-133-16: Cluster Analysis: A Spatial Approach to Actuarial Modelling, Milliman, 2008

Commentary on Question:

This question tested the candidates' understanding of different stochastic valuation techniques for segregated fund businesses and the steps required to perform the clustering technique.

Solution:

(a) Describe the drawbacks of the classic compression approach, which could have led to the reserve volatility.

Commentary on Question:

Candidates were generally able to earn partial credit for their responses.

- Rules are particularly hard to derive and apply for produces with guaranteed minimum benefit features that may have nonhomogeneous values of in the moneyness or historical behavior
- Traditional model valuation techniques - which often focus on actual vs model values of opening reserves, # policies, etc do not necessarily mean that a model will work well across multiple scenarios
- Mapping rules need to be refreshed and enhance as new plan are created or other characteristics of the in-force block change
- The modeler need to know something about each minor plan in order to map it to a major plan
- Rules for mapping are subjective and can be hard to automate

(b) List the advantages of using a clustering technique as opposed to a classic approach.

Commentary on Question:

Candidates did relatively well on this part of the question and received full credit.

5. Continued

- Applies to any product type and can be extended to includes assets as well as liabilities
- Achieves far better compression ratios for a given model-to-actual fit
- Is easily automated
- Can be maintained and applied in similar ways at later valuation dates
- Allows customization to place different priorities on different measures of model fit
- Applies to seriatim in-force or to modeled in-force to create an even more modeled Inforce
- Allows easy adjustment to the number of model points to produce more or less model granularity
- Allows easy on the fly analysis of model fit for differing levels of granularity

(c) Apply the clustering technique described in *Cluster Analysis: A Spatial Approach to Actuarial Modelling* to produce a policyholder extract composed of 2 cells.

Show all work.

Commentary on Question:
Candidates did relatively poorly on this part of the question. Few candidates were able to describe the accurate steps and determine the final 2 cells. For candidates who were able to describe the steps of the clustering technique, partial credit was given.

Step 1

- Define the location variable(s). A location variable is the value which you would like your compressed model to be able to closely reproduce. In this situation, the Reserve is most meaningful component

Step 2

- Define the size variable. A size variable represents the importance of a given policy, which ensures large policies are not mapped away as easily as small policies. The account value is the most suitable for segregated fund products

Step 3

- Divide the business into segments which do not get mapped across. In this case, GMMB and GMWB should be divided and not mapped across. As specified in the question, the targeted number of cells for the model is 2.
    - 1 cell from GMMB = policy {1, 3, 6, 8}
    - 1 cell from GMWB = policy {2, 4, 5, 7}

5. Continued

Step 4

- Calculate the distance between each policy. The distance is defined by using an n-dimensional sum-of-squares approach, as if the n-location variables represented a location in a n dimensional space:

$$\sqrt{(Var1_1 - Var1_2)^2 + (Var1_1 - Var1_2)^2 + \ \ldots}$$

In this case, there is only 1 variable so it simplifies to:

$$\text{ABS}(Res_1 - Res)$$

Cohort GMMB

Policy #	Reserve	Distance
1	10	Policy 1 vs. Policy 3: 5 1 vs. 6: 6 1 vs. 8: 4
3	15	3 vs. 6: 1 3 vs. 8: 1
6	16	6 vs. 8: 2
8	14	

Cohort GMWB

Policy #	Reserve	Distance
2	25	Policy 2 vs. Policy 4: 5 2 vs. 5: 15 2 vs. 7: 5
4	30	4 vs. 5: 10 4 vs. 7: 10
5	40	5 vs. 7: 20
7	20	

Step 5:

- Define the Importance of each policy. The importance is defined as the policy size (account value) times the distance from the nearest policy

Cohort GMMB

Policy #	Importance
1	Account Value = 100; Distance from the nearest policy is 1 vs. 8 = 4 Importance = 100 x 4 = 400
3	125
6	130
8	110

5. Continued

Cohort GMWB

Policy #	Importance
2	500
4	650
5	1400
7	550

Step 6:

- Find the policy with the lowest importance
- Map it to its nearest policy (the destination policy)
- Adjust the size of the destination policy
- Iterate until the target number of policies are reached

Iteration 1

- Cohort GMMB: Policy 8 gets mapped to 3
- Cohort GMWB: Policy 2 gets mapped to 7

Iteration 2

- Recalculate importance by adjusting the size

Cohort GMMB

Policy #	Importance
1	Account Value = 100; Distance from the nearest policy is 1 vs. 3= 5 Importance = 100 x 5 = 500
3	235
6	130

Cohort GMWB

Policy #	Importance
4	1300
5	1400
7	2100

5. Continued

Following the above steps and repeat the iterations, then you will arrive at the following clustered inforce:

Policy #	Age	Guarantee Type	AV
3	68	GMMB	465
5	84	GMWB	480

6. Learning Objectives:

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

Learning Outcomes:

(2c) Recommend and justify appropriate valuation assumptions.

Sources:

Best Estimates Assumptions for Expenses

Margins for Adverse Deviations

Use of Actuarial Judgment in Setting Assumptions and Margins for Adverse Deviations

Final Communication of a Promulgation of Prescribed Mortality Improvement Rates Referenced in the Standards of Practice for the Valuation of Insurance Contract Liabilities: Life and Health Insurance

Considerations in the Valuation of Segregated Fund Products

Commentary on Question:

This question tested the candidates' understanding of segregated fund liabilities and their impact on balance sheet and income statement.

Solution:

(a) List four common characteristics of segregated fund products that can contribute to volatility on the balance sheet.

Commentary on Question:

Candidates that performed well on this question focused on the inherent volatility of the products. Any four of the items below resulted in full credit.

- Future revenue is dependent on investment income resulting from a single premium deposit
- Assets are typically invested in stocks, which typically have volatile returns
- Policyholder liability payments vary with market performance, depending on whether guarantees are in or out of the money
- Acquisition costs have to be recovered from future unstable revenue streams
- Investment guarantees and revenue streams are inversely correlated

(b) Describe the methodology used in setting the appropriate best estimate expense assumption for the new segregated fund product.

6. Continued

Commentary on Question:
Candidates had to explain the general approach for setting expense assumptions, identify the expenses to be included and excluded for valuation, and identify specific considerations with respect to segregated funds.

- Collect and summarize expense data for existing product.
- Check the data against internal and external sources for consistency. Adjust for business plan considerations, such as additional system requirements or marketing costs. Only allow for productivity gains based on reasonably certain projections.
- Allocate expenses by category, such as acquisition, admin and investment expenses. Exclude expenses incurred prior to balance sheet date and those not related to the policies. Add back an appropriate portion of overhead, such as third party expenses related to claims or external reporting.
- Determine an appropriate driver of expenses, such as account value of annual benefit payments
- Consider features of new product which are not associated with the existing product, such as the cost of administering the withdrawal payments
- Extend term of liability to allow for recovery of acquisition costs if necessary. Write the remaining balance to zero.

(c) Evaluate the appropriateness of using the existing product surrender assumptions for the valuation of the new product. Justify your answer.

Commentary on Question:
Candidates were required to separately discuss considerations for each product, and compare them.

In general, surrender assumptions for the existing product would not be appropriate for new product
For the existing product, surrender considerations are tied to the fund / guarantee ratio and the time till maturity. Surrenders will vary significantly depending on market performance. Contracts that are well out-of-the-money with little remaining time to maturity will exhibit lapse experience similar to mutual funds. Surrenders will be expected to spike once surrender charges have worn off.
For the new product, during the accumulation phase policyholders will be less likely to lapse out-of-the-money contracts as there is perceived value in the GLWB. Thus, this product should have lower lapse experience than the current product. Once the annuity period is reached, if the current market returns are below 5%, then total surrenders will decrease but partial surrenders will increase as the monthly payments reduce the account value. If the current market returns are above 5%, there will be higher lapses as the guarantee will be of less value, but not as high as the existing product under similar market conditions.

6. Continued

Other considerations include the different considerations in purchasing the product (wealth protection vs accumulation), and the different target age groups of those purchasing the product. Proposed assumptions should be compared against industry experience and / or CIA guidance.

(d) A recent mortality experience study of the existing product showed a significant increase in mortality rates compared to past trends. The valuation actuary recommends revising the best estimate mortality assumption of the existing product to reflect the recent experience and removing the mortality improvement assumption. These revised assumptions will also be used in the new product's reserve calculation.

(i) Critique the above recommendation with respect to the best estimate mortality assumption.

(ii) Recommend an appropriate mortality assumption MfAD. Justify your recommendation.

Commentary on Question:
This part of the question tested candidates' understanding of the differences in mortality risks between GMDB and GLWB, and the considerations for changing the valuation assumptions.

(i) The actuary needs to determine whether the recent mortality experience represents an emerging trend or random fluctuation. Further analysis of the results should be undertaken in order to determine whether to adopt all or any of the change. For example, if the increase was due to one or two large claims, the increase could be ignored. Further, the GLWB product is death supported in the payout phase, and as such increased mortality would reduce reserves. Therefore, any increase needs to be tested. Mortality improvement should not be removed, as this is a separate assumption, and the increase in mortality does not imply that mortality improvement will not happen in the future. The assumption can be applied at an appropriate level of aggregation, which could be for the whole product.

6. Continued

(ii) Separate PfADs might be needed to account for GMDB and GLWB benefits. For the GMDB benefits, the range of PfADs is between 3.75 and 15 / 1000 ex. As this is a new product and there will be uncertainty regarding future experience, a value of at least 9.375 or higher should be contemplated. In the payout phase, the low and high margins are between 2% and 8%. A value of at least 5% should be used. The actuary should test the margins to ensure they are appropriate at an aggregate level. Regarding the mortality improvement margin, the actuary should test the liabilities by including both a positive margin and by including a negative margin, and then using the assumption which produces the highest liability. The increases and decreases to the base assumption should be consistent with the Actuarial Standards Board guidance.

7. Learning Objectives:

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

Learning Outcomes:

(2b) Evaluate, calculate, and interpret liabilities.

(2c) Recommend and justify appropriate valuation assumptions.

Sources:

CIA Educational Note: Investment Assumptions Used in the Valuation of Life and Health Insurance Contract Liabilities, September 2015

CIA Standards of Practice: Insurance Sections 2100, 2300, 2500

Commentary on Question:

This question tested the candidates' knowledge of the Canadian Asset Liability Method (CALM), including assumption setting, determining an appropriate level of contract liabilities and approximations. Candidates were expected to identify projected income and alternative taxes related to insurance contracts. Candidates were expected to know when stochastic scenarios are appropriate and how to decide on the approximate level based on product features and company's investment and ALM strategies.

Solution:

(a) List considerations which would cause an actuary to include other interest rate scenarios in addition to the prescribed scenarios when calculating insurance contract liabilities under Canadian reserving standards.

Commentary on Question:

Full credit is given if candidates list at least 5 of the items listed in the CSOP. Many candidates did not demonstrate full knowledge of this section of the standards of practice.

For all insurers, common prescribed scenarios are used to calculate insurance contract liabilities. Other interest rate scenarios are also tested and should be relatively large if certain circumstances are present:

1. Current risk-free interest rates are near the limits or outside the range of ultimate risk-free reinvestment rate-low to ultimate risk-free reinvestment rate-high
2. The pattern of forecasted net cash flow in the base scenario is such that the classification of scenarios between favourable and unfavourable is unclear
3. Forecasted net cash flow is sensitive to the selection of interest rate scenarios
4. The range of present values of forecasted net cash flow is wide, suggesting exposure to mismatch risk

7. Continued

5. Investment policy does not control mismatch risk
6. Asset-liability management is loose
7. Flexibility to manage assets or liabilities is limited

(b) Propose the insurance contract liabilities Company BDC should hold for its IUL block. Justify your recommendation.

Commentary on Question:
This part of the question required candidates to apply the considerations from part (a) to the specific situation and demonstrate the knowledge that the base scenario result should be the minimum. Candidate were required to list the considerations and explain how they apply in this case. For example, simply saying that there is asset liability mismatch is insufficient; candidates would need to explain that since the company uses one asset portfolio to support both, the ability to manage asset liability mismatch is low.

- When considerations in part (a) are met, insurance contract liabilities should be held in the range of CTE70 and CTE80, subject to a minimum of the value obtained under the base scenario.
- UL is a long term product with flexible premiums with interest rate sensitive cash flows that can vary under different scenarios
- Forecasted cash flows of this product are sensitive to interest rate scenarios, since there is a minimum guaranteed crediting rate
- The range of PV of net cash flows is broad and unpredictable as the policyholder has a high degree of freedom in making changes to the account value.
- XYZ's investment policy does not control mismatch risk, as it does not have a separate asset portfolio to support this product
- XYZ's ability to manage the asset liability mismatch is limited, since the asset portfolio is used to support both an IUL product and a Term product
- Current risk-free interest rate is 3.1%, which close to both the ultimate risk-free reinvestment rate-low limit and the minimum guaranteed crediting rate
- Due to the above considerations, contract liabilities should be held in the range of CTE70 and CTE80, i.e. between $45 and $50 million
- However, a minimum of the base scenario should be held. Therefore, the contract liabilities should be in the range of $47-50 million.

7. Continued

(c)

(i) Calculate the market-related value of liabilities including C-3 Margin as at December 31, 2016. Show all work.

(ii) It is proposed that the Loss Carry Forward for this new single premium product be treated as insurance contract related.

Critique this proposal and recommend changes if appropriate.

Commentary on Question:
Candidates generally did well on part (i) and poorly on part (ii).
A common error for part (i) is to treat the CALM yield as forward rates rather than actual yields when calculating the present value.
For part (ii), most candidates mentioned that the original source of the underclaim / liability cash flow determines whether the associated projected taxes are insurance contract-related or not. However, few candidates recommended whether it is appropriate to treat as insurance contract related.

(i)

Period	Asset CF	Liability CF	CALM Yield	PV Asset CF	PV Liab CF
2017	-30	30		($30.00)	$30.00
2018	-30	25	2.25%	($29.34)	$24.45
2019	-30	40	2.33%	($28.65)	$38.20
2020	-45	45	2.45%	($41.85)	$41.85
				MRVA0	GPL0
				($129.84)	$134.50

CALM analysis completed on the test date (Dec 31, 2016)

Time 0 is December 31, 2016

GPL0 = Statement Value (Asset at time 0) + (*MRVL0-MRVA0)
GPL0 = PV (Liability Cash Flows) based on CALM Yield
$134.50
MRVA0 = PV (Asset Cash Flows) based on CALM Yield
($129.84)
*MRVL0 = $1.66 <-- estimating market value of liability

7. Continued

(ii)

There are two approaches for (LCF). Both approaches can be correct

1. Non-insurance contract related

   This is consistent with the view that if MTARs were equal to GAAP insurance contract liabilities, there would be no need for the actuary to make provision in the valuation for temporary differences between GAAP insurance contract liabilities and tax liabilities.

2. Insurance contract related
   If the LCF arose because of an insurance contract-related item, then the projected reversal of the underclaim or amortization of the LCF is considered insurance contract-related.

   The actuary would assess whether the underclaim and LCF, or portions thereof, are insurance contract related. Consideration would be given to the company's tax allocation policy in determining which business segment "owns" the underclaim or the LCF (i.e., which business segment is entitled to realize the benefit when the underclaim or the LCF is utilized).

   However, based on company circumstances, each of these approaches can be reasonable, and consistent with current standards of practice. However, it would not be appropriate to apply the approaches inconsistently, for example, by choosing different approaches by block of business.

8. Learning Objectives:

1. The candidate will understand financial statements and reports of Canada life insurance companies as well as the professional standards addressing financial reporting and valuation.

Learning Outcomes:

(1d) Describe, apply and evaluate the appropriate accounting treatments for insurance products, assets, derivatives and reinsurance.

Sources:

CIA Educational Note on IFRS: Classification of Contracts under IFRS (IASP 3)

CIA Educational Note on IFRS: Measurement of Investment Contracts and Service Contracts under IFRS (IASP 4)

Commentary on Question:

This question tested candidates' knowledge of IFRS classification. Candidates generally did not do well on this question.

Solution:

(a) Define the following:

(i) Insurance contract under IFRS 4

(ii) Investment contract under IAS 32

Commentary on Question:

Most candidates were able to provide general definition of insurance and investment contracts, but many candidates failed to touch on the specifics asked in the context of IFRS 4 and IAS

(i) Insurance contract definition: a contract under which one party accepts significant insurance risk from another party agreeing to compensate the policyholder, if a specified uncertain future event adversely affects the policyholder'.

(ii) IAS 32.11 defines an investment contract as 'any contract that gives rise to both a financial asset of one entity and a financial liability or equity instrument of another entity'

8. Continued

(b) Recommend the appropriate IFRS classification for each of the following contracts and state which IFRS/IAS guideline applies:

(i) Deferred variable annuity with a Guaranteed Minimum Accumulation Benefit (GMAB)

(ii) Deferred fixed annuity with no rider

(iii) Participating whole life product with a deposit account for dividends paid

Justify your answers.

Commentary on Question:
Candidates generally did not show an understanding of the material. Many candidates were unable to identify the classification of insurance vs. investment contracts. For example, many candidates stated the VA has significant longevity risk and therefore should be classified as insurance contract. Few candidates correctly identified which IAS/IFRS rules should apply to these products.

Part (i):
- Deferred VA with GMAB - host contract is an investment contract as it creates financial assets & liabilities.
- IAS 39 applies.
- GMAB does have significant insurance risk. Therefore, it should be classified as insurance contract
- IFRS 4 applies

Part(ii)
- Deferred FA with no rider does not contain significant mortality/morbidity risk. The contract creates financial assets/liabilities; hence it should be classified as investment contract.
- IAS 39 applies.

Part(iii)
- Participating whole life product is a insurance contract as there is significant insurance risk (in this case mortality risk).
- Contain DPF; Two approaches: (1) can recognize the DPF as a separate liability or separate component of equity; or (2) recognize the DPF together with the guaranteed element so the whole contract is classified as a liability
- IFRS 4 applies.

8. Continued

- The saving option can be measured without considering any other component. However, there are no rights and obligations of the saving component that would remain unrecognized if not unbundled. Hence, unbundling of the saving option is permitted, but not required.
- IAS 39 if unbundled; IFRS 4 if not unbundled.

(c)

(i) List the steps of the discounted cash flow approach.

(ii) You are given:

- All of the policyholders are between ages 18-35 and are healthy.
- The operating expenses of similar annuity products offered by other companies are not readily available.
- The operating expenses for PZZ's annuity product have increased significantly in recent years.

Recommend an appropriate level for the margin of risk and uncertainty for the following assumptions:

- Mortality
- Lapse
- Expense

Justify your answer.

(iii) Recommend a replicating portfolio for determining the discount rate used to calculate the fair value of PZZ's annuity product.

(iv) Recommend approaches of IFRS fair value measurement other than the discounted cash flow approach which are appropriate to determine the fair value of this annuity.

Commentary on Question:
For part (i), candidates were only able to address one or two of the steps. For part (ii) most candidates could recommend the high margin for expense with sufficient justification, but many candidates failed to utilize the specific information given to recommend correct mortality and lapse assumptions. For parts (iii) and (iv), few candidates provided sufficient details.

8. Continued

Part (i)

1. Selection of an appropriate model;
2. Selection of current estimate assumptions;
3. The determination of margins for risk and uncertainty;
4. Availability of market data to calibrate the provisions for risk and uncertainty
5. Application of the requirements of IFRSs

Part (ii)

- Low level of risk margin for mortality & lapse assumption as there is little financial consequence of such events. There is a short term and low probability of claim.
- High level of risk margin for expense as there is less confidence in current estimate due to little available data and higher level of uncertainty due to the increasing trend in expense.

Part (iii)

- The replicating portfolio of assets should reflect the nature, structure, and term of the cash flows.
- The market value of the contract normally would be equal to the market value of the replicating portfolio.
- One *possible* portfolio would be 110% 10-year x% coupon paying bond (with x=annuity rate) and -10% 10-year zero coupon bond.

Part (iv)

There is no observable market data. Hence, a valuation technique is to be used.

1. Recent arm's length market transactions;
2. current fair value of instruments that are substantially the same;
3. option-pricing models

9. Learning Objectives:

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

Learning Outcomes:

(4a) Assess financial performance, including analyzing and interpreting the financial performance of a product line or company.

Sources:

CIA: Sources of Earnings: Determination and Disclosure, August 2004

LFV-603-13: OSFI Guideline D-9: Sources of Earnings Disclosure

Commentary on Question:

This question tested the candidates' knowledge of source of earnings.

Solution:

(a) List 4 of OSFI's desired attributes for an effective source of earnings disclosure.

Commentary on Question:

Candidates generally performed well on this part of the question. Most candidates listed at least four attributes and earned full credit.

Reconcile to reported earnings without material balancing items
Consistently applied from period to period
Easy for external user to understand
Comparable to other companies' analyses
Consistent with the manner in which earnings are reported and described and the way the business is managed.
Produced and disclosed in a timely way
Describe all material components of reported earnings

(b) Prepare a Source of Earnings Disclosure for this product as at December 31, 2016. Show all work.

Commentary on Question:

Many candidates had trouble calculating the Expected Release in PfADs and Experience Related Change in PfADs. Candidates generally calculated other parts of the experience gain and loss correctly but some had trouble demonstrating whether actual and expected death benefits, reserve released from death and interest would have a positive or negative impact to the experience gain.

9. Continued

Calculation of Expected Profit on In-force business
PfADs in 2015 = Statutory Reserves - Best Estimate Reserves = 1,126,846 - 1,013,933 = 112,913
Expected PfADs in 2016 = Exp Stat Res - Exp Best Est Res = 1,103,944 - 994,603 =109,341
Expected Release in PfADs = 112,913 - 109,341 =**3,572**

Calculation of the Impact of New Business
None

Calculation of Experience Gain and Losses
Actual death benefits (from I/S) = -100,000
Expected death benefits (from RMA) = 75,000
Actual Reserves Released on Death (from RMA) = 6,631
Expected Reserves Released on Death (from RMA) = -4,973

Actual PfADs in 2016 = Actual Stat Res - Actual Best Est Res = 1,096,584 - 987,972 = 108,612
Experience Related Change in PfADs = Actual PfADs in 2016 - Expected PfADs in 2016 = 109,341 -108,612 =729

Actual Interest earned (from I/S) = 50,708
Required Interest (or Expected Interest) (from RMA) = -50,697

Total Experience or Experience Gain / (Loss)= -100,000 + 75,000 +6,631 - 4,973 + 729 + 50,708 – 50,697 **= (22,602)**

Calculation of Management Action and Changes in Assumptions
None

Calculation of Other
None

Calculation of Earnings on Surplus
Interest on Assets backing Surplus (from I/S) = 1,042

Calculation of Income before Tax = 3,572 + (22,602) +1,042 = (17,988)

Calculation of Income Tax = 17,988 * 30% =5,396

Income net of taxes = (17,988) +5,396 = (12,592)

9. Continued

(c) Calculate the impact on the Source of Earnings disclosure related to the introduction of this new product. Show all work.

Commentary on Question:
Candidates were generally unable to calculate the impact of new business.

Calculation of the Impact of New Business
Difference between the premium received and the sum of the expenses incurred as a result of the sale and the new liabilities established at the point of sale
= 1,162,500 - (5,700 + 1,016,000) = 140,800

(all else stays the same, except the following):

Loss due to difference between actual and best estimate acquisition expenses
=1,016,000-1,138,000 = (122,000)

Impact of new business (before tax) = 140,800 - 122,000 =18,800

Expected PfADs release in 2016 =400
Actual PfADs release in 2016 =300

Calculation of Income Tax = -30% * (18,800 +300) = 5,730

Calculation of Net Income
Income net of taxes =18,800 + 300 – 5,730 = 13,370
Experience after point of sale considered part of experience gain/loss as experience emerges

(d) Recommend actions to improve earnings based on the results of the Source of Earnings Disclosures from (b) and (c) above. Justify your recommendations.

Commentary on Question:
Candidates generally performed well on this part of the question. Candidates were able to recommend general actions, highlight the loss from mortality and acquisition expenses and justify their recommendations.

General actions available to management
Change price of product
Change fees or fee structure
Change asset mix
New or revised reinsurance deals on in-force business
Acquisition or sale of block

9. Continued

Recommendations for in-force business
Actual death benefits paid caused $25,000 loss over expected
Could be one time event or management could revisit pricing, reinsure block, or even sell
Actual interest on assets slightly higher than interest on reserves.
Management could look to alter asset mix to boost investment income

Recommendation for new business
Actual vs best estimate acquisition expenses causing large reduction in earnings
Management could revisit pricing, reduce acquisition expenses, etc.

10. Learning Objectives:

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

Learning Outcomes:

(2c) Recommend and justify appropriate valuation assumptions.

Sources:

LFV-634-16: CIA Standards of Practice: Practice-Specific Standards for Insurers (Section 2100, 2300, 2500) (March, 2016)

CIA Educational Note: Expected Mortality: Fully Underwritten Canadian Individual Life Insurance Policies: July 2002 (excl. appendices)

CIA Educational Note: Margins for Adverse Deviations (MfAD) – November 2006

Commentary on Question:

This question tested the candidates' knowledge of determining appropriate valuation assumptions.

Solution:

(a)

(i) Recommend changes (if any) to the base assumption and MfAD on mortality. Justify your answer.

(ii) Recommend changes (if any) to the MfAD on lapse. Justify your answer.

(iii) Critique the appropriateness of the base assumption and MfAD for expenses.

(iv) Explain how the Provision for Adverse Deviation (PfAD) for interest rate risk should be determined.

Commentary on Question:

For the mortality and lapse assumptions, most candidates correctly identified the appropriate sign and range of MfADs. but few candidates provided commentary on mortality improvement or that lapse MfAD should not perform uniformly.
For the expense assumption, most candidates did not address inflation.
For the interest rate risk PfAD, some candidates did not discuss performing CALM.

10. Continued

(i)
Base assumption should include mortality improvement
Sign of mortality MfAD is incorrect and should be changed since decreasing reserve instead of increasing
Margin must be at least average of low and high margin if at least one significant consideration exists
Using industry experience is a significant consideration
MfAD must be at least 3.75/ex and 15/ex
Give any recommendation between 3.75/ex and 15/ex
Should also add MfAD for mortality improvement before mortality MfAD

(ii)
Sign and application of lapse MfAD is incorrect and should be changed since decreasing reserve instead of increasing due to non-par Term-to-100 being a death-supported product.
Lapse MfAD should not be applied uniformly (i.e. all increase or all decrease) for all age and all policy duration. In order to ensure that the margin for adverse deviations increases policy liabilities, the choice between addition and subtraction may need to vary by interest scenario, age, policy duration, and other parameters.
Current PfAD does not fall in valid range of 5% to 20%
Can use margin below average since company using fully credible company experience
Give any recommendation between 5% and 12.5%

(iii)
Probably missing other expenses such as overhead expenses
Base assumption should also include inflation
Not appropriate to use 0 for MfAD. Needs to be between 2.5% and 10%

(iv)
CALM run required to determine the interest PfAD
Interest PfAD can be calculated by using deterministic prescribed scenarios or by stochastic modeling
Interest PfAD is the difference between the reported liability and the base scenario liability

10. Continued

(b) TTC Life plans to continue selling this T100 product, but will relax the underwriting requirements by removing an expensive underwriting test that the previous company required.

Assume:

- The condition detected by the underwriting test exists in 4% of insurance applicants.
- Individuals with the condition were previously deemed uninsurable.
- An additional 6% of applicants with the condition will now apply for this insurance due to the relaxed underwriting requirements.
- Additional mortality for people with this condition at all ages is 400% of the average mortality for people without this condition.

Determine the percentage increase in expected mortality for new issues as a result of this underwriting change. Show all work.

Commentary on Question:
Most candidates were able to use the correct formula and factors. Few candidates received full mark by correctly swapping the mortalities in the calculation

$Q(NEW) = Q(OLD) \times [1 – A – B – C \times (A + B)] \div (1 –A – B)$

"A = the impairment frequency, or frequency that the underwriting technique will screen otherwise undetectable medical impairments"

"B = the sentinel frequency, or frequency that prospects with those impairments will avoid the company because of the underwriting change."

"C = the additional mortality, or average amount of increased mortality that can be expected to occur in the impaired group defined by A and B"

But because we are removing a test and not adding one, the Q(OLD) and Q(NEW) need to be swapped

change is given by (Q(w/o test)/Q(w test)) - 1

$Q(w\ test) = Q(w/o\ test) \times [1 – A – B – C \times (A + B)] \div (1 –A – B)$
$A = 4\%$
$B = 6\%$
$C = 400\%$
$Q(w\ test) = Q(w/o\ test) \times (1 - .04 - .06 - 4 * (.04 + .06) / (1 - .04 - .06)$
$Q(w\ test) = Q(w/o\ test) \times 0.5556$

10. **Continued**

Solve for (Q(w/o test)/Q(w test)) - 1
= ((Q(w test)/0.55556) / Q (w test)) - 1
= ((Q(w test) * 1.8) / Q (w test)) - 1
= 80%