ILA LFMU Model Solutions
Fall 2023

1.

Learning Objectives:
4. The candidate will understand the fundamental purpose of capital, and its determination and stakeholders.

Learning Outcomes:
(4a) The Candidate will be able to describe and evaluate the theory of capital (including economic capital), and evaluate its applicability for various purposes and its value to different stakeholders.

Sources:
The Theory of Risk Capital in Financial Firms

Commentary on Question:
This question tested the candidates' understanding of risk capital frameworks. Candidates demonstrated an understanding of the basic concepts but did not demonstrate an in depth understanding.

Solution:
(a) Critique the following statements regarding a risk capital framework:

Commentary on Question:
Candidates generally did well on this part of the question. For statement A, candidates that answered 'partially true' received full credit if they provided appropriate justification (e.g., if some specific fixed income asset may have higher risk).

A. *All else being equal, a firm that invests predominantly in equities will require more risk capital than a firm that invests predominantly in fixed income securities.*

True
Risk capital depends on the riskiness of the assets. The riskier the assets, the more risk capital.

B. *As long as there are no changes in a firm's underlying gross assets, changes in any liabilities will have no impact on the amount of risk capital required.*

1. Continued

False
Risk capital depends on the amount of net assets (gross assets less liabilities). Changes in either would impact risk capital.

(b) You are given:

- Marginal risk capital is used to allocate risk capital across business units.
- The continuously compounded risk-free rate of interest is 3%.

Correlation of profits by business unit

	Annuities	Mutual Funds	Seg Funds	Term Life
Annuities	1.00			
Mutual Funds	0.25	1.00		
Seg Funds	0.50	0.20	1.00	
Term Life	0.00	0.00	0.00	1.00

Business Unit Group	Annual Volatility of profits	Liabilities at time 0	Risk-free value of net assets at the end of the first year
Annuities (1)	30.0%	2,000	250
Mutual Funds (2)	40.0%	1,000	200
Seg Funds (3)	25.0%	3,000	500
Term Life (4)	20.0%	8,000	500
1 & 2 & 3	22.2%	6,000	950
1 & 2 & 4	16.2%	11,000	950
1 & 3 & 4	15.2%	13,000	1,250
2 & 3 & 4	15.3%	12,000	1,200
1 & 2 & 3 & 4	14.8%	14,000	1,450

(i) Calculate the variance of business profits of a portfolio consisting of mutual funds and segregated funds.

(ii) Calculate the proportion of unallocated risk capital for MGP at the end of the second year.

Commentary on Question:
Candidates generally did not do well on this part of the question. Candidates received partial credit for providing high level definition of total, unallocated, and marginal capital. Common errors included:

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1. Continued

- *Using net assets instead of total assets for the time 0 asset calculation*
- *Failing to reflect timing in the calculation of asset at time 0, and consequently getting the incorrect results for weighting*
- *Failing to include weighting in the calculation of variance*
- *Missing the square root in the calculation for approximate RC*

i)

	A	B	C	D
Business Unit Group	Annual Volatility of profits	Liabilities at time 0	Risk-free value of net assets at the end of the first year	Assets at time 0
Annities (1)	30%	2,000	250	2,242.61
Mutual Funds (2)	40%	1,000	200	1,194.09
Seg Funds (3)	25%	3,000	500	3,485.22
Term Life (4)	20%	8,000	500	8,485.22
1 & 2 & 3	22.2%	6,000	950	6,921.92
1 & 2 & 4	16.2%	11,000	950	11,921.92
1 & 3 & 4	15.2%	13,000	1,250	14,213.06
2 & 3 & 4	15.3%	12,000	1,200	13,164.53
1 & 2 & 3 & 4	14.8%	14,000	1,450	15,407.15

Where D = C/Exp(risk free rate)+B, and risk free rate is 3% as given – most candidates missed adding back B to get the assets at time 0

Solve for asset at time 0:

Risk-Free Value of Net Assets
$$= (Assets_0 - Liabilities_0) * e^{rT}$$

Calculate the weights of a portfolio of only mutual and seg funds

$$\omega_i = Weight_i = \frac{Assets_{0,i}}{Assets_{0,portfolio}}$$

Calculate variance for a portfolio of mutual funds (2) and seg funds (3):

$$Variance = \sum_i \sum_j \omega_i \omega_j \rho_{i,j} \sigma_i \sigma_j$$

1. Continued

i	j	a p(i,j)	b vol(i)		c vol(j)		d weight(i)	e weight(j)	f Product
2	2	1	40%		40%		25.5%	25.5%	0.0104
2	3	0.2	40%		25%		25.5%	74.5%	0.0038
3	2	0.2	25%		40%		74.5%	25.5%	0.0038
3	3	1	25%		25%		74.5%	74.5%	0.0347
								Sum:	**5.3%**

Where f = a*b*c*d*e

ii)
Solve for Assets at time zero for all business unit groups using formula from part i)
Calculate the Approximate Risk Capital for each business unit group. Volatilities as
given, T = 2

$$Approx.\ Risk\ Capital = 0.4 * Assets_0 * \sigma * \sqrt{T}$$

Where T = 2

Calculate the Marginal Risk Capital for each business:

Marginal Risk capital for business unit i = Total RC - RC for the portfolio without
business i.
Unallocated Risk Capital = Total Risk Capital - Sum of all Marginals
Proportion = Unallocated Risk Capital / Total Risk Capital

Business Unit Group	Marginal Business	Annual Volatility of profits	Assets at time 0	Approx. Risk Capital	Marginal Risk Capital
1 & 2 & 3	4	22.2%	6,921.92	869.27	420.64
1 & 2 & 4	3	16.2%	11,921.92	1,092.54	197.37
1 & 3 & 4	2	15.2%	14,213.06	1,222.10	67.81
2 & 3 & 4	1	15.3%	13,164.53	1,139.39	150.52
1 & 2 & 3 & 4		14.8%	15,407.15	1,289.91	

Unallocated Risk Capital:
= 1289.91 – (420.64+ 197.37+67.81+150.52) = 453.57

Proportion:
453.57/1289.91 = 35%

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1.   Continued

(c)   MGP is considering expanding their business to include whole life insurance but is concerned about the impact on risk capital.

Recommend two criteria for MGP to use in making this decision.

Commentary on Question:
A sample of valid criteria is provided below. Only two are required for full credit. Most candidates provided two valid criteria. The most common criteria given were the correlation aspect and the additional capital needed for introducing new line of business.

- Entering a business will increase the overall risk capital of the firm. Need to calculate how much this increase is to know how much additional risk capital you need. (risk capital is a function of assets, new business = more assets = increase)
- New business may change the economic cost of risk capital for the firm, should understand those impacts.
- Should understand how correlated the profits of the new business are to current business. It is likely whole life insurance will be somewhat correlated with other insurance products. (correlation is a part of the risk capital formula)
- Should ensure the expected profits of the business are in excess of the risk capital & spread required.

2.   **Learning Objectives:**

1.   The candidate will understand and apply U.S. GAAP valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

Learning Outcomes:

(1a)   Describe, apply and evaluate the appropriate valuation methods and techniques and related accounting treatments for reserves and related items (e.g., DAC), and other assets and liabilities for specific insurance products under U.S. GAAP. Further, describe and recommend assumptions and margins appropriate to these GAAP reserves.

Sources:

US GAAP for Life Insurers, 2022, Chapter 11: Deferred Annuities

Commentary on Question:

This question tested the candidates' knowledge the index credit and GAAP reserve for fixed indexed annuity policies.

Solution:

(a)   You are given:

IR: Index return	7%
PR: Participation rate	110%
SR: Index spread	2%
CR: Cap rate	6%
FR: Floor rate	1%

Calculate the index credit for this crediting period.

Commentary on Question:

Candidates generally did well on this part of the questions and were able to calculate the index credit correctly.

Step 1: Multiply PR * IR = 110% * 7% = 7.7%
Step 2: Subtract SR = 7.7% - 2 % = 5.7%
Step 3: Cap at CR = Min (5.7%, 6.0%) = 5.7%
Step 4: Floor at FR = Max (5.7%, 1.0%) = 5.7%
Steps 3 and 4 can be in reverse order and still results in the correct answer.

2. Continued

(b) You are given:

Option budget	3.0%
Guaranteed interest rate	0.5%
Risk-free interest rate	2.0%
Discount rate	3.5%

Year	Index AV	Guaranteed Value	Mortality	Lapse	Persistency	Decremented Index AV	Decremented Guaranteed Value
0	100,000	100,000			0.94050	100,000	100,000
1	103,060	100,500	1%	5%	0.88454	96,928	94,520
2	106,214	101,003	1%	5%	0.83191	93,950	89,341
3	109,464	101,508	1%	5%	0.78241	91,064	84,445
4	112,813	102,015	1%	5%	0.73586	88,266	79,818
5	116,265	102,525	1%	5%	0.69207	85,555	75,444
6	119,823	103,038	1%	5%	0.65090	82,927	71,310
7	123,490	103,553	1%	5%	0.61217	80,379	67,402
8	127,269	104,071	1%	5%	0.57574	77,910	63,709
9	131,163	104,591	1%	5%	0.00000	75,516	60,218
10	135,177	105,114	1%	100%		0	0

Calculate the GAAP benefit reserve for this policy at the end of year 5. Show all work.

Commentary on Question:
Results were mixed among candidates who demonstrated their knowledge of the GAAP methodology, candidates who knew some of the steps of the methodology and candidates who did not demonstrate any knowledge of the methodology. While candidates generally did not calculate the index and guaranteed benefits in the same way as the example in the study note, partial credit was received if the subsequent reserve methodology and formulas were correct. Most candidates did not use the un-decremented AVs to calculate the index and guaranteed benefits. Many candidates were able to demonstrate some knowledge of the calculation of the VED, Host IRR and Host Value, and received partial credit for calculation errors such as using the wrong discount rate.

Following are the steps to calculate the GAAP reserve.

Step 1: Calculate Index AV Death Benefits (n) = Mortality * Index AV at end of year (n).

Step 2: Calculate Index AV Surrender Benefits (n) = Lapse * Index AV at end of year (n) * (1 - Mortality).

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2. Continued

Step 3: Calculate Guaranteed Value Death Benefits (n) = Mortality * Guaranteed Value at end of year (n).

Step 4: Calculate Guaranteed Value Surrender Benefits (n) = Lapse * Guaranteed Value at end of year (n) * (1 - Mortality).

Step 5: Calculate Excess Benefits (n) = Index AV Death Benefits (n) + Index AV Surrender
Benefits (n) - Guaranteed Value Death Benefits (n) - Guaranteed Value Surrender Benefits (n).

Step 6: Calculate VED (n) = NPV (Discount Rate, Future Excess Benefits).

Step 7: Host Cashflow (0) = Decremented Index AV (0) - VED (0),
Host Cashflow (n) = - Guaranteed Value Death Benefits (n) - Guaranteed Value Surrender Benefits (n)

Step 8: Host Contract Interest Rate = IRR (Host Cashflows)

Step 9: Value of Host Contract (0) = Host Cashflow (0),
Value of Host Contract (n) = Value of Host Contract (n-1) * (1 + Host Contract Interest Rate) - Host Cashflow (n).

Step 10: GAAP Reserve (n) = Value of Host Contract (n) + VED (n)

Below is a table of all the values for each step with the final answer highlighted in yellow.

2. Continued

	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9	Step 10
	Index Account Value	Index Account Value	Guaranteed Value	Guaranteed Value		Value of Embedded	Host Cash	Host Contract Interest	Value of Host	GAAP
Year	Death Benefits	Surrender Benefits	Death Benefits	Surrender Benefits	Excess Benefits	Derivative	Flow	Rate	Contract	Reserve
0						27,377	72,623	**10.59%**	72,623	100,000
1	1,031	5,101	1,005	4,975	152	28,183	(5,980)		74,335	102,518
2	1,062	5,258	1,010	5,000	310	28,859	(6,010)		76,198	105,057
3	1,095	5,418	1,015	5,025	473	29,396	(6,040)		78,228	107,624
4	1,128	5,584	1,020	5,050	642	29,782	(6,070)		80,443	110,225
5	1,163	5,755	1,025	5,075	818	**30,007**	(6,100)		**82,863**	**112,869**
6	1,198	5,931	1,030	5,100	999	30,058	(6,131)		85,508	115,566
7	1,235	6,113	1,036	5,126	1,186	29,924	(6,161)		88,402	118,326
8	1,273	6,300	1,041	5,151	1,380	29,591	(6,192)		91,573	121,164
9	1,312	6,493	1,046	5,177	1,581	29,046	(6,223)		95,048	124,094
10	1,352	133,825	1,051	104,063	30,063	-	(105,114)		(0)	(0)

3.   **Learning Objectives:**
1.   The candidate will understand and apply U.S. GAAP valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

Learning Outcomes:
(1b)   Describe and apply the requirements, calculations, and disclosures related to GAAP "Targeted Improvements".

Sources:
US GAAP for Life Insurers, 2022, Chapter 12: Annuities Payout
Targeted Improvements Interactive Model

Commentary on Question:
This question tested the candidates' understanding of LFPB, DAC, and LFPB for payout annuities under LDTI. Candidates had to demonstrate knowledge on how to decompose LFPB to illustrate drivers of earnings.

Solution:
(a)   Calculate the projected Liability for Future Policyholder Benefits (LFPB) at the end of the third policy year.

Commentary on Question:
Generally, candidates did well on calculating the LFPB for this part of the question.

Candidates received credit if they showed the benefits were guaranteed at $110/year for the first 10 policy durations.

Candidates received partial credit if they did not extend out the formulas until no lives remained. (i.e. at attained age 93).

Some candidates checked to see if this contract qualified as an investment contract by calculating the PV of benefits vs. PV of premium at issue. If this ratio was <=5-10% and calculated correctly by the candidate, then it would qualify as an investment contract and then corresponding IRR would be an appropriate discount rate. Otherwise, full credit was given for using the given 4.25% discount rate.

Under LDTI, the LFPB no longer requires provisions for adverse deviation (PADs) and only claim-related expenses are included in the calculation. As such, candidates received credit if they did NOT include a PAD on the mortality and if they did NOT include the maintenance expense assumption of $10/policy.

The solution for this part of the question is provided in an Excel spreadsheet.

3. **Continued**

(b) Calculate the projected DAC at the end of the third policy year using the group contract method.

Commentary on Question:
Candidates generally did well on this part of the question in calculating the DAC on these SPIA contracts.

Some candidates only included the per policy acquisition expense and did not include the commission component. In this instance, only partial credit was received for the total deferrable expenses.

Candidates received partial credit if they did not extend out the formulas until no lives or benefits remained (i.e. at attained age 93).

Under LDTI, interest accretion is no longer applicable, so no credit was received if interest was included in the DAC calculations.

In order to receive full credit for the DAC amortization, candidates had to amortize the initial deferable expenses over the SPIA benefit stream, including the 10 years of period certain payments. Full credit was also received if deferred expenses were amortized over the projected lives, but reflecting no decrements in the first 10 durations due to the period certain portion of the contract.

Some candidates attempted to calculate DAC by taking the difference between the LFPB on a gross and net basis. This approach does not work under LDTI, partially because DAC no longer includes an interest component, whereas the LFPB does. Rather, DAC needs to be amortized over a constant basis.

The solution for this part of the question is provided in an Excel spreadsheet.

(c) You are given:

- Experience was equal to expected for 2023-2025
- Actual annual mortality rate increased from 20% to 60% in 2026
- No change to future best estimate mortality rate
- No change to the current discount rate in any year

Calculate the LFPB remeasurement gain or loss in 2026.
Show all work.

Commentary on Question:
Candidates generally did well on this part of the question, particularly if they understood part (a).

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3. Continued

To receive full credit, candidates needed to state whether the remeasurement was a gain or a loss. While it was not required to explain why the remeasurement was a gain or loss, providing a rationale demonstrated that the candidate understood the ramifications of elevated mortality in duration 3 and how that impacted the LFPB (i.e. the restated LFPB offsets part of the elevated mortality).

Similar to part (a), the LFPB under LDTI does not include any PADs. Credit was not received if the 10% PAD was also applied to the 60% experience in year 3.

Most candidates did not reflect the correct time period for the remeasurement gain/loss.

The solution for this part of the question is provided in an Excel spreadsheet.

4.

Learning Objectives:

1. The candidate will understand and apply U.S. GAAP valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

Learning Outcomes:

(1a) Describe, apply and evaluate the appropriate valuation methods and techniques and related accounting treatments for reserves and related items (e.g., DAC), and other assets and liabilities for specific insurance products under U.S. GAAP. Further, describe and recommend assumptions and margins appropriate to these GAAP reserves.

Sources:

US GAAP for Life Insurers, 2022, Chapter 6: Participating Traditional Life Insurance

Commentary on Question:

This question tested the candidates' knowledge of U.S. GAAP valuation principles and methods. Candidates were asked to describe the changes which need to be made to GAAP benefit reserve calculations for a traditional life insurance product that is "non-participating" rather than "participating".

Please note that the Terminal Dividend of $600 was not provided in the exam question for part (a). Candidates received full credit if they demonstrated the proper steps necessary instead of the solution shown in the model solution below.

Solution:

(a) Calculate the following at the end of the third policy year, based on GAAP accounting rules for participating life insurance.

(i) Liability for future policyholder benefits

(ii) Terminal dividend liability

Commentary on Question:

Candidates did not perform well on this part of the question. Candidates had difficulty determining the GAAP benefit net premium and the GAAP benefit reserve. Common omissions from the calculations include the calculation of the present value of net premiums, the endowment amount, and the additional benefits beside the death and endowment benefits. Candidates did not select the proper assumptions for mortality and interest. This may have to do with the cash value mortality rates not being clearly labelled in the exam question. Candidates were expected to know that the proper mortality rates to be used in calculating GAAP benefit reserves for participating traditional life insurance products which pay cash values would be the mortality rates used to compute those cash values.

4. Continued

The mislabeling of mortality rates in the exam question also impacted the candidates' calculation of the termination dividend liability. Again, candidates were expected to know that the mortality basis used in the termination dividend liability calculation is the same as the mortality basis used to determine the DAC asset. If candidates acknowledge the proper mortality basis, but instead, used the valuation mortality rates, as noted in the exam question, because they felt the cash value mortality rates were not provided, they received credit for using the valuation mortality rates.

The solution for this part of the examination question appears in the associated Excel workbook.

(b) SJG Life is considering the development of a non-participating endowment at age 65 product.

Describe how the calculation of GAAP benefit reserves would differ.

Commentary on Question:
Candidates demonstrated knowledge on some of the differences in the calculation of GAAP benefit reserves for non-participating traditional life insurance products relative to participating life traditional insurance products. Many candidates focused on the difference in the calculation of the net premium ratio and that they are unlocked annually but failed to state the cause of such differences. Candidates briefly mentioned that cash flows other than death benefits and endowment benefits are considered in the calculation of GAAP benefit reserves for non-participating products. Some candidates mistakenly assume that non-participating insurance products do not pay dividends and failed to note that such dividends are included in reserve calculations for non-participating traditional life insurance products.

The following are among the differences between the calculation of GAAP benefit reserves for non-participating traditional life insurance relative to participating traditional life insurance products:

1. GAAP benefit reserves will now include expenses and other cash flows in addition to death and endowment benefits.
2. Actual and expected dividend payments are included in reserve calculations for non-par products. For par products, annual dividends are included elsewhere and terminal dividends are included in liability calculations.

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4. Continued

3. Mortality assumptions are determined differently for non-par products relative to par products.
4. Interest rate assumptions are also determined differently for non-par products versus par products.
5. Mortality rates are unlocked periodically for non-par products and not unlocked for par products.
6. Interest rates are unlocked periodically as well for non-par products relative to par products.
7. Reserve calculations for par products can be performed in an aggregate cohort fashion or on a seriatim basis, whereas seriatim reserve calculations are primarily used for par products.
8. A deferred profit liability is required for non-par products with premium payment periods shorter than their lifetimes. Such is not the case for par products.

5.   **Learning Objectives:**
2.   The candidate will understand and apply U.S. Statutory valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

Learning Outcomes:
(2a)   Describe, apply and evaluate the appropriate valuation methods and techniques and related accounting treatments for reserves and related items, and other assets and liabilities for specific insurance products under the U.S. Statutory rules. Further, describe and recommend assumptions and margins appropriate to these statutory reserves.

(2b)   Describe, apply and evaluate the Principle-Based Reserves valuation methods and techniques for specific insurance products under U.S. Statutory rules.

(2c)   Describe and evaluate the fundamental features and design of the U.S. Statutory regulatory system.

Sources:
Principle-Based Reserves Interactive Model
Fundamentals of the Principle-Based Approach to Statutory Reserves for Life Insurance

Commentary on Question:
This question tested the candidates' understanding of U.S. Statutory valuation principles and methods.

Solution:
(a)   ABC Life sold an identical level term product to a policyholder population with the same demographics, but ABC Life's premium is lower than XYZ Life's.

Evaluate which company's net premium reserve will more likely dominate its PBR reserves.

Commentary on Question:
Many candidates failed to recognize the difference between what drives the deterministic reserve versus NPR. In cases where candidates correctly identified XYZ's NPR will likely dominate, partial credit was lost due to not identifying that ABC and XYZ will have the same NPR.

The NPR will more likely dominate for XYZ Life because higher premiums decrease its deterministic reserve relative to the NPR. ABC Life will have a higher deterministic reserve due to its lower premiums; therefore, there is a less likelihood that NPR will dominate.

5. **Continued**

The NPR is a formulaic reserve using prescribed assumptions and sets the reserve floor. Since the insurable populations are identical, the NPR will be the same between the two companies (assuming the premium slope is the same between the two companies).

The deterministic reserve is principle-based calculation that allow for assumptions based on company experience. The deterministic reserve will be different between the two companies, depending on the premium amounts.

(b) Critique the following statements under PBR Reserves

    A. *The mortality margin for adverse deviation is based on actuarial judgement and analysis, with support shown in the PBR Actuarial Report.*

    B. *The expense margin for adverse deviation is prescribed based on credible company experience.*

    C. *The lapse margin for term products should decrease the lapse assumption.*

    D. *VM-20 prohibits future mortality improvement but allows a company to recognize a percentage of its post-level term profits based on a prescribed formula.*

    E. *The investment rate margin is implicitly prescribed based on VM-20 required treasury rates, gross spreads, defaults, recoveries, and guardrails on the reinvestment strategy for fixed income.*

    F. *The sum of the individual margin impacts equals the total impacts of all margins.*

Commentary on Question:
Most candidates did well for this part of the question especially for statements C, E and F. Credit was not received if justification was not provided where applicable, and credit was received for reasonable critiques not provided below.

    A. Incorrect. The mortality margin for adverse deviation is based on the calculated credibility considering both company's own experience and industry experience.

    B. Incorrect. The expense margin for adverse deviation relies on a company's actuarial judgement and analysis to determine the margin, with support shown in the PBR Actuarial Report.

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5. Continued

    C.   Correct. In most cases, term products are lapse supportive thus the margin should decrease the lapse assumption to make reserve more conservative.

    D.   Incorrect [or Partially Correct]. VM-20 prohibits not only future mortality improvement but also post-level term profits to the extend of prescribed limits.

    E.   Correct. The investment rate margin is implicitly prescribed based on VM-20 required treasury rates, gross spreads, defaults, recoveries, and guardrails on the reinvestment strategy for fixed income.

    F.   Incorrect. The sum of individual margins exceeds the total margin given some assumptions and margins are correlated. For instance, there is correlation between the lapse margin, mortality margin, and post-level profit restriction in the deterministic reserve. The sum of the individual margin impacts won't equal the total impacts of all margins.

(c)   Explain the impact on XYZ Life's net premium reserve of the following:

    (i)   Changing the post-level premium-to-benefit ratio to 150% from the VM-20 prescribed ratio

    (ii)   Changing the post-level premium-to-benefit ratio to 100% from the VM-20 prescribed ratio

Commentary on Question:
Some candidates did not recognize how a change in post-level premium-to-benefit ratio would impact NPR. Candidates were expected to specify it is the change from the "projected" post level profits cash flows that impacted the reserve to receive full credit.

- When the ratio goes up from 135% to 150%, the reserve goes down, especially in the later years within the level period. This is because increasing the constraint from 135% to 150% effectively allows 50% of post-level profits (instead of 35%) projected in the NPR calculation to be recognized when determining the reserve during the term level premium period.

- In contrast, if the ratio were changed to 100%, essentially, no post-level profits are allowed to pre-fund the level period reserve, then the reserves would increase. The impact is greater towards the end of the level period because the present value of post-level cash flows is greater at this point in the projection.

5. Continued

(d)   As part of its US Statutory valuation, XYZ Life performed the stochastic exclusion test.

- Baseline scenario reserve = 300 million
- Maximum reserve of 16 scenarios prescribed by VM-20 scenario generator = 350 million
- Baseline scenario present value of benefits and expenses = 2,500 million

(i)   Determine whether XYZ Life passed the stochastic exclusion test.

(ii) Explain whether this product contains significant interest rate risk.

(iii) Explain why a company might calculate the stochastic reserve despite passing the stochastic exclusion test.

Commentary on Question:
Most candidates did well in part (i) of the question. For part (ii) of the question full credit was received only if candidates elaborated on the SERT test itself and commented on the short duration nature of term products. Most candidates did not do well on part (iii) of the question as candidates generally did not explain the broader benefits of doing the stochastic reserve when the term product itself passes the SERT.

(i)   The exclusion ratio = (Adjusted DR from baseline scenario- Max Adjusted DR)/ PVFB from baseline scenario = (350-300)/2500 = 2%

XYZ Life passes the SET since its ratio of 2% is less than 6% required.

(ii) No. The product passed the stochastic exclusion ratio test which evidenced the limited exposure to the interest rate risk. VM-20 scenario generator prescribes 16 scenarios in the stochastic exclusion ratio test, where a range of interest rate shocks are selected combined with varying levels of equity makeup. More broadly, this is driven by the short duration of the term product relative to other permanent products, creating less exposure to interest rate risk.

5. **Continued**

    (iii)   A company might calculate the stochastic reserve despite passing the stochastic exclusion test for the following possible reasons:

        a. Potential diversification benefits with other products and/or less than 100% correlation of risks with another product.

        b. The benefit due to the net premium reserve being greater than the deterministic or stochastic reserve, can partially or even fully offset the surplus of the deterministic or stochastic reserve being greater than the NPR of another product.

        c. If the company has clearly defined hedging strategy (CDHS), it is required to calculate stochastic reserve regardless of the result of SERT.

        d. Could also be a judgement call of the company/actuary, due to desire of better understanding interest rate risk sensitivities and appetite (or other reasonable rational).

6. **Learning Objectives:**
2. The candidate will understand and apply U.S. Statutory valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

Learning Outcomes:
(2a) Describe, apply and evaluate the appropriate valuation methods and techniques and related accounting treatments for reserves and related items, and other assets and liabilities for specific insurance products under the U.S. Statutory rules. Further, describe and recommend assumptions and margins appropriate to these statutory reserves.

Sources:
Statutory Valuation of Individual Life and Annuity Contracts – Chapters 18 and 21

Commentary on Question:
This question tested the candidates' understanding of U.S. Statutory valuation principles and methods.

Solution:
(a) Critique the following statements:

A. *For a deferred annuity contract with the option to annuitize at the guarantee or current annuitization purchase rates, the basic CARVM reserve shall be no less than 80% of the amount used to purchase annuitization benefits at the time of valuation.*

B. *Structured settlements are not permitted to use substandard mortality when calculating statutory reserves.*

C. *A cash refund annuity would have a lower reserve at issue than an installment refund annuity.*

Commentary on Question:
Candidates generally did well on this part of the question.

A. This is false – the 80% needs to be upped to 93%
B. This is false – you can use substandard mortality for the valuation of settlement annuities.
C. This is false- installment refunds get more discounting than cash refund annuities resulting in a lower reserve

6. Continued

(b)   You are given the following for a deferred annuity policy:

- Term: 10-year
- Contract is terminated after the initial term
- Guaranteed Interest Rate: 3%
- Issue date: July 1, 2020
- Valuation date: June 30, 2021
- Account value of 103,000 on June 30, 2021
- Policyholder will turn 46 on July 1, 2021
- Valuation interest rate is 3.25%
- All benefits are paid at the end of the period

Year	Surrender Charge %
1	9%
2	8%
3	7%
4	6%
5	5%
6+	0%

Calculate the CARVM reserve at the valuation date using the mortality table provided in Excel. Show all work.

Commentary on Question:
Few candidates received full credit for this part of the question. Full credit was received if the calculation was done on an annual or monthly basis as long as the mortality was adjusted accordingly.

The solution for this part of the question is provided in an Excel spreadsheet.

7.

Learning Objectives:

2. The candidate will understand and apply U.S. Statutory valuation principles and methods applicable to individual life insurance and annuity products issued by U.S. life insurance companies.

Learning Outcomes:

(2a) Describe, apply and evaluate the appropriate valuation methods and techniques and related accounting treatments for reserves and related items, and other assets and liabilities for specific insurance products under the U.S. Statutory rules. Further, describe and recommend assumptions and margins appropriate to these statutory reserves.

(2b) Describe, apply and evaluate the Principle-Based Reserves valuation methods and techniques for specific insurance products under U.S. Statutory rules.

(2c) Describe and evaluate the fundamental features and design of the U.S. Statutory regulatory system.

Sources:

Statutory Valuation of Individual Life & Annuity Contracts, 5th Ed, 2018, Chapters 10, 14, and 23

Fundamentals of the Principle-Based Approach to Statutory Reserves for Life Insurance, July 2019

Impacts of AG 48, Financial Reporter, Dec 2015

Commentary on Question:

This question tested the candidates' ability evaluate the differences between valuation methods before and after VM-20 was effective.

Solution:

(a) Compare the following under Universal Life Insurance Model Regulation and VM-20's Net Premium Reserve (NPR).

  (i) Guaranteed Maturity Premium

  (ii) r-ratio

  (iii) Reserve calculation assumptions

  (iv) Minimum reserve floor

7. Continued

Commentary on Question:
Candidates generally did well on this part of the question. To receive full credit, candidates were required to compare both regulations. Candidates who only stated a fact about one regulation, without comparing it to the other, did not receive full credit.

(i)   The Guaranteed Maturity Premium (GMP) is used to determine a premium that should be used within the UL Reserving calculation. The GMP in the UL Model Regulation is assumed to endow the fund value to equal the face amount at maturity. The GMP within NPR is assumed to the get the fund value to 0 at maturity instead.

(ii)   The r-ratio is the ratio of the Guaranteed Maturity Fund (GMF) to the Actual Fund Value (FV), capped at 1 (r-ratio = max(1,GMF/FV)). This ratio calculated consistently within both regulation calculations.

(iii)   The Mortality and Interest assumptions largely remained the same, where they are determined as of the Issue date of the underlying policy. Both reserve assumption also allows the use of an expense assumption. The NPR however, allows the use of a lapse assumption, depending on the underlying funding level, while UL Model Regulation does not allow it.

(iv)   The minimum reserve floor remained the same within both regulations, where there is a Cash Value floor and the Cost of Insurance to the next paid-to-date.

(b)   Critique the following statements pertaining to BFB's business.

   A.   *Under VM-20, mirror reserves are no longer required. Under VM-20, BFB can use their own experience-based mortality assumption as long as the mortality assumption credibility is above 99%.*

   B.   *When calculating the Deterministic Reserve, starting assets must be between 98% and 102% of modeled net reserves.*

   C.   *After VM-20 went into effect, the formulaic Net Premium Reserve (NPR) completely replaced CRVM*

Commentary on Question:
For statement A, candidates generally recognized that VM-20 allowed a company to use their own assumption, if their credibility was above 20%. However, most candidates did not acknowledge that regardless of the level of credibility, a company has to grade to an industry standard.

7. Continued

Candidates generally did not do well critiquing statement B. Most candidates focused on the portion discussing net reserves, rather than within the ratio itself. Most candidates did well critiquing statement C.

A. The first statement is true, but the second is not. Under VM20, as each insurance company has to use part of their own assumptions, a Cedant and a Reinsurer may have different assumptions. VM20 allows a company to use their own experience, if a minimum level of credibility is achieved. However, even if the credibility is close to 100%, a company is required to grade their own mortality assumption to an industry assumption, just at a later date.

B. This is not necessarily a true. If a company cannot demonstrate that their deterministic reserves are within 98% and a 102% of modeled net reserves, they need to provide reasonable assurances within the PBR report that they are still complaint and holding a sufficient reserve. This can involve additional testing, such as sensitivity testing.

C. This statement is false. There are a few situations where CRVM is still required. The first situation is for all policies issued pre-2017, as VM20 is not retroactive, so any policy issued prior to 2017 (or 2020 if elected for deferral), CRVM remains into effect. The second situation is when a Non-Term or UL Policy, issued after the operative date passes the Deterministic Exclusion Test, it will then use CRVM. A Whole Life policy would typically fall under this section.

(c) You are given:

Present Values	In millions
Benefits with margins	150
Expenses with margins and commissions	25
Premiums with margins	80
Aggregate CRVM reserve	120
Aggregate AG38 reserve	200
Aggregate NPR reserve	40

Calculate the following:

(i) VM-20 reserve, assume the information given is from policies issued in 2022.

(ii) AG-48 reserve, assume the information given is from policies issued in 2016.

7. **Continued**

Commentary on Question:
Candidates generally did well on part (i) of the question and generally did not do well on part (ii) of the question. For part (i) of the question, credit was received if the appropriate formula was used. For part (ii) of the question, most candidates did not demonstrate understanding of AG-48 reserves. Many candidates restated the part (i) reply or just stated the AG-38 reserve.

(i)   VM20 Reserve = NPR + Max [0, (DR-NPR)]

DR = Present Value of outflows with margins - Present Value of inflows with margins

DR = 150 + 25 - 80 = 95

NPR = 40

VM20 Reserve = 40 + Max [0, (95-40)] = 95

(ii)   Under AG48, the Primary Security is the DR calculated under PBR = 95

The Redundant Reserve = AG38 Reserve – CRVM Reserve = 200-120=80

The Retained Reserve = CRVM Reserve + Primary Security = 95+120 = 215

AG48 Reserve/Amount to be Financed = AG38 Reserve – Retained Reserve
$$= 200 – 215 = -15$$

As the amount to be financed is -15, nothing would be financed. The final answer would be 0.

8.

Learning Objectives:

3. The candidate will:
   - Understand the significant impact on individual life insurance and annuity product design and management of U.S. insurance product taxation rules.
   - Understand and apply the significant rules of U.S. insurance company taxation as they apply to U.S. life insurers.

Learning Outcomes:

(3a) Describe and apply the significant US tax regulations relating to the taxation of individual life and annuity insurance products.

(3b) Describe, apply and evaluate the valuation methods and techniques for specific insurance products under U.S. taxation rules. Further, evaluate and calculate deferred tax items.

Sources:

Chapters 1 and 2 of Life Insurance and Modified Endowments Under IRC §7702 and §7702A, Desrochers, 2nd Edition

Company Tax – Introductory Study Note

The Tax Cuts and Jobs Act of 2017— Effects on Life Insurers, American Academy of Actuaries, Oct 2020

Commentary on Question:

This question tested the candidates understanding of taxation rules as they apply to product design and as they apply to life insurers.

Candidates that showed their work and described justification for their answers were awarded partial credit for the concepts they demonstrated even if they did not arrive at the correct solution.

Solution:

(a) You are given:

Coverage	Insured	Coverage Period	Premium per Year	Death Benefit
Base policy	Policyowner, age 20 at issue	Whole life	2,004	100,000
Accidental death benefit rider	Policyowner	Attained age 65	120	10,000
Child term rider	Child age 0 at issue	Attained age 25	108	10,000
Term life insurance rider	Business Partner, age 20 at issue	25 years	600	10,000

8. Continued

- All premiums are paid at the beginning of each policy year.
- $1000\,A_{20} = 111.99$
- $\ddot{a}_{20:\overline{25}|} = 16.07$
- $\ddot{a}_{20:\overline{45}|} = 21.04$
- $\ddot{a}_{20:\overline{7}|} = 6.23$

(i)   Assume no other changes are made to the policy's benefits.

Determine if the policy is a modified endowment contract, assume premiums are paid throughout the 7-pay test period without any modification.

(ii)   You are given:

- At the beginning of the 5th policy year, the owner elects to reduce the primary benefit face amount to 50,000 and cancels all riders.
- Premiums are reduced to 1,080 per year.

Determine if the policy is a modified endowment contract, assume premiums are paid throughout the 7-pay test period.

Commentary on Question:
This part of the question tested the candidates understanding of 7702 rules for determining if a life insurance policy is a Modified Endowment Contract (MEC). Candidates generally did well on this part of the question. Generally, candidates were able to demonstrate that they understood what qualifies a contract as a MEC. Many candidates had challenges with the treatment of Qualified Additional Benefits (QABs) in the 7-pay test.

For part (i) of the question, candidates received credit if they understood that if the actual premium paid is less than the 7-Pay Premium then the contract is not a MEC. A common error in the calculation was incorrectly determining the premium by incorrectly including non-QAB premium paid in actual premium used in 7-Pay test or only using the base contract's premium and ignoring QABs. Some candidates incorrectly used the death benefits associated with the QAB instead of using the QAB charges to determine the 7-pay premium.

For part (ii) of the question, most candidates were able to calculate the new 7-pay premium of $899. However, to receive full credit candidates had to (1) understand that the 7-pay test needed to be restarted from policy inception using the $899 as the 7-pay premium and (2) demonstrate that the original actual premium should be used for first 4 years and the revised actual premium for the remaining 3 years of the 7-pay test.

8. **Continued**

(i) The Annual Premium for the policy is $2,232. This includes the premium from the primary benefit, accidental death benefit rider, and the child term. The premium for the term insurance on the business co-owner is not included since it is not a qualified additional benefit.
Premium paid = $2,004 + $120 + $108 = $2,232

7-pay premium calculation:
Primary benefit = Death benefit * 1000 A_{20} / 1000 = $11,199
Accidental death benefit rider = Premium per year * $\ddot{a}_{20:\overline{45|}}$ = $2,524
Child term rider = Premium per year * $\ddot{a}_{20:\overline{25|}}$ = $1,735
Total = (Primary benefit + Accidental death benefit + Child term) / $\ddot{a}_{20:\overline{7|}}$
= ($11,199 + $2,524 + $1,735)/6.23 = $2,481

Policy Year	Premium Paid	7-Pay Premium	Accumulated Premium Paid	Accumulated 7-Pay Premium	7-Pay Test
1	$2,232	$2,481	$2,232	$2,481	Pass
2	$2,232	$2,481	$4,464	$4,963	Pass
3	$2,232	$2,481	$6,696	$7,444	Pass
4	$2,232	$2,481	$8,928	$9,926	Pass
5	$2,232	$2,481	$11,160	$12,407	Pass
6	$2,232	$2,481	$13,392	$14,889	Pass
7	$2,232	$2,481	$15,624	$17,370	Pass

Actual premium paid < 7-pay premium in each year, therefore the 7-pay test is passed and the policy is not a modified endowment contract.

(ii) The testing of the policy is restarted from the start of the 7-pay period since there has been a reduction in the face amount and removal of riders.
Revised 7-pay premium:
Primary benefit = Revised death benefit * 1000 A_{20} / 1000 = $50,000 * 111.99 / 1000 = $5,600
7-pay premium = Primary benefit / $\ddot{a}_{20:\overline{7|}}$ = $5,600 / 6.23 = $899

8. **Continued**

Policy Year	Premium Paid	7-Pay Premium	Accumulated Premium Paid	Accumulated 7-Pay Premium	7-Pay Test
1	$2,232	$899	$2,232	$899	Fail
2	$2,232	$899	$4,464	$1,798	
3	$2,232	$899	$6,696	$2,696	
4	$2,232	$899	$8,928	$3,595	
5	$1,080	$899	$10,008	$4,494	
6	$1,080	$899	$11,088	$5,393	
7	$1,080	$899	$12,168	$6,292	

Actual premium paid > 7-pay premium in the first year, therefore the 7-pay test is failed and the policy is a modified endowment contract.

(b) You are given:

Line of Business	Non-Variable Life		Variable Universal Life	
Product Segment	Term Life	Whole Life	General Account	Separate Account
Account Value			20,000	80,000
Net Surrender Value	45,000	150,000	14,000	74,000
Statutory Reserve	50,000	225,000	21,000	75,000

Calculate the total tax reserve for the company.

Commentary on Question:
This part of the question tested the candidates' understanding of the tax reserve calculation based on the Tax Cuts and Jobs Act (TCJA).

Candidates generally understood the formula for non-variable life tax reserve. Most candidates demonstrated that the variable life tax reserve formula differs from the non-variable life tax reserve. Candidates had the greatest challenges incorporating full net surrender value in the calculation of the variable life tax reserve.

For Non-Variable Life:
Tax Reserve for each product = Max(Net Surrender Value, 92.81% * Statutory Reserve)
Term Life Tax Reserve
= Max($45,000, 92.81% * $50,000)
= $46,405

8. **Continued**

Whole Life Tax Reserve
= Max($150,000, 92.81% * $225,000)
= $208,823

For Variable Life:
Tax Reserve = Min(Max(Total Net Surrender Value, Separate Account Statutory Reserve) + 92.81% * (Total Statutory Reserve - Max (Total Net Surrender Value, Separate Account Statutory Reserve)), Total Statutory Reserve)
Total Net Surrender Value
= $14,000 + $74,000
= $88,000
Total Statutory Reserve
= $21,000 + $75,000
= $96,000
Variable Universal Life Tax Reserve
= Min(Max($88,000, $75,000) + 92.81% * ($96,000 – Max($88,000, $75,000)), $96,000)
= Min($88,000 + 92.81% * ($96,000 - $88,000), $96,000)
= Min($88,000 + $7,425, $96,000)
= $95,425

Total Company Tax Reserve = Term Life Tax Reserve + Whole Life Tax Reserve + Variable Life Tax Reserve
= $46,405 + $208,823 + $95,425
= $350,652

9.

Learning Objectives:
6.   The candidate will understand the fundamental features of the U.S. and International regulatory framework.

Learning Outcomes:
(6b)   The features of the emerging International regulatory framework, and its development in Canada.

(6c)   The valuation methodology specified in IFRS 17.

Sources:
IFRS 17 Insurance Contracts – IFRS Standards Effects Analysis, May 2017, IASB (sections 1, 2, 4 & 6.1-2 only)

OSFI Guideline – Life Insurance Capital Adequacy Test (LICAT), July 2022, Only Ch. 1 Life Insurance Regulatory Framework, OSFI, 2012

Commentary on Question:
This question tests the candidate's knowledge of IFRS 17, specifically impacts from LICAT and from the discount rate.

Solution:
(a)   Calculate the comprehensive income for all years under the following:

      (i)   IFRS 4

      (ii)   IFRS 17

      Commentary on Question:
      This part of the question tested the candidates' knowledge of the make-up of the comprehensive income under IFRS 4 and IFRS 17. Full credit was received if the candidates were able to get the final answer with mention of adding the OCI (which is zero) and the insurance finance income or expense (IFIE). The question did not specify the assumptions to be used for the IFIE hence candidates who specified the assumptions they used for the IFIE were rewarded with credit. Candidates generally did well on this part of the question and identified the related components for both standards.

9. **Continued**

(i)   IFRS 4:

	Year 1	Year 2	Year 3	Total
Premiums	22,500			22,500
Investment income	2,250	1,922	2,516	6,687
Incurred claims and other expenses	(255)	(257)	(27,120)	(27,632)
Change in insurance contract liabilities	(24,072)	(1,116)	25,188	-
Profit or loss	**423**	**549**	**584**	**1,556**
Other comprehensive income	-	-	-	-
Comprehensive income	**423**	**549**	**584**	**1,556**

The figures provided are from a profit and loss perspective (+ve as profit).

IFRS 4 Profit or Loss = Premiums + Investment income + incurred claims and other expenses + Change in insurance contract liabilities

IFRS 4 Comprehensive Income = Profit or loss + Other comprehensive income

(ii)   IFRS 17:

IFRS 17 splits out the insurance results and the financial results.

Insurance service result = Insurance revenue + Incurred claims and other expenses

Net Financial result = Investment income + Insurance finance expenses

IFRS 17 Comprehensive Income = Insurance service result + Net financial result + Other comprehensive income

The total income recognized under IFRS 17 is the same as IFRS 4. To get to that final result, the insurance finance expense is assumed to be fully offsetting the investment income.

	Year 1	Year 2	Year 3	Total
Insurance revenue	480	509	579	1,568
Incurred claims and other expenses	(12)			(12)
Insurance service result	**468**	**509**	**579**	**1,556**
Investment income	2,250	1,922	2,516	6,687
Insurance finance expenses	(2,250)	(1,922)	(2,516)	(6,687)
Net financial result	**-**	**-**	**-**	**-**
Profit or loss	**468**	**509**	**579**	**1,556**
Other comprehensive income	-	-	-	-
Comprehensive income	**468**	**509**	**579**	**1,556**

9. Continued

(b) Evaluate the following statements:

A. IFRS 17 will have minimal impact on DJS's LICAT ratios.

B. When moving from IFRS 4 to IFRS 17, DJS will not need to reevaluate whether a contract is an insurance contract, a reinsurance contract, or an investment contract with discretionary features.

C. In contrast with short-term insurance contracts, updating the assumed interest rate for long-term insurance contracts with guaranteed returns from 4 to 6% will increase the current value of the contract under IFRS 17.

D. IFRS 17 requires DJS to measure insurance contract liabilities using a discount rate based on the 'expected return on assets held' to match the insurance contract liabilities.

Commentary on Question:
Candidates generally did well evaluating statements A and D. For statement B, most candidates did not provide the rationale. For statement C, candidates confused the assumed interest rates and guaranteed rates.

A. LICAT ratio is calculated using available capital/available margin, surplus allowance, eligible deposits and base solvency buffer/required margin. Some components are impacted by IFRS 17. Surplus allowance is the net risk adjustment. IFRS 17 reserve will change the surplus and available capital/margin.

When OSFI updated LICAT for IFRS 17, one of its intentions was to refine the capital rules such that they will minimize industry-wide capital impacts on implementation of IFRS 17. There are still continuous efforts at OSFI to further refine LICAT to minimize capital volatility.

B. IFRS 17 substantially retains the existing definition of insurance contracts, where insurance contracts are defined to transfer significant insurance risk. Certain exceptions can occur depending on the IFRS 4 application which can vary across different jurisdictions. IFRS 17 applies only to investment contracts with discretionary participation features that are issued by company that also issues insurance contracts.

9. **Continued**

C. The current value will decrease as policyholders may hold insurance contracts for less time than expected or switch to more advantageous policies from other insurers, hereby increasing lapses and profitability of the contract. Moreover, the increase in assumed discount rate increases discount rate and thus will decrease the current value due to higher discounting. In contrast, changes in interest rates do not typically have a significant effect on short-term insurance contracts because those contracts are typically renewed or repriced annually.

D. IFRS 17 requires a company to use a discount rate that reflects the characteristics of the insurance cash flows. As such, expected return on assets held can be included in the discount rate only if the liability cash flows are linked to those assets. Care should be taken in using such approach as it could obscure economic exposures and misstate the liabilities.

10. **Learning Objectives:**
5.	The candidate will understand important insurance company issues, concerns and financial management tools.

Learning Outcomes:
(5a)	The candidate will be able to describe, apply and evaluate considerations and matters related to:
- Insurance company mergers and acquisitions
- Management of variable deferred annuities
- Embedded Value determinations
- VM-20 financial impacts
- Rating agency considerations
- Model Audit Rule and Sarbanes-Oxley Section 404 considerations
- Source of Earnings analysis

Sources:
Introduction to Source of Earnings Analysis

Commentary on Question:
This question tested the candidates' knowledge of Source of Earnings (SOE).

Solution:
(a)	Describe objectives in creating a Source of Earnings Analysis.

Commentary on Question:
This part of the question tested the objectives of a SOE Analysis. Many candidates described an SOE Analysis as merely an actual-to-expected report or talked solely about earnings "drivers" in isolation without indicating that a restructuring of the Income Statement is occurring. Most candidates described only one of the objectives.

SOE Analysis has up to three objectives.

Restructure the Income Statement to:
Objective 1 - Relate reported profits more directly with significant economic and actuarial profit drivers.
		a.	Accounting regime financial statements may not be optimal for understanding profit emergence.
Objective 2 - Evaluate actual profits against profits anticipated to emerge under valuation assumptions.
		a.	Intended for understanding impact on profit emergence of valuation assumptions versus actual experience.
Objective 3 - Evaluate actual profits against profits anticipated to emerge under alternative assumptions, which may include pricing and/or plan.
		a.	Internal management tool to critique performance against alternative assumptions.

10. Continued

(b) You are given the following for a block of single premium deferred annuities (SPDA):

	Actual	Plan
Average annual assets	150,000,000	100,000,000
Annual yield	5.00%	2.50%
Annual non-investment expenses	1,500,000	1,250,000

- Assume expenses vary directly with average annual assets.

Calculate the following Source of Earnings components:

(i) Investment income variance

(ii) Variance due to yield

(iii) Variance due to assets

(iv) Non-investment expense variance

(v) Variance due to expense ratio

Commentary on Question:
This part of the question tested SOE Analysis calculations using a total and rate vs volume simplified SOE Analysis. The following technique is provided to assist the candidates' understanding.

($\triangle$ = Change)
Total variance =   New Volume * New Rate – Old Volume * Old Rate
Two variables are changing, need to change only one at a time.
Total $\triangle$ involves   New Volume New Rate Old Volume Old Rate

For a volume variance drop the rate in the way:
Volume $\triangle$ involves   New Volume ~~New Rate~~ Old Volume Old Rate
Volume $\triangle$ =   (New Volume – Old Volume) * Old Rate

For a rate variance drop the volume in the way:
Rate $\triangle$ involves   New Volume New Rate ~~Old Volume~~ Old Rate
Rate $\triangle$ =   New Volume * (New Rate – Old Rate)

Total $\triangle$ was asked in parts (i) and (iv), Rate $\triangle$ was asked in parts (ii) and (v), though in part (v) the rate was not directly provided, and Volume $\triangle$ was asked in part (iii).

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10. Continued

Note it is always Actual minus whatever Actual is being compared to in this case Actual – Plan.

Candidates were much more likely to correctly answer a Total△ than to correctly answer a Volume△ or a Rate△. Few candidates answered parts (i) through (v) correctly, however partial credit was received. Common errors include using the wrong yield or rate, or the wrong asset or volume. A few candidates incorrectly subtracted non-investment expenses from investment income.

Some candidates answered part (ii) as 2.5%, part (iii) as 50,000,000, part (v) as +/-0.25%. These are not expressed as an estimated dollar effect on earnings that is the function of an SOE Analysis. Partial credit was received; however, it demonstrated that the candidates did not understand that an SOE Analysis is not solely an actual-to-expected report. The SOE attributes certain amounts of earnings to changes in specified variables that are believed to affect earnings.

Although not necessary to received full credit, it is possible to determine whether components add up to the total (see checks after parts (iii) and (v)). A few candidates realized the rate and volume components add up to the total.

(i)
Investment income variance=Actual Assets*Actual Yield–Plan Assets*Plan Yield
Investment income variance= 5,000,000 =150,000,000*0.05 –100,000,000*0.025

(ii)
Variance due to yield = Actual Assets * (Actual Yield – Plan Yield)
Variance due to yield = 3,750,000 = 150,000,000 * (0.05 – 0.025)

(iii)
Variance due to assets = (Actual Assets – Plan Assets) * Plan Yield
Variance due to assets = 1,250,000 = (150,000,000 – 100,000,000) * 0.025

Investment income variance = Variance due to yield + Variance due to assets, can be proven algebraically. Check: 5,000,000 = 3,750,000 + 1,250,000 ✓

(iv)
Non-Investment expense variance = Actual – Plan
Non-Investment expense variance = 250,000 = 1,500,000 – 1,250,000

10. Continued

(v)
Variance due to expense ratio = Actual Assets * (Actual Ratio – Plan Ratio)

Actual Ratio = Actual non-investment expenses / Actual Assets
Actual Ratio = 1.00% = 1,500,000 / 150,000,000

Plan Ratio = Plan non-investment expenses / Plan Assets
Plan Ratio = 1.25% = 1,250,000 / 100,000,000

Variance due to expense ratio = (375,000) = 150,000,000 * (1.00% - 1.25%)

*Variance due to assets is analogous to (iii) and (Actual Assets - Plan Assets) * Plan Ratio = 625,000 = (150,000,000 – 100,000,000) * 1.25%*
Non-Investment expense variance = Variance due to expense ratio + Variance due to assets. Check: 250,000 = (375,000) + 625,000 ✔

(c)   List additional drivers of earnings for the SPDA.

Commentary on Question:
This part of the question tested the candidates' knowledge on additional profit drivers specifically relate to an SPDA. Everything investment related and expense related was covered in part (b) of the question. Most candidates correctly answered withdrawal or surrender, and mortality or longevity. A few candidates incorrectly answered there was no risk of withdrawal, surrender or lapse due to the single premium. Some candidates described premium/sales experience, which is indeed a major driver of earnings.

Premium/Sales Experience
Withdrawal or Surrender
Mortality or Longevity