ILA LFMU Model Solutions
Spring 2025

1. 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.

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

Sources:

US GAAP for Life Insurers, Chapter 7: Universal Life Insurance (only sections 1-3, 5-7)

US GAAP for Life Insurers, - Chapter 3: Product Classification

Commentary on Question:

This question tested the candidates' understanding of US GAAP.

Solution:

(a) Describe how the following riders and/or features affect the liabilities under US GAAP:

(i) Accelerated death benefits

(ii) Waiver of deduction rider, where the charge increases with age

Commentary on Question:

Candidates generally struggled on this part of the question to make the connection between the base GAAP liability (i.e. account value) and how these riders were (or were not) covered by the AV. Most candidates described the accelerated death benefits and waiver of deduction rider and how these riders would likely impact GAAP liabilities.

1. Continued

However, candidates generally did not equate that the accelerated death benefits only impacted the timing of benefits, not the level, thereby not materially impacting the liability. To receive full credit, candidates needed to address that the accelerated death benefits would not constitute gains followed by losses, so no additional liability would be required.

For the waiver of deduction rider, the charge increases with age and in proportion to the risk. Thus, no additional GAAP liability would be required. To receive credit, candidates needed to make this connection between the rider charge and the impact on the liability.

Accelerated death benefit riders are assessed to determine whether they result in an expectation of profits followed by losses. No adjustment is typically required to be made to the account value reserve as the feature typically does not generate losses in excess of those that would otherwise be generated on a policy without the rider.

Because the rider fees for-waiver-of-deduction riders are proportional to the risk incurred (i.e., they increase as the policyholder ages), no additional liability for these waivers is normally required, except for a liability to recognize the unearned portion of the monthly rider fee existing at the end of the month.

(b) Calculate each of the following at the end of policy year 2:

(i) Account value

(ii) Sales Inducement Liability

(iii) Unearned Revenue Liability

(iv) Liability for Future Policyholder Benefits

Show all work.

Commentary on Question:
In general, liabilities should first be calculated without decrements. Once the end of period liabilities has been calculated, it can be multiplied by the projected inforce (i.e. Inforce(t-1)(1-lapse(t))).*

Most candidates did well on part (i) (calculating the AV), particularly on the premium, charge, and interest components. The NAR calculation, including the sum of premiums death benefit option, was the one part of the AV that many candidates struggled to calculate correctly – either candidates did not discount the death benefit, did not adjust for the AV, or both.

1. Continued

To receive full credit, candidates needed to calculate the expected AV at the end of year 2 by multiplying by the projected inforce, reflecting the impact of lapses. Some candidates incorrectly interpreted the COI charges as deaths and used as decrements, but lapses were the only decrement given.

On the Sales Inducement Liability (SIL), candidates did not do well on this calculation. Most candidates calculated the persistency bonus correctly but struggled on either what interest rate to use (i.e. should use the crediting rate of 5%, not the guaranteed rate of 3%) and/or that the amortization should be based on interest only (decrements cannot be assumed in the determination of the SIL). To receive full credit, candidates had to calculate the expected SIL at end of year 2 by multiplying by the projected inforce

On the Unearned Revenue Liability (URL), most candidates did not correctly calculate the deferred revenue amounts, which is defined as the per unit expense in excess of the ultimate rate of $10/unit. Beyond the calculation of the deferred revenue, most candidates calculated the URL roll-forward and amortization by using the projected inforce (with decrements). To receive full credit, candidates should not accrete the URL with interest (i.e. interest is not allowed under LDTI for DAC/URL), and the ending URL balance in year 10 should be zero.

For the total GAAP liability, candidates received full credit if they calculated the liability to be either the AV or the AV + SIL + URL. Some candidates recomputed an LFPB, defining it as the PV Future Benefits – PV net premiums. However, that LFPB definition applies to traditional life products, such as Term. For UL products, the LFPB is the accumulation of past premiums and interest credits and reduced for accumulated charges (i.e. AV)

See the spreadsheet for calculations for part (b).

Part b.i:
Calculating Option C Death Benefit = face amount + cumulative premiums.
General Formula for Calculating Unit AV: UnitAV(t) = UnitAV(t-1) + Prem(t) - Expense Loads(t) - Mortality Charges(t)+ Interest Credited(t) + Persistency Bonus(t).
Expense Loads per unit(t) = (Prem per unit(t) x Percentage of Premium Load(t)) + Annual Load per 1000 Face
Mortality Charges(t) = Net Amount at Risk(t) x COI Charges(t).
Net Amount at Risk(t) = Option C Discounted Death Benefits(t) - UnitAV(t-1) = Discounted DB - [AV(t-1) + Prem(t) - Exp Load(t)], where
Option C Discounted Death Benefits = Option C Death Benefits / (1 + guaranteed interest rate(t)).

1. Continued

Interest Credited(t) = (UnitAV(t-1) + Prems(t) - Expense Loads(t) - Mortality Charges(t)) x Credited Interest Rate(t).
Units(t) = Units(t-1) x (1 - Termination Rate(t)), where Units(0) = 1.
AV(t) = AV(t)* Units(t). AV before decrement (t) x Unit(t)
Correct AV in policy year 2. $49,040 if premiums accumulated with interest, or $49,077 if not accumulated with interest.

Part b.ii:
Persistency Bonus(t) = (UnitAV(t-1) + Prems(t) - Expense Loads(t) - Mortality Charges(t) + Interest Credited(t)) x Persistency Bonus%(t).
Cumulative Interest Discount Factor(t) = Cumulative Interest Discount Factor(t-1) / (1 + Credited Interest Rate), where Cumulative Discount Factor(1) =1.
Bonus Accrual Factor = Cumulative Interest Discount Factor(11) / Sum from t=1 to t=10 of Cumulative Interest Discount Factor(t) x Bonus(t)
Sales Inducement Liability(t) = (Persistency Bonus Liability(t-1) + Bonus Accrual Factor) x (1 + Credited Interest Rate), where Persistency Bonus Liability(0) = 0.
Sales Inducement Liability(2) = Persistency Bonus(2) =8.66 Correct value in PY 2 is $4,473 (cum prem with interest) or $4,512 (cum prem w/o interest)

Part b.iii:
Unearned Loads(t) = (Per Policy Expense Load(t) - minimum(Per Policy Expense Loads from t=1 to t=10)) x Units(t).
The question didn't specify the amortization base. Amortization base is inforce counts in the solution, Inforce amount is acceptable as well, however, the face amount will need to account for the Accumulated premium which is more complex.
Amortization Factor(t) = (Unearned Revenue Liability(t-1) + Unearned Load(t)) / Sum from t = t-1 to 10 of Units(t).
Amortization(t) = Amortization Factor(t) x Units(t-1). Note – interest on URL is not accredited under LDTI.
Unearned Revenue Liability(t) = (Unearned Revenue Liability(t-1) + Unearned Loads(t) - Amortization(t))* Units(t), where Unearned Revenue Liability(0) = 0
Unearned Revenue Liability(2) = $22,700.

Part b.iv:
Sum the account balance (adjusted for units), Sales inducement liability (adjusted for units) and unearned revenue liability or in practice, policy reserve for UL can be = AV. Either solution is acceptable.

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:

Implementation Considerations For VA Market Risk Benefits, Financial Reporter, Sep 2019

US GAAP for Life Insurers, Chapter 11: Deferred Annuities

Commentary on Question:

This question tested the candidates' understanding of Market Risk Benefits (MRB) and their financial reporting treatment under US GAAP.

Solution:

(a) Describe the disclosure requirements for Market Risk Benefits (MRB).

Commentary on Question:

Few candidates demonstrated knowledge of the disclosure requirements.

- The disclosure requirements for Market Risk Benefits (MRBs) under U.S. GAAP include aggregating the MRBs with similar characteristics into categories to present a disaggregated and detailed roll forward of each category's reserves from the beginning of the reporting period to the end.
- This type of analysis often requires many successive layered valuation runs to quantify the reserve movements due to changes in calculation inputs, such as changes in economic environment or actuarial assumptions.
- Certain items that are required in the disclosures include net amount at risk and weighted attained age.
- Fair value disclosure requirements should also be considered in identifying the roll forward components, so that both requirements will be satisfied in a single disclosure.

2. Continued

(b) Describe whether each of the following products requires the calculation of an MRB:

(i) Variable annuity with guaranteed minimum death benefit (GMDB)

(ii) Universal life death benefit

(iii) Fixed indexed annuity

(iv) Single premium fixed deferred annuity with an annuitization guarantee

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

(i) Variable annuities with GMDBs would be considered to have an MRB benefit regardless of the performance of the underlying investments.

(ii) UL with a death benefit would not be considered to have an MRB since the death benefit is not exposed to "other than nominal capital market risk"

(iii) The index credits of an FIA, which are amounts that "credit" the account value, are not considered MRBs. But if the FIA has a feature such as a Guaranteed Minimum Withdrawal Benefit (GMWB) that exposes the insurer to "other than nominal capital market risk", then the contract should be considered to have an MRB.

(iv) Deferred Annuity with an annuitization guarantee could be considered to have an MRB. The insurer is exposed to capital market risk due to the guarantee to provide a certain annuity payment regardless of the performance of the underlying investments.

2. Continued

(c) For a variable annuity policy with a rollup GMDB you are given:

At Issue				At Valuation Date		
Scenario	PV (Excess Benefits)	PV (Contract Charges)		Scenario	PV (Excess Benefits)	PV (Contract Charges)
1	4,449	6,979		1	565	3,357
2	2,029	5,884		2	340	2,889
3	1,811	5,801		3	252	2,668
4	964	3,623		4	134	2,468
5	712	4,087		5	110	2,346
6	428	4,529		6	65	2,337
7	158	4,762		7	24	2,564
8	12	4,176		8	5	2,415
9	9	4,635		9	3	2,296
10	8	4,914		10	2	2,570

Calculate the MRB reserve on the valuation date. Show all work.

Commentary on Question:
Candidates did well on this part of the question although a fair number of candidates erroneously thought the MRB reserve would be floored at zero.

At Issue: Average PV (Excess Benefits) = 1,058
At Issue: Average PV (Contract Charges) = 4,935
AF% = 21.44% = 1,058 / 4,935 = Average PV (Excess Benefits) / Average PV (Contract Charges)

At Valuation: Average PV (Excess Benefits) = 150
At Valuation: Average PV (Contract Charges) = 2,591
MRB Reserve = (405.38) = 150 - 21.44% * 2, 591 = Average PV (Excess Benefits) - AF% * Average PV (Contract Charges)

Note that the MRB reserve can be negative and does not need to be floored at zero.

(d) Describe the general change in reserve levels if one of the following designs of the GMDB is used instead of a rollup GMDB:

(i) Return-of-premium design

(ii) Annual ratchet design

2. Continued

(i) For Return-of-premium the benefit is guaranteed to be no less than the total deposits made into the contract, less withdrawals, regardless of market performance.
ROP generally has less reserve than the rollup design

(ii) Annual ratchet design means the guarantee is reset each year if the account balance is greater than prior year.
Annual ratchet could result in a higher MRB reserve than the rollup design in volatile scenarios. The reserve will depend on market conditions and volatility for annual ratchet compared to rollup

3. 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.

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

Sources:

Valuation of Life Insurance Liabilities, Lombardi, Louis J., 5th Edition, 2018, Chapter 10 – Valuation Assumptions

Valuation of Life Insurance Liabilities, Lombardi, Louis J., 5th Edition, 2018, Chapter 18 – Fixed Deferred Annuities

Commentary on Question:

This question tested the candidates' understanding of Actuarial Guideline XXXIII and CARVM (Commissioners' Annuity Reserve Valuation Method) in the context of valuing single premium deferred annuities.

Solution:

(a) Identify which Actuarial Guideline XXXIII benefit stream category applies to each of the following:

(i) Making a partial withdrawal

(ii) Making a full withdrawal by surrendering the contract

(iii) Death of the annuitant

(iv) Receiving benefits under a disability rider

(v) Annuitizing the contract

(vi) Receiving benefits under a nursing home rider

3. Continued

Commentary on Question:
Candidates generally performed well on this part of the question. The most successful candidates were able to identify the correct benefit stream categories (non-elective benefits and elective benefits) for each benefit type. A common mistake was to mention integrated benefit streams without categorizing the elective/non-elective components of the integrated stream. Candidates also received credit where they were able to make the proper distinctions between the categories even when using alternative phrases such as voluntary/non-voluntary.

Elective benefits are benefit options that may be elected by the contract holder in accordance with the terms of the contract. The following are integrated benefit streams:

1. Making a Partial Withdrawal
2. Making a Full Withdrawal and Surrendering the contract
3. Annuitizing the contract

Non-elective benefits are benefits that are payable after the occurrence of a contingent or scheduled event independent of a contract owner's election of an option specified in the contract.

1. Death of the Annuitant
2. Receiving benefits under a disability rider
3. Receiving benefits under a nursing home rider

(b) You are given the following information for a single premium deferred annuity contract:

- The valuation date is the annuity contract issue date
- The annuity contract guarantees the credited interest rate for five years at which time the contract matures at the accumulated value.

Single premium deposit	15,000
Credited interest rate	5.50%
Statutory valuation interest rate	5.00%

Surrender charge by contract year				
Year 1	Year 2	Year 3	Year 4	Year 5
4.00%	3.00%	2.00%	1.00%	0.00%

Calculate the contract's reserve under CARVM as of the valuation date considering full surrender benefits only. Show all work.

3. Continued

Commentary on Question:
Calculations in this part of the question were generally done well. Candidates showed a good understanding of CARVM reserving mechanics. Some candidates provided a qualitative justification for selecting the Year 5 benefit stream as the CARVM reserve. Candidates that provided justifications based on the difference between the crediting rate and statutory valuation interest rate along with no surrender charge at Year 5 received full credit provided calculations were done correctly and the reasoning demonstrated that this would be the greatest present value benefit stream. The most common calculation mistakes included the timing of cashflows and application of the surrender charges. Some candidates only calculated the CARVM reserve by calculating the present value of one benefit stream with cash flows from all years, rather than an evaluation of the possible benefit streams ending in each year.

See the spreadsheet for the calculations for this part of the question.

Step 1: Project the cash surrender value using the **5.5%** guaranteed credited rate and the surrender penalty specified.

Step 2: Discount the cash surrender value using the **5%** statutory interest rate back to the valuation date (assumed to be the issue date).

Step 3: The Commissioners' Annuity Reserve Valuation reserve is the maximum present value.

The maximum present value is **$15,361**. See the accompanying Excel file for details on the calculation.

(c) You are given the following information for a specific issue year:

Time Period	Monthly average of Moody's composite yield on seasoned corporate bonds
3 months	5.53%
6 months	5.64%
12 months	5.56%
24 months	5.57%
36 months	5.46%

3. Continued

	Statutory Valuation Interest Rates	
Guaranteed Duration	Life insurance	Annuity – Type A
5 years or less	4.50%	5.50%
More than 5 years but not more than 10 years	4.50%	5.50%
More than 10 years but not more than 20 years	4.25%	5.00%
More than 20 years	4.00%	4.50%

(i) Identify which rates could be used as the "reference rate" in the dynamic valuation interest rate formula from the 1980 Amendments to the Standard Valuation Law. Justify your answer.

(ii) You are given the following guaranteed credited interest rates for a single premium deferred annuity issued the same year:

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9 and later
5.10%	4.90%	4.70%	4.50%	4.30%	4.10%	3.90%	3.70%	3.50%

Determine the guaranteed duration to be used in selecting the maximum statutory valuation interest rates for this annuity. Justify your answer

Commentary on Question:
In part (i), many candidates received partial credit for the correct bond lengths, but few were able to identify that the reference rate is the least of the two options.

Part (ii) was more challenging for candidates as the valuation rate comparison was not commonly identified to get the specific guaranteed duration criterion for this product.

(i)

The reference rate would be either:
[1] the **lesser** of (a) and (b), where:
(a) the monthly average over a thirty-six months period of the composite yield on seasoned corporate bonds, as published by Moody's Investors Service, which is 5.46%

3. Continued

(b) the monthly average over a twelve months period of the composite yield on seasoned corporate bonds, as published by Moody's Investors Service, which is 5.56%

or,
[2] the monthly average over a twelve months period of the composite yield on seasoned corporate bonds, as published by Moody's Investors Service, which is 5.56%

The "reference rate" will be either 5.46% if the product uses the formula in [1] or 5.56% if the formula in [2] is used.

(ii)

Single Premium Deferred Annuity would be categorized as 'Other Annuities'.

Therefore, the guarantee duration is the number of years that the contract guarantees an interest rate in excess of the calendar year statutory valuation interest rates for life insurance policies with a guaranteed duration in excess of twenty years.
The valuation interest rate for life insurance policies with guaranteed duration > 20 years issued in this year is 4%, while the annuity guaranteed rate is > 4% until the start of year 7.

Therefore, the guaranteed duration of this annuity is 6 years.

4. 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:

Valuation of Life Insurance Liabilities, Lombardi, Louis J., 5th Edition, 2018, Chapter 23 – PBR for Life Products (exclude 23.1)

Reflection of COVID-19 in Life Insurance Mortality Improvement: A Discussion Brief, American Academy of Actuaries, May 2022

LFM-143-20: Fundamentals of the Principle Based Approach to Statutory Reserves for Life Insurance, Rudolph

Commentary on Question:

This question tested the candidates' knowledge of US Statutory principles.

Solution:

(a) Critique the following statements with respect to VM-20:

A. Post-level term profits may be used to subsidize reserves from other similar products as well as other products which also fall under VM-20.

B. When computing IUL deterministic and stochastic reserves, the starting assets must fall between 98% and 102% of net reserves.

C. Any conservative reinvestment strategy may be used when performing the ALM model run, as long as the reserve is positive.

D. When modeling the Stochastic Reserves, a prescribed set of 100 scenarios must be used.

4. Continued

E. RTS is undergoing a modernization project in which expenses are expected to decrease 10% year over year. Management feels the expected expense reduction can be reflected in VM-20.

Commentary on Question:
This part of the question tested the candidates' knowledge of the mechanics of VM-20. Indicating whether each statement was true or false, and providing supporting rationale was required to receive full credit. Most candidates did well on this part of the question, with the exception of Statement B. Failing to identify that the threshold pertains to the sum of starting assets for all segments was a common mistake.

(A) This is false. There are limits governing reliance on post-level term profits. In calculating a net premium reserve, the net level premiums are limited to the scale of the gross premiums up to 135%. In calculating a deterministic reserve, inflows should not materially exceed outflows. Also, different product types cannot be grouped together. Excess profitability from term insurance cannot be utilized to subsidize Universal Life or Whole Life.
(B) This is false. Starting assets should be determined at the level of each segment. The threshold is considered against the sum of all segments. If the reserves fall outside of the threshold, the actuary must provide reasonable assurances in the PBR report that reserves are not misestimated.
(C) This is false. The reinvestment strategy should be consistent with company practice and take into account variations seen between the company's investment segments. The minimum reserve produced should be no lower than a reserve produced using an investment strategy that's half A-bonds, and half AA-bonds.
(D) This is false. The number of scenarios are not prescribed. Use of a prescribed scenario generator is required, however. Demonstrating that the scenarios produce a sufficient reserve can be done via simplifications or approximations.
(E) This is false. VM-20 does not permit assumptions of future expense reductions.

(b) Determine which reserves (NPR, DR, SR) under VM-20 need to be calculated for each of the following products:

(i) Whole Life

(ii) Term

(iii) UL

4. Continued

(iv) IUL with material secondary guarantee

Commentary on Question:
Attaining full credit required defining the Stochastic Exclusion Test (SET) and the Deterministic Exclusion Test (DET), including their formulas. Determining the relevance of the SET and the DET to each product was also required, along with an assessment of whether the product passed/failed each test, when applicable. Numerical support was also sought.

(i) Only the NPR needs to be calculated for Whole Life.

The product passes the Stochastic Exclusion Test because its ratio is less than 6%.

SET Ratio = (Largest DR without margin – Baseline DR without margin) / PV of Benefits = (30 – 10)/400 = 5% < 6%

The product passes the Deterministic Exclusion Test, because the sum of gross guaranteed premiums (300) exceeds the sum of valuation net premiums (200).

(ii) The NPR and DR both need to be calculated.

The product passes the Stochastic Exclusion Ratio Test, because the SET Ratio is less than 6%:

SET Ratio = (Largest DR without margin – Baseline DR without margin) / (PV of Benefits) = (50-20)/600 = 5% < 6%

The product does NOT pass the Deterministic Exclusion Test, because the sum of gross guaranteed premiums (400) does NOT exceed the sum of valuation net premiums (500).

(iii) The NPR and DR both need to be calculated.

The secondary guarantee lasts only 1 year, and thus this product does not have a material secondary guarantee. Therefore, it qualifies for the Stochastic and Deterministic Exclusion Tests.

The product passes the Stochastic Exclusion Test, because the SET Ratio is less than 6%:

4. Continued

SET Ratio = (Largest DR without margin – Baseline DR without margin) / (PV of Benefits) = (60-40)/1000 = 2% < 6%

The product does NOT pass the Deterministic Exclusion Test, because the sum of gross guaranteed premiums (500) does NOT exceed the sum of valuation net premiums (600).

(iv) The NPR and DR must be calculated. UL with material secondary guarantees is not eligible for the Deterministic Exclusion Test.

The product passes the Stochastic Exclusion Test, because the Set Ratio is less than 6%.

SET Ratio = (Largest DR without margin – Baseline DR without margin) / (PV of Benefits) = (70-50)/2000 = 1% < 6%

(c) Explain whether COVID should impact any reserve components of VM-20.

The NPR will not be impacted; mortality is prescribed. The 2017 CSO mortality tables should be utilized until new tables are put forth.

COVID experience could be included in future or historic mortality improvement for the purpose of calculating the deterministic or stochastic reserves. There are arguments for and against the inclusion of COVID. Some see COVID as having accelerated the deaths of unhealthy lives, leaving behind a healthier population and more favorable mortality outcomes on a go-forward basis. Others would argue it was a one-off event that should not be reflected.

The decision ultimately requires actuarial judgement as the long-term effects of COVID are not yet known.

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.

Sources:

Valuation of Life Insurance Liabilities, Lombardi, Louis J., 5th Edition, 2018, Chapter 11 – Valuation Methodologies (exclude 11.3.9 to 11.3.11)

Valuation of Life Insurance Liabilities, Lombardi, Louis J., 5th Edition, 2018, Chapter 13 – Term Life Insurance

Commentary on Question:

This question tested the candidates' knowledge of US statutory reserves in accordance with the Valuation of Life Insurance Policies Model Regulation. The regulation requires the calculation of unitary and segmented reserves, using either the net level premium or the CRVM valuation methodologies and basic mortality. The basic reserve is the larger of these two reserve calculations. The candidates had to determine total reserves (that may include deficiency reserves) using the same valuation methodology that was used by the basic reserve but using deficiency reserve mortality with X-factors and the lesser of the resulting valuation net premium and gross premium. Finally, candidates had to calculate a mean reserve and a deferred premium asset, which are important elements of a statutory balance sheet and income statement.

Candidates generally did not do well on this question, primarily due to their difficulty of computing an expense allowance that is needed to calculate CRVM reserves. Candidates did not completely follow through on the different steps required for calculating statutory reserves as outlined in the Valuation of Life Insurance Policies Regulation.

Solution:

(a) You are given the mortality rates, X-factors, and guaranteed premiums rates for a 25-year term life insurance contract in this block (see Excel spreadsheet). Assume no policy fees.

Commentary on Question:

For this part of the question candidates had to determine segments for calculation of a segmented reserve. Most candidates were able to determine segments, but many of these candidates incorrectly included x-factors in their calculation of mortality ratios.

5. Continued

The model solution for part (a) is provided in the spreadsheet.

(b) You are given the guaranteed premiums, contract segments, tabular cost per 1000 of death benefit, and various actuarial present values based on mortality rates applicable for basic and deficiency reserve calculations, for a 35-year term contract (see Excel spreadsheet).

Assume the following:

- Policy was issued July 1, 2014
- Cash value is zero for all years
- Death benefit is 250,000
- Premiums are assumed to be payable annually at beginning of the policy year for reserve calculations

(i) Calculate the mean reserve for the policy as of Dec. 31, 2024.

(ii) Calculate the deferred premium asset for the policy as of Dec. 31, 2024, assuming actual policy premiums are paid monthly.

Commentary on Question:
For part (i), candidates had to determine statutory reserves as outlined in the Valuation of Life Insurance Policies Model Regulation. This required (1) calculating segmented and unitary reserves using the appropriate valuation methodology (net level premium or CRVM), (2) determining the basic reserve, which is the greater of the unitary and segmented reserves, and (3) calculating the total statutory reserve (which possibly include deficiency reserves) using the same valuation methodology that determined the basic reserve, using deficiency reserve mortality with X factors, and using the lesser of the net premium and gross premium as the valuation net premium. Finally, candidates had to determine the mean total statutory reserves. Candidates did not do well on part (i). Most candidates demonstrated that they knew how to determine mean reserves but failed to use the correct values.

For part (ii), candidates had to determine the deferred premium asset, based on the results in part (i) and assuming the payment of monthly premiums.

Candidates had to calculate a deferred premium asset. Most candidates were able to correctly calculate a deferred premium asset but used the incorrect valuation net premium. The correct valuation net premium is equal to the valuation net premium associated with the basic reserve, which is the greater of the unitary and segmented reserves, as determined in part (i).

5. Continued

Another valuation net premium, that is also acceptable for use in the calculation of the deferred premium asset due to a requirement in certain U.S. states, is equal to the lesser of the valuation net premium used in the calculation of the basic reserve and the valuation net premium used in the calculation of the total statutory reserve (which may include deficiency reserves).

The model solution for part (b) is provided in the spreadsheet.

6. 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:

LFM-845-20: Chapters 1 and 2 of Life Insurance and Modified Endowments Under IRC §7702 and §7702A, Desrochers, 2nd Edition

LFM-850-22: Changes to Section 7702

Commentary on Question:

This question tested the candidates' knowledge of the different regulations that impact on the life insurance industry today, considering disbursements and how they are taxable with respect to a Modified Endowment Contract (MEC) and a non-MEC contract. The question also tested the candidates' understanding of different elements of the MEC requirements.

Solution:

(a) Describe whether a modified endowment contract (MEC) and a Non-MEC individually owned life insurance contract have the same or different tax treatment for the following:

(i) Death benefits and inside buildup

(ii) Distributions of investments and income

(iii) Policy loans

(iv) Penalty tax

Commentary on Question:

This part of the question tested the candidates' knowledge of the tax treatment of specific events for a MEC compared to a non-MEC insurance contract. Full credit was received for describing the key tax differences between the types of contracts.

6. Continued

(i) Death benefit and inside buildup have the same tax treatment for a MEC and a non-MEC. In particular, the death benefit is not considered income and therefore not taxable, and the inside buildup is not taxed, until removed from the contract.

(ii) Investment and income distributions are different between a MEC and a non-MEC. For a non-MEC, distributions are taxed on a first in, first out basis (FIFO). The investment in the contract is distributed first, and is not taxed. For a MEC, the earnings are returned first and are taxed, i.e. last in, first out (LIFO).

(iii) Policy loans are treated differently between a MEC and a non-MEC. For a non-MEC, policy loans are not taxable. For a MEC, policy loans are taxable, with an investment adjustment

(iv) For a non-MEC, there is no penalty tax. For a MEC, there is a 10% penalty tax unless the taxpayer has attained age 59.5 or is disabled.

(b) Critique the following statements:

A. If the cash surrender value is equal to the death benefit, this is an endowment contract which is not eligible for favorable life insurance tax treatment.

B. A policyholder owns a Non-MEC life insurance policy with a spouse rider. Upon divorce, the policy will continue to not be a modified endowment contract.

C. A policy has a guaranteed 8% first year interest bonus. The CVAT NSP should be calculated using statutory minimum rates.

D. An individual whole life policy has the following riders: accidental death benefits, family term coverage, and long-term care insurance by accelerating the base plan's death benefit. These riders increase the definitional limitation for the contract.

Commentary on Question:
This part of the question tested the candidates' knowledge of the taxation of riders between a MEC and a non-MEC insurance contract.

A. This statement is true. Since the cash surrender value is equal to the death benefit, it is an endowment and is therefore not eligible for favorable income tax treatment. The policy will fail the Cash Value Accumulation Test (CVAT) or the Guideline Premium Test (GPT)

6. Continued

B. If a policyholder owns a non-MEC policy with a spouse rider, and divorces, then the status of the policy depends on whether divorce occurs in the first 7 years or afterwards. If divorce occurs in the first 7 years, then it is a reduction event under section 7702A and the revised MEC premium would be used to retest the policy for non-Mec status. If divorce occurs after 7 years, the policy is not re-tested and continues to be a non-MEC policy.
Candidates received credit for noting that the policy needed to be retested for non-MEC status after divorce.

C. The guaranteed 8% first year interest bonus must be used for the first year only. Subsequent years should use the greater of the statutory minimum rate and the guaranteed rate to calculate the CVAT net single premium (NSP).

D. Of these riders, only the family term coverage rider and the accidental death benefits rider are Qualified Additional Benefits (QAB) which increase the definitional limitation for the contract. The long-term care rider is not a QAB.

(c) You are given the following for a whole life policy:

Issue age	50
Issue date	Dec. 1, 2022
Face amount	100,000
Guaranteed minimum crediting rate	1%
CSV at beginning of policy year 3	5,000

Calculate the 7-pay premium under each of the following circumstances using the information given in the Excel spreadsheet:

(i) At-issue

(ii) A 50,000 face amount increase at the beginning of policy year 3

(iii) A 25,000 face amount reduction at the beginning of policy year 3.

Show all work.

Commentary on Question:
This part of the question required candidates to calculate the MEC premium at three points in time for a whole life policy. It is important to note that the policy is reflective of the Consolidated Appropriations Act of 2021.

The calculations of the model solution are also provided in a spreadsheet.

6. Continued

(i) At issue (beginning of policy year 1), the policyholder is age 50. Under section 7702 of the Internal Revenue Code (IRC), the interest rate to be used is 2%. *For candidates that used 4% in the calculation, partial credit was given.*

MEC premium = ((Face Amount) x A_{50} / 1000 – CSV_{50}) / $add_{50:7}$, where
NSP = Face Amount x A_{50}, and
$add_{50:7}$ = an annuity due at age 50, for 7 years

Using this formula,
MEC premium = (100,000 x A_{50} / 1000 – CSV_{50}) / $add_{50:7}$
MEC premium = (100,000 x 517.98 / 1000 – 0) / 6.55 *[note that CSV at issue is 0]*
MEC premium = 7,908.09

(ii) At the beginning of policy year 3, the policyholder is aged 52. Under Section 7702, if the death benefit increases, this is a considered a material change and the 7-year period should be restarted at age 52. Again, the interest rate used should be 2%. *Candidates who used 4% received partial credit. Partial credit was also given to candidates who correctly used the formula but omitted the CSV.*

Using the same formula, adjusted for age 52,
MEC premium = ((Face Amount) x A_{52} / 1000 – CSV_{52}) / $add_{52:7}$
MEC premium = (150,000 x 536.61 / 1000 – 5,000) / 6.541
MEC premium = 11,541.28

(iii) A reduction in the face amount is considered a reduction event, and not a material change. If there is a reduction in benefits under the contract within the first 7 years, then the calculation assumes that the contract had originally been issued at the reduced amount. Therefore, the calculation is re-done at age 50 using the revised death benefit of 75,000.

Using the same formula, adjusted for age 50,
MEC premium = ((Face Amount) x A_{50} / 1000 – CSV_{50}) / $add_{50:7}$
MEC premium = (75,000 x 517.98 / 1000 – 0) / 6.55
MEC premium = 5,931.07

7. 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:

Lombardi, Chapter 29 – Risk-Based Capital, Valuation of Insurance Liabilities, 5th Ed.

Rating Agency Perspectives on Insurance Company Capital, SOA Research Institute, August 2023 (excluding appendices)

Commentary on Question:

This question tested the candidates' knowledge of the fundamental purpose of capital.

Solution:

(a) Compare and contrast a Financial Strength Rating and an Issuer Credit Rating.

Commentary on Question:

Candidates generally did well on defining the two ratings. To receive full credit, candidates needed to distinguish the different purpose and/or audience for both ratings, as well as list several similarities or differences in their use and/or derivation. Other reasonable answers not listed below were considered for credit.

A financial strength rating (FSR) analyzes an insurer's ability to meet ongoing policyholder claims and contract obligations.

An issuer (or issue) credit rating (ICR) looks beyond the claim-paying ability and reviews the relative future credit risk of an entity or specific obligations as they come due.

Similarities include:

- Both FSR and ICR follow the rating process and are generally communicated on the same set of rating scales
- Rating agencies may assign a rating for the individual insurer following a combined assessment of the single entity along with adjustments for holding and other noninsurance companies, or they may determine a rating for the largest insurer within the group or a consolidated rating for the insurance group

7. Continued

Differences include:

- FSR is analyzed from policyholders' perspective, and policyholders rank higher than investors in the event of default. That means an insurer's FSR is usually notched higher than that of an ICR

(b) Explain two ways a credit rating impacts capital charge factors.

Commentary on Question:
Most candidates explained the inverse relationship between credit rating and capital charge factors, and/or resulting secondary impacts. Candidates struggled to explain how capital charge factors are generally derived.

Four ways include:

- Investment classifications and capital charges for investments and counterparties using credit ratings (higher credit ratings leads to lower capital charges and vice versa)
- The bond factors are based on cash flow modeling using historically adjusted default rates for each bond category
- The bond factors were developed to determine a capital requirement that is adequate 96% of the time under various economic conditions over a 10-year time horizon
- The NAIC has changed the number of bond factor categories from 6 to 20, similar to the number of categories used by S&P and Moody's

(c) Calculate the following:

(i) Authorized Control Level

(ii) Company Action Level

(iii) Best's Capital Adequacy Ratio (BCAR)

(iv) Fitch Prism Score

Show all work.

Commentary on Question:
To receive full credit for this part of the question candidates had to demonstrate knowledge of the full covariance adjustment formula and its components.

7. Continued

In part (i), candidates generally did well on deriving the bond size factor adjustment and insurance risk RBC requirement, but many candidates did not reflect the 21% tax rate. Occasionally, candidates included extra multiplicative factors or did not reflect the appropriate magnitude of capital. Candidates that wrote down an incorrect/incomplete covariance adjustment formula received credit for the calculation if it was consistent with the formula.

Most candidates did well on part (ii). The solution below is based on applying a 200% factor; however, candidates that used factors in the range of 150-200% received full credit. In addition, candidates that used the incorrect value from part (i) were still given full credit for part (ii) if the methodology in part (ii) was correct. Some candidates attempted to derive an implied factor to assess whether the company had fallen below the Company Action Level, which did not address the question as intended.

For parts (iii) and (iv), some candidates incorrectly listed the same formula and/or answer to both parts.

(i) Bond size factor adjustment:

Calculate weighted issuers based on size factor:
First 50 → 50 * 2.5 = 125
Next 50 → 50 * 1.3 = 65
Only 100 issuers, so 125 + 65 = 190.
Divide by total number of issuers → 190/100 = 1.9

Insurance risk RBC requirement:

Calculate weighted RBC requirement:
First 500M of NAAR → 500M * 0.0023 = 1.15M
Next 4.5B of NAAR → 4.5B * 0.0015 = 6.75M
Next 15B of NAAR → 15B * 0.0012 = 18M
Total RBC requirement = 1.15 + 6.75 + 18 = 25.9M
Post-tax RBC requirement = 25.9M * (1-21%) = 20.461M

For pre-tax C1 bond charge, apply bond size factor to bonds * average factor:
1.9 * 100M * 0.02 = 3.8M
Post tax = 3.8M * (1-21%) = 3.002M

For pre-tax C1 common stock charge, apply capital charge for common stock to value of common stock:
10M * 30% = 3M
Post tax = 3M * (1-21%) = 2.37M

7. Continued

Covariance adjustment formula = 0.50 * [C0 + C4a + SQRT[(C1o+C3a)^2 + (C1cs + C3c)^2 + C2^2 + C3b^2 + C4b^2]]

In this case, this formula simplifies to:
0.50 * SQRT[(3.002)^2+(2.37)^2 + (20.461)^2] = 10.407707M = Authorized Control Level (ACL)

(ii) Company Action Level = 200% * ACL = 20.815413M

(iii) BCAR = (Available Capital - Net Required Capital) / Available Capital * 100 = (350,000,000 - 75,000,000) / (350,000,000) * 100 = 78.57

(iv) Prism Score = Available capital / Target Capital = 350,000,000 / 75,000,000 = 4.666

8. 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:

LFM-106-07: Insurance Industry Mergers and Acquisitions, Chapter 4 (Sections 4.1-4.6)

Commentary on Question:

This question tested the candidates' knowledge of appraisal value and the risks inherent in deferred annuities.

Solution:

(a) You are given:

Risk-free rate	4.00%
Expected rate of return for the market as a whole	17.75%
Company beta	0.80
Market value of debt	300
Market value of equity	700
Required return on debt	5.00%
After-tax investment earnings rate	3.95%
Value of inforce business	100
Adjusted book value	120

Year	0	1	2	3	4	5
Required capital	100	90	80	70	60	0

Calculate the actuarial appraisal value of this block. Show all work.

8. Continued

Commentary on Question:
This part of the question required candidates to calculate the actuarial appraisal value given the information above. Candidates generally did well on setting up the formulas. Common mistakes included using the wrong interest rates in the return on equity, hurdle rate, cost of capital and cost of required capital. Candidates that missed portions of the formula received partial credit. Candidates that used the incorrect value from prior steps received full credit for subsequent steps if the methodology was correct. The following is the solution for full credit.

See the spreadsheet for the model solution.

(b) With respect to a fixed deferred annuity block:

(i) Identify two key risks.

(ii) Propose a sensitivity for each of the two risks identified in part i. Justify your answer.

Commentary on Question:
This part of the question tested the candidates' knowledge of management of deferred annuity risks.

For part (i), candidates who addressed disintermediation risk, reinvestment risk, or risks associated with lapse due to change in interest rate, did well. Credit was received only for risks associated with fixed deferred annuities. Credit was received for other reasonable risks associated with deferred annuities.

For part (ii), candidates that described sensitivities related to the risks in part (i) and provided a reasonable justification did well. Candidates that did not provide justification for the sensitivity did not receive full credit.

Model solution for part b)

(i) Identify two key risks.

- Disintermediation risk: The assets backing the block decrease in value when interest rates rise.
- Reinvestment risk: In a decreasing interest rate environment, guaranteed rates will be better than the market rate. However, reinvestment returns will not match the rates leading to spread compression over time.

8. Continued

Alternatives:

- Interest Rate risk – Risk that the company will not earn enough money on investments compared to the interest credited to policyholders.
- Lapse risk – Risk that there will be more lapses than expected due to changes in interest rates, causing the company to pay out account values sooner than expected.

(ii) Propose a sensitivity for each of the two risks identified in part i. Justify your answer.

- Disintermediation risk. Run sensitivity tests increasing the market yield to consider the impact on the block of annuities. This will show whether the company will be able to take advantage of the interest environment to lower crediting rates on inforce blocks more quickly than portfolio yields fall, thereby widening spreads.
- Reinvestment risk: The sensitivity here would be to decrease the market yield and observe the block of business. This would show the spread compression and calculate how different it is from the baseline scenario.

Alternatives:

- Interest Rate risk – Lower the assumed investment interest rate by 1%, 2%, etc. until between 0%. This will allow the company to see what would happen in different scenarios if their investments earn less than expected.
- Lapse risk – Increase lapse rates by 10%, 20%, etc. to see how lapses may affect the product. It may also be appropriate to run a scenario in which lapses dramatically increase in the year right after the surrender charge period, since that is when policyholders are more likely to lapse.

9. Learning Objectives:

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

Learning Outcomes:

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

Sources:

Insurance Contracts First Impressions: 2020 Edition IFRS 17, KPMG, July 2020
Bridging the GAAP: IFRS 17 and LDTI Differences Explored, Financial Reporter, July 2022

Commentary on Question:

This question tested the candidates' knowledge of IFRS 17..

Solution:

(a) Calculate the following using the general measurement model:

(i) Contractual service margin at issue

(ii) Comprehensive income for Year 1

Show all work.

Commentary on Question:

In part (i), most candidates demonstrated an understanding of the fundamental principle that the Contractual Service Margin (CSM) represents the difference between the present value (PV) of risk-adjusted inflows and outflows. However, few candidates accurately identified all the necessary components for each side of the calculation. A frequent omission was the exclusion of investment income from the inflows.

In part (ii), many candidates arrived at the correct solution. However, candidates were uncertain, combining components in a seemingly arbitrary or circular manner. Most candidates correctly recognized that both investment income and Other Comprehensive Income (OCI) should be included in the calculation of comprehensive income.

Part (i)
CSM = PV of Risk Adjusted Inflows – PV of Risk Adjusted Outflows
PV Risk Adjusted Inflows = Premium + Investment Income = 405,000
PV Risk Adjusted Outflows = Commissions + Underwriting and Service Expenses + Claims + Acquisition Costs = 334,290
CSM = 405,000 – 334,290 = 70,710

9. Continued

The above can alternatively be shown as FCF = Outflows – Inflows then stating CSM = -FCF

Part (ii)

As the question states "assume that experience emerges in line with the initial assumptions for year 1", it can be interpreted that
Insurance Service Results = Release of CSM + Release of Risk Adj.
Insurance Service Result = Release of CSM + Release of risk Adj = 12,000
Profit = Insurance Service Result + Investment Income = 12,000 + 2,350 = 14,350
Comprehensive Income = Profit + OCI = 14,350 + 50 = 14,400

(b) Critique the following statements.

A. *If there is a net cash outflow at inception, a loss component is created for the net cash outflow and the contractual service margin is set to zero. The net cash outflow is reflected in the insurance revenue line as an offset.*

B. *Reinsurance contracts are still considered insurance contracts even if the contract does not expose the reinsurer to the possibility of a significant loss.*

C. *MSE Life should recognize the group of reinsurance contracts at the earlier of the beginning of the coverage period or the date the entity recognizes an onerous group of underlying insurance contracts for reinsurance contracts that provide proportional coverage.*

D. *MSE Life may use the premium allocation approach to measure the liability for remaining coverage (LRC).*

E. *The premium allocation approach could give a liability for remaining coverage that is close to the general measurement model approach if the entity expects significant variability in fulfillment cash flows under both approaches.*

Commentary on Question:
Candidates generally did well on this part of the question. A few candidates failed to provide any justification, opting instead to simply state "true" or "false" without explanation.
For statement B few candidates correctly identified the critical issue that the requirement is to reinsure all of the underlying risk, rather than focusing on the probability of a high-magnitude loss.

9. Continued

For statement C candidates y failed to explain the differing treatments of proportional versus non-proportional reinsurance arrangements.
For statements D and E, candidates demonstrated a clear understanding of the concepts involved.

A) The first statement is true. A loss component is created at inception and recognized immediately. The CSM is zero. However, the second statement is not true. The net cash outflow does not include the loss at inception.

B) This statement is true. Even if the reinsurer is not exposed to the possibility of a significant loss, as long as substantially all of the underlying insurance risk relating to the reinsured portions of business is transferred under the reinsurance contract, then this is still deemed to have transferred significant insurance risk and meets the definition of an insurance contract.

C) This statement is true for a group of non-proportional reinsurance contracts, which should be recognized at the earlier of the beginning of the coverage period of the group, and the date MSE Life recognizes an onerous group of underlying insurance contracts. This is because MSE Life benefits from the beginning of the coverage period of the group of reinsurance contracts held, as the losses accumulate throughout the coverage period in a non-proportional reinsurance arrangement that pays out when aggregate losses exceed a certain threshold. For proportional reinsurance, the group of reinsurance contracts should be recognized at the date MSE Life recognizes any underlying insurance contracts.

D) This statement is false. Eligibility criteria for using the Premium Allocation Approach requires that coverage period does not extend beyond one year. Given this is a 20 year level term product, this criteria is not met and PPA is not appropriate for use.

E) This statement is false. If MSE Life expects significant variability in the fulfillment cashflows during the period before a claim is incurred, then MSE Life cannot reasonably expect materially similar calculated measurements of liability under the PPA and general measurement approach. Variability in the fulfilment cashflows increases with the extent of expected cash flows relating to any embedded derivatives in the contracts, and also the length of the coverage period.