1. **Learning Objectives:**

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

**Learning Outcomes:**

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

(4b) Apply methods and principles of embedded value.

**Sources:**

LFV-106-07: Mergers and Acquisitions, Chapter 4 (Sections 4.1-4.6)

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

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

**Commentary on Question:**

Candidates generally did well on this question. Most candidates demonstrated basic understanding of the underlying concepts. For the qualitative parts, some candidates had a tendency of writing very long answers without staying focused and relevant to what was being asked. When asked to describe impacts from one calculation component being changed, some candidates were not focused on answering the question and gave descriptions that were contradictory.

**Solution:**

(a)

(i) Describe unique aspects of the insurance industry that require actuarial analysis during a merger and acquisition (M&A) transaction.

(ii) List five key assumptions underlying actuarial appraisals.
1. Continued

Commentary on Question:
This part of the question was generally well answered. A minority of candidates were able to list the unique aspects of the insurance industry. Some candidates only stated that few transactions take place and therefore a market price could not be observed, but this is not uniquely applicable to insurance. Most candidates were able to list many key assumptions, though some candidates only addressed the value of the business needs to be projected, without describing the underlying variables that would need assumptions within that projection.

(i) Insurance liabilities can extend over a very long period of time. Insurance companies therefore have long term fiduciary responsibilities to policyholders. Further, insurance liabilities involve a great deal of uncertainty. The projection of the risks and the setting of reserves thus require actuarial techniques and analysis. Finally, the insurance industry is subject to specialized statutory accounting and capital requirements, determined by insurance regulators. Interpreting these regulatory reporting requirements requires actuarial expertise.

(ii) Key assumptions include: mortality, morbidity, lapse and persistency, investment returns and spread, operating expenses, determining the appropriate discount rate, cost of capital, and taxes.

(b) Calculate the Embedded Value (EV) as at December 31, 2018. Show all work.

Commentary on Question:
Many candidates got the correct discount rate. Most candidates knew to calculate a WACC, but often candidates neglected to make the cost of debt after tax. Some candidates subtracted the risk-free rate from the risk premium given in the question without realizing that the given value was itself already the difference versus the risk-free rate. Candidates correctly calculated the Adjusted Net Worth, but most candidates struggled with the Inforce Business Value component. Candidates often included the time zero profit in the go forward PV Book Profit, and incorrectly captured the timing of when each period’s cost of capital is incurred.

Discount rate, using CAPM and implicit recognition of debt:
Weighted Average Cost of Capital = 70% equity * cost of equity + 30% * cost of debt = 0.08185
Cost of equity = r + (beta * market risk premium) = 0.026+(1.4*0.055) = 10.3%
Cost of debt = 0.05 * (1-tax rate) = 0.05*(1-0.35) = 3.25%
1. Continued

EV = Adjusted Net Worth + Inforce Business Value
ANW = Required Capital + Free Surplus = 500 + 100 = 600
IBV = PV Book Profit – PV Cost of Capital = 211.69
PVBP = 90v + 95v^2 + 103v^3 = 245.71
PVCoC = 500*(0.08185-0.06)v + 480*(0.08185-0.06)v^2 + 460*(0.08185-0.06)v^3
+ 440*(0.08185-0.06)v^4 = 34.02
where v = 1/(1 + WACC)
EV = 600 + 211.69 = 811.69

(c) Explain the impact of each of the following events on the various components of Embedded Value for this company. Calculations are not required.

(i) Corporate tax rate decreases

(ii) A shift in the company’s business to less risky traditional products

Commentary on Question:
Candidates did well on this part of the question. Most candidates were able to describe how the components of the EV calculation moved with the changes in the question. Some candidates did not demonstrate understanding of the interactions.

(i) Firstly, a decrease in the corporate tax rate causes after tax book profits to be larger. This increases the Inforce Book Value since PV of book profits would be higher. Secondly, a lower corporate tax rate would increase the cost of debt, which in turn increases the weighted average cost of capital, thus amounts on a PV basis would decrease. While these two changes are directionally opposite, the impact of higher after-tax profits will more than offset the impact of discounting at a higher rate. Therefore, EV will be higher.

(ii) Currently, the company’s beta is greater than one. When insurance companies offer less risky traditional products, they usually have a beta of less than one, so a decrease in beta is expected here. This would reduce the cost of equity, thereby reducing the WACC, and amounts on a PV basis will be larger. In addition, shifting to less risky products would reduce the amount of required capital that needs to be held. In the other direction, lower risk traditional products will likely be less profitable.
1. Continued

(d) Assuming a hurdle rate of 9%:

(i) Calculate the risk adjusted return on capital (RAROC) and Economic Value Added (EVA) as at December 31, 2018

(ii) Determine if the company is creating value for shareholders based on these metrics.

Commentary on Question:
Candidates generally did well on this part of the question. Most candidates knew the relationship of RAROC versus hurdle rate and its implication on value creation. A few candidates mistakenly thought that value was being created as long as the two were equal. Some candidates were confused as to which values should be used for Risk Adjusted Capital, and erroneously used Required Capital instead of Economic Capital. There were also candidates who thought EVA was a percentage metric, or that RAROC was a dollar metric.

RAROC = NOPAT / Risk Adjusted Capital = 49.5 / 550 = 9%
where Risk Adjusted Capital = Economic Capital

RAROC = (EVA / Risk Adjusted Capital) + Cost of Capital
Since Cost of Capital = Hurdle Rate = 9%,
Then RAROC = 9% = (EVA / 550) + 9%, and EVA = 0

In order to create shareholder value, RAROC must exceed Cost of Capital, or expressed differently, EVA must exceed 0.

Therefore, in this case, the company is neither creating nor destroying value.
2. Learning Objectives:
5. The candidate will understand the nature and uses of basic reinsurance arrangements used by life insurance companies.

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

Sources:

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a) Construct ABC's statutory income statement and year-end balance sheet for 2018. Show all work.

Commentary on Question:
This part of the question tested the candidates’ ability to create an income statement and balance sheet under a reinsurance agreement. Candidates generally did well on this part of the question. Most candidates created an appropriate income statement with reasonable calculations. The most common omissions were the policy fee, annual cession fee, or maintenance expense. Some candidates incorrectly classified the components (for example, categorizing an expense item as revenue). Candidates struggled more with constructing a balance sheet or splitting out items that do not belong on a balance sheet (for example including investment income as its own item).

The sample solution below assumes that the commission is based on the full premium received (including the annual policy fee). Full credit was given if the annual policy fee was excluded from the commission calculation.

The Investment Income calculation assumes that all time 0 cash flows accrue investment income. Full credit was also rewarded for calculating investment income based on starting surplus only (consistent with Life, Health and Annuity Reinsurance, Tiller: Chapter 4).
2. Continued

Income statement
NAR ceded =
ceded % x face amount x (1 - terminal reserve per 1,000 / 1,000) =
0.75 x 1,000,000 x (1 - 0 / 1,000) = 750,000

gross premium =
(premium per 1,000) x face amount / 1,000 + annual policy fee =
10 x (1,000,000 / 1,000) + 50 = 10,050

ceded premium =
NAR ceded x (YRT premium per 1,000 / 1,000) + annual cession fee =
750,000 x (0.5 / 1,000) + 25 = 400

reinsurance allowance =
expense allowance % x ceded premium =
0.02 x 400 = 8

gross reserve =
face amount x (mean reserve per 1,000 / 1,000) =
1,000,000 x (0.55 / 1,000) = 550

ceded reserve =
NAR ceded x (YRT mean reserve per 1,000 / 1,000) =
750,000 x (0.4 / 1,000) = 300

commissions =
commissions % x gross premium =
0.95 x 10,050 = 9,547.50

premium tax =
premium tax % x gross premium =
0.02 x 10,050 = 201

expenses =
commissions + first year per policy + premium tax =
9,547.50 + 500 + 201 = 10,248.50

investment income =
investment rate of return x (initial surplus + gross premium - ceded premium +
reinsurance allowance - expenses) =
0.05 x (1,200 + 10,050 - 400 + 8 - 10,248.50) = 30.48
2. **Continued**

revenue =
gross premium - ceded premium + reinsurance allowance + investment income =
10,050 - 400 + 8 + 30.48 = 9,688.48

benefits =
claims + surrenders + increase in gross reserve - increase in ceded reserve =
0 + 0 + (550 - 0) - (300 - 0) = 250

gain from operations =
revenue - benefits - expenses =
9,688.48 - 250 - 10,248.50 = -810.02

Income Statement
Revenue: 9,688.48
  Premium:
    Gross 10,050
    Ceded 400
    Net 9,650
  Investment Income 30.48
  Reinsurance Allowance 8
  TOTAL REVENUE 9,688.48

Benefits:
  Claims 0
  Surrenders 0
  Reserve Increase:
    Gross 550
    Ceded 300
    Net 250
  TOTAL BENEFITS 250

Expenses:
  Commissions 9,547.5
  Maintenance 500
  Premium Tax 201
  TOTAL EXPENSES 10,248.50

GAIN FROM OPERATIONS -810.02
2. Continued

Balance sheet
assets =
initial surplus + revenue - claims - surrenders - expenses =
1,200 + 9,688.48 - 0 - 0 - 10,248.50 = 639.98

liabilities =
gross reserve - ceded reserve =
550 - 300 = 250

surplus =
assets - liabilities =
639.98 - 250 = 389.98

Balance Sheet

Assets
Invested Assets 639.98
TOTAL ASSETS 639.98

Liabilities and Capital
Policy Reserves
Gross 550
Ceded 300
Net 250
TOTAL LIABILITIES 250

Surplus 389.98
TOTAL CAPITAL 389.98

TOTAL CAPITAL AND LIABILITIES 639.98

Alternative solution
This solution is identical to the solution above, except it uses the textbook approach for investment income. The calculations for investment income are shown below, along with the calculations for all items that are impacted by investment income. All other calculations are unchanged from the solution above.
2. Continued

investment income =
investment rate of return x (initial surplus + initial reserve) =
0.05 * (1,200 + 0) = 60

revenue = 10,050 - 400 + 8 + 60 = 9,718

gain from operations = 9,718 - 250 - 10,248.50 = -780.50

assets = 1,200 + 9,718 - 0 - 0 - 10,248.50 = 669.50

surplus = 669.50 - 250 = 419.50

(b) You are given the following pre-reinsurance information for ABC:

- Risk based capital (RBC) ratio is 350%
- Total Adjusted Capital (TAC) is 3.5 million

Assume the reinsurance has the following impact:

- 2.5% decrease in ABC’s total RBC requirement
- 250,000 increase in TAC

Calculate the new RBC ratio. Show all work.

Commentary on Question:
This part of the question tested the candidates’ knowledge of the effect of reinsurance on the RBC ratio. Partial credit was received for calculating each of the following: RBC requirement before reinsurance, RBC requirement after reinsurance and TAC after reinsurance.

Candidates generally did well on this part of the question. Some candidates flipped the numerator and denominator of the RBC ratio formula.

RBC ratio = TAC / RBC requirement

Before reinsurance
RBC ratio = 3.5 = 3,500,000 / RBC requirement
RBC requirement = 3,500,000 / 3.5 = 1,000,000

After reinsurance
TAC = 3,500,000 + 250,000 = 3,750,000
RBC requirement = 1,000,000 x (1 - 0.025) = 975,000
RBC ratio = 3,750,000 / 975,000 = 3.85 or 385%
3. Learning Objectives:
2. The candidate will understand valuation principles and methods of individual life insurance and annuity products issued by U.S. life insurance companies.

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

Learning Outcomes:
(2a) Compare and apply methods for life and annuity product reserves.

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


Sources:
US GAAP for Life Insurers, Herget et al., 2nd Edition, 2006, Ch. 3, 4

LFV-835-17: Overview of the FASB’s Proposal for Long-Duration Contracts of Insurers, PwC, October 17, 2016

LFV-824-16: Model Risk Mitigation and Cost Reduction Through Effective Documentation, PWC, 2013


Commentary on Question:
Commentary listed underneath question component.

Solution:
(a) Calculate the DAC balance at the end of 12/31/2019 based on the current FAS 60 methodology. Show all work.

Commentary on Question:
In general, candidates calculated the K factor using the best estimate present value, as opposed to using the best estimate with PAD present value. Partial credit was given provided the candidate performed the other calculations correctly. Some candidates used the second retrospective method but often applied the PAD to the survival factors, in which case partial credit was given provided the candidate performed the other calculations correctly.
3. Continued

\[
DAC(t) = (DAC(t-1)+DAE(t))*(1+i) - K*Gross \text{ Premium}
\]

where

\[
K = \frac{PV(\text{Deferred acquisition costs} @ 4.5\%)}{PV(\text{Gross Premiums @ Best Estimate +PAD}@ 4.5\%)}
\]

\[
= \frac{10,000}{160,935}
\]

\[
= 6.214\%
\]

\[
\text{Gross Premium}(t) = \text{Face Amount} (t) \times 8\%
\]

\[
= 250,000 \times 0.8
\]

\[
= 20,000
\]

\[
DAC(1) = 10,000 \times 1.045 - 6.214\% \times 20,000
\]

\[
= 9,207
\]

Alternative Calculation Methods

**Retrospective Method #2**

\[
DAC(t) = (DAC(t-1)+DAE(t)-K*Gross \text{ Premium})*(1+i)\times\text{Surv}(t-1)/\text{Surv}(t)
\]

where

\[
K = \frac{PV(\text{Deferred acquisition costs} @ 4.5\%)}{PV(\text{Gross Premiums @ Best Estimate +PAD}@ 4.5\%)}
\]

\[
= \frac{10,000}{160,935}
\]

\[
= 6.214\%
\]

\[
\text{Survival} = 1 - \frac{6}{1000}, \text{not assuming any PAD}
\]

\[
DAC(1) = (10,000 - 6.214\% \times 20,000)\times 1.045 \times 1/(1-.006)
\]

\[
= 9,207
\]

**Prospective Method**

\[
DAC(t) = K \times PV \text{ Gross Premium}(t) - PV \text{ DAE}(t)
\]

Where

\[
PV \text{ Gross Prem}(1) = PV \text{ Gross Prem}(0) \times (1+i) - \text{Gross Prem}(0)
\]

\[
= 160,935 \times 1.045 - 20,000
\]

\[
= 148,177
\]

\[
DAC(1) = 6.214\% \times 148,177
\]

\[
= 9,207
\]
3. Continued

(b) For each graph below:
   • Identify which line (solid or dashed) is under current GAAP and which is under proposed GAAP.
   • Provide possible explanations for the differences.

(i) GAAP Earnings

(ii) Benefit Reserves
3. Continued

(iii) Benefit Reserve Percentage Change When Current Best Estimate Mortality Increases by 10%

![Benefit Reserve % Change Graph]

(iv) DAC Asset Percentage Change When Current Best Estimate Mortality Increases by 10%

![DAC % Change Graph]

Commentary on Question:
This part of the question test the candidates’ knowledge of changing GAAP rules. Partial credit was received for identifying between current GAAP and proposed GAAP. For full credit, candidates had to provide a reasonable explanation for the differences shown between current and proposed GAAP.
3. Continued

(i) GAAP Earnings:
Solid line=Proposed GAAP;
Dashed line=Current GAAP

The difference in earnings emergence will be driven by the net GAAP liability (net of reserve & DAC). Initial DAC should be close between current GAAP and proposed GAAP, then diverge later. Initial reserve growth expected to be lower under proposed GAAP, so it will start out with higher income, then switch later.

(ii) Benefit Reserves:
Solid Line=Current GAAP;
Dashed line=Proposed GAAP.

The benefit reserves are expected to be lower under proposed GAAP due to the elimination of PADs from the calculation.

(iii) Benefit Rsvs% Change (+10% mortality):
Solid Line=Current GAAP;
Dashed line=Proposed GAAP.

Higher mortality leads to higher reserve under the proposed GAAP changes, and slightly lower projected reserve under the current method. Under Current GAAP reserve factors are locked in. Higher mortality leads to lower face amount. Thus, projected reserves will be slightly lower due to the same factors applied to the lower face amount.

(iv) DAC Asset % Change (+10% mortality):
Solid Line=Proposed GAAP;
Dashed line=Current GAAP.

DAC is less sensitive to mortality change under the proposed method. With higher mortality, the projected amortization basis decreases under both methods. But under the proposed method, k factor increases due to lower inforce, which leads to DAC under the proposed method being less sensitive or dampens impact from mortality changes. K factors under current method are locked in with no offset effects.
3. Continued

(c) If proposed GAAP is adopted, the implementation effort will require many changes to existing models.

(i) Describe a significant model implementation concern regarding the calculation of term reserves under this proposal.

(ii) Recommend a model testing technique that can be used to reduce model risk related to the concern you identified in part (i). Justify your response.

**Commentary on Question:**
For part (i), some candidates just listed a significant model concern without describing it. Likewise, for part (ii), most candidates did not justify their recommendation. In most cases, partial credit was received.

Below is a sample of solutions which warrant full credit. The list is not exhaustive and other solutions would receive full credit if appropriate and adequately described. No credit was given for a modeling concern or testing technique not applicable to term GAAP reserves.

**Part (c)(i) Sample Solutions:**

**Sample Solution 1**
When calculating a revised net premium ratio, it must be calculated as of contract inception with a combination of actual historical experience and updated future cash flow assumptions. Therefore, the model implementation will need to create a process to store historical experience and combine it with the modelled future cashflows at the appropriate level of detail.

**Sample Solution 2**
Updating of future cash flow assumptions would be required on an annual basis. This is in contrast to the current model where assumptions are “locked-in” unless a premium deficiency exists.

**Sample Solution 3**
Use of the high-quality fixed-income yield for discounting cash flows is a significant change from current GAAP, under which entities discount future cash flows using an entity’s expected future investment yields at the time of issuance and updated expectations of such yields are used in premium deficiency calculations.
3. Continued

Sample Solution 4
Discount rate assumptions would need to be updated on each reporting date, with the change presented in OCI rather than net income. Disconnecting the yield used to discount cash flows from expected investment yields may significantly change the emergence of income from current practice.

Part (c)(ii) Sample Solutions:

Sample Solution A
Recommend a "back-testing" approach. For term reserves this testing would involve (1) collecting historical data, (2) projecting future values as of different past valuation dates, and (3) reviewing the calculation with combined cash flows. This will reduce model risk by validating that the storage of historical values and the calculation is correctly done at different valuation dates.

Sample Solution B
Benchmarking of model predictions against other models or data.

Sample Solution C
Sensitivity Analysis of model predictions to shocks in model inputs and changes in model parameters, including extreme values. This will reduce model risk by detecting potential weaknesses.

Sample Solution D
Stress testing of model predictions against changes in key assumptions. This will help determine the level of uncertainty associated with the outputs of a given model.
4. **Learning Objectives:**

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

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

**Learning Outcomes:**

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

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

(4d) Explain and evaluate the respective perspectives of regulators, investors, policyholders and insurance company management regarding the role and determination of capital.

(4f) Explain and apply methods in earnings management and capital management.

**Sources:**

LFV-807-09: Market Value Margins for Insurance Liabilities in Financial Reporting and Solvency Applications, October 2007 (p. 2-41 and 46-65 only)

A Multi-Stakeholder Approach to Capital Adequacy, Conning Research


**Commentary on Question:**

*Commentary listed underneath question component.*

**Solution:**

(a) List at least five advantages of using cluster modeling to reduce the number of model cells.

**Commentary on Question:**

*Candidates generally did well on this part of the question.*

Advantages of using cluster modeling include:

- Can be used for assets and liabilities
- Can be applied to any product type
- Achieves better compression ratios for a given model-to-actual fit
- Significantly reduces runtime
- Can be easily automated
- Can be maintained and updated similarly for future valuation dates
- Can assign different priorities on different measures of model fit
4. Continued

- Easy to adjust the number of model points to achieve more or less granularity
- Allows easy on-the-fly analysis of model fit for different levels of granularity, without re-running the model

(b) Describe the views of capital adequacy held by the various stakeholders of SAT.

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

Stakeholders include:
- **Policyholders:** want sufficient levels of capital to be fully protected in the event of a loss
- **Regulators:** main concerns are solvency and policyholder protection; want insurer to offer affordable rates and be able to fully pay claims
- **Debtholders:** want capital levels maximized in order to minimize the risk of default
- **Rating agencies:** concerned with the insurer’s ability to meet obligations; higher capital will typically result in a higher rating
- **Shareholders:** focused on efficient use of capital; want to maximize the return on capital while maintaining adequate levels of capital to absorb unexpected losses
- **Company management:** seeks to balance the opinions of other stakeholders; wants company to grow, be profitable and have sufficient levels of capital

(c)

(i) Calculate the capital base at the start of year 3 over the one-year risk-exposure horizon. Show all work.

(ii) Calculate the capital base at the start of year 3 over the ultimate risk-exposure horizon. Show all work.

(iii) Describe the considerations that would lead you to recommend one of these risk-exposure horizons over the other.

Commentary on Question:
_This question was intended to test candidates’ knowledge related to mortality risk, and the word “certain” should not have been included in the question. Most candidates ignored the word “certain” and assumed mortality risk in their answers. Credit was given for either approach, assuming mortality risk or assuming no mortality risk._
4. Continued

Candidates who assumed no mortality risk were given credit for indicating that the requested calculations and considerations were irrelevant because a certain annuity has no mortality risk. Candidates who assumed mortality risk were given credit based upon the model solution shown below, and the remaining commentary pertains to the performance of these candidates.

Candidates generally struggled with the calculations in parts (i) and (ii), especially the PV(Liability) calculation in part (i). Partial credit was received for providing correct formulas. Some candidates mixed up the formulas between parts (i) and (ii).

For part (i), a common error was to assume the annuity payments occur at the beginning of the year, even though the question says the payments occur at the end of the year.

For part (ii), some candidates calculated the PV(Liability) even though it was provided. Candidates who did not correctly calculate the BEL in part (i) received full credit for part (ii) if they used the BEL from part (i) and did everything else correctly.

Overall performance for part (iii) was satisfactory, with candidates generally noting that where the company operates is an important consideration in choosing between the two exposure horizons.

(i) One-year capital base = PV(Liability)_3 - BEL_3

Best Estimate Liability (BEL) calculation
Liability is calculated using the 5% best estimate mortality rate

Number of policies in force at end of year t =
NP_t = 1,000 \times \text{probability of surviving to end of year t}

NP_3 = 1,000 \times (1 - 0.05)^3 = 857
NP_4 = 1,000 \times (1 - 0.05)^4 = 815
NP_5 = 1,000 \times (1 - 0.05)^5 = 774

Expected payments in year t =
EP_t = 10,000 \times NP_t

EP_3 = 10,000 \times 857 = 8,570,000
EP_4 = 10,000 \times 815 = 8,150,000
EP_5 = 10,000 \times 774 = 7,740,000
4. Continued

\[
\text{BEL}_3 = \frac{\text{EP}_3}{1.03} + \frac{\text{EP}_4}{1.03^2} + \frac{\text{EP}_5}{1.03^3} \\
= 8,570,000 / 1.03 + 8,150,000 / 1.03^2 + 7,740,000 / 1.03^3 \\
= 23,085,741
\]

**PV(Liability) calculation**

Liability is calculated using the 1.9% mortality rate (99.5th percentile) in year 3 and the 5% best estimate mortality rate in other years

\[
\text{NP}_3 = 1,000 \times (1 - 0.05)^2 \times (1 - 0.019) = 885 \\
\text{NP}_4 = 1,000 \times (1 - 0.05)^2 \times (1 - 0.019) \times (1 - 0.05) = 841 \\
\text{NP}_5 = 1,000 \times (1 - 0.05)^2 \times (1 - 0.019) \times (1 - 0.05)^2 = 799
\]

\[
\text{EP}_3 = 10,000 \times 885 = 8,850,000 \\
\text{EP}_4 = 10,000 \times 841 = 8,410,000 \\
\text{EP}_5 = 10,000 \times 799 = 7,990,000
\]

\[
\text{PV(Liability)}_3 = \frac{\text{EP}_3}{1.03} + \frac{\text{EP}_4}{1.03^2} + \frac{\text{EP}_5}{1.03^3} \\
= 8,850,000 / 1.03 + 8,410,000 / 1.03^2 + 7,990,000 / 1.03^3 \\
= 23,831,446
\]

One-year capital base = 23,831,446 - 23,085,741 = 745,705

(ii) Ultimate capital base = 99.5th percentile PV(Liability)_3 - BEL_3

\[
= 24,000,000 - 23,085,741 \\
= 914,259
\]

(iii) Considerations include:
- The one-year risk-exposure horizon produces a lower capital base but assumes the company can raise capital each year, whereas the ultimate risk-exposure horizon produces a higher capital base and assumes the company can raise all capital up front
- Solvency II and Swiss Solvency requirements use the one-year risk-exposure horizon
- U.S. requirements use the ultimate risk-exposure horizon, which is an important consideration for the company since it operates in the U.S.
4. Continued

(d) Your team member has asked you to review their calculation of the Market Value Margin using the cost of capital method on a block of Term Life Insurance policies. They have provided you the following results:

<table>
<thead>
<tr>
<th></th>
<th>One-Year Risk Exposure Horizon</th>
<th>Ultimate Risk Exposure Horizon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Base at Start of Year 1 (millions)</td>
<td>20.54</td>
<td>11.12</td>
</tr>
<tr>
<td>Cost of Capital Rate</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Market Value Margin (millions)</td>
<td>0.68</td>
<td>1.76</td>
</tr>
</tbody>
</table>

Identify any inconsistent relationships between the results of the two horizons.

**Commentary on Question:**
This part of the question tested the candidates’ understanding of the two risk-exposure horizons and did not require any calculations. Most candidates recognized that the capital base under the one-year risk-exposure horizon should be less than the capital base under the ultimate risk-exposure horizon. Very few candidates mentioned that the cost of capital rate should be adjusted to make the market value margin the same under horizons.

Cost of capital rate should be adjusted to equate the market value margin under both horizons. In addition, the capital base under the one-year risk-exposure horizon should be less than the capital base under the ultimate risk-exposure horizon.
5. **Learning Objectives:**

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

**Learning Outcomes:**


**Sources:**


**Commentary on Question:**

*This question tested the candidates’ knowledge of principle-based reserves.*

**Solution:**

(a) List two differences and two similarities between the existing CRVM standard and the PBR Net Premium Reserve.

**Commentary on Question:**

*Candidates were generally able to list some or all the differences and similarities. A few candidates mentioned prescribed assumptions which was too generic relative to mentioning mortality and interest.*

Differences:

- Expense allowance amount is different
- Term and certain UL policies may utilize prescribed lapse rates

Similarities:

- Prescribed mortality continues to be CSO table
- Prescribed interest rates have same approach
- Gross premiums are still guaranteed gross premiums of the contract

(b)

(i) Solve for X, the Scenario 10 GPVAD.

(ii) Calculate the aggregate minimum PBR reserve.

Show all work.
5. Continued

Commentary on Question:
Many candidates attempted to use Working Reserve in combination with Assets in some way; however, assets alone are used in the PVAD and GPVAD calculation. A few candidates used either After-Tax Portfolio Rate or 10Yr Treasury to form a discount rate when the 1Yr Treasury was the necessary rate basis. Assets were positive for years 1 and 2 and it was not necessary to calculate the PVAD for them as they will not affect the GPVAD as long as there is also a negative Assets year. Partial credit was given for calculations that were correct even if numerical inputs were incorrect.

The table below is presented in the same format used in the study note and was not necessary for full credit but helped keep the solution organized. Some candidates did not calculate a CTE (70) and instead used either the worst scenario of the 10 scenarios (Scenario 8) or the Scenario 10 result alone to set the reserve. A few candidates counted Scenarios 3 and 7 as part of the worst three scenarios when they are the best scenarios. Some candidates did not add the Starting Assets to the GPVAD in the CTE (70) calculation for the scenario reserve, which will result in the NPR being used as the PBR reserve. The final Aggregate Minimum PBR Reserve can be described in two common ways and both are shown; however, only one was needed for full credit.

(i) GPVAD Calculation
- Use 1.05 * 1Yr Treasury as interest rate
- Calculate discount rate to time 0 for each year
- \[ \text{PVAD}(y) = - \text{Asset}(y) \times \text{Discount}(y) \]
- Scenario(10) GPVAD = MAX \( \text{PVAD}(y) \)

<table>
<thead>
<tr>
<th>Projection Period (y)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Assets</td>
<td>130</td>
<td>120</td>
<td>70</td>
<td>-10</td>
<td>-30</td>
</tr>
<tr>
<td>2 - Assets</td>
<td>-130</td>
<td>-120</td>
<td>-70</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>3 1Yr Treasury (boy)</td>
<td></td>
<td>1.500%</td>
<td>1.000%</td>
<td>0.500%</td>
<td>0.200%</td>
</tr>
<tr>
<td>4 1.05 * 1Yr Treasury</td>
<td></td>
<td>1.575%</td>
<td>1.050%</td>
<td>0.525%</td>
<td>0.210%</td>
</tr>
<tr>
<td>5 Discount (y)</td>
<td>1.00000</td>
<td>0.98449</td>
<td>0.97426</td>
<td>0.96918</td>
<td>0.96715</td>
</tr>
<tr>
<td>6 PVAD (y) = 2 * 5</td>
<td></td>
<td>-118.14</td>
<td>-68.20</td>
<td>9.69</td>
<td>29.01</td>
</tr>
<tr>
<td>7 GPVAD (0)</td>
<td></td>
<td>29.01</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Continued

(ii) Aggregate Minimum PBR Reserve
- Scenario Reserve = Starting Assets + GPVAD
- For CTE(70) calculation, average worst 3 of 10 scenarios
  - Scenario (2) = 164 = 130 + 34
  - Scenario (8) = 198 = 130 + 68
  - Scenario (10) = 159 = 130 + 29
- CTE(70) = 173.7 = (164 + 198 + 159) / 3
- Aggregate Minimum PBR Reserve = 173.7 = Max (173.7, 40, 65) = Max (Stochastic, Deterministic, NPR) or
  Aggregate Minimum PBR Reserve = 173.7 = 65 + Max (0, Max (173.7, 40) – 65) = NPR + Max (0, Max (Stochastic, Deterministic) – NPR)

(c) Critique the following statements about PBR implementation:

A. While the Deterministic and NPR Reserves are based on aggregate calculations, the Stochastic Reserve must be calculated on a seriatim basis for conservatism.

B. Unlike CRVM, the reinsurer will be able to hold lower reserves than our ceded reserve balance.

C. Separate Account Assets, Derivatives, and Interest Maintenance Reserve should not be included in starting assets in the modelled reserves.

D. The Qualified Actuary may sometimes be required to opine on the adequacy of the aggregate reserve.

Commentary on Question:
Candidates were generally able to identify whether the statement was true or false with a brief justification. Some candidates wrote a critique without identifying whether the statement was true or false. Statement B is true and related to the CRVM requirement of holding “mirror reserves” between ceding and assuming companies, which is not required under PBR. In some cases ceding and assuming companies may end up with similar reserves, however, it is extremely unlikely the two reserves would be the same.
5. Continued

A. False – NPR is seriatim, Stochastic and Deterministic are both aggregate

B. True – Under PBR ceding reserve credit and assuming reserve are not likely to be the same

C. False – Separate Account assets and derivatives should be included. Pre-tax Interest Maintenance Reserve (PIMR) balance should be included in the starting assets, but would be deducted in the final reserve calculation.

D. False – The Qualified actuary is not required to opine upon the adequacy of the aggregate reserve – The Appointed Actuary performs this function.

(d) You are given the following information for a block of business:

- 10-year Level Term product with a steep renewal premium increase
- New underwriting guideline

Describe how you should set each of these assumptions for the modeled PBR reserve of the above block of business:

(i) Mortality
(ii) Surrender
(iii) Interest Rates
(iv) Expenses

Commentary on Question:
Candidates were generally able to describe some items for parts (i)-(iv). Not all the statements provide below were required for full credit. The question implied the company likely had experience with Level Term and there was no indication the new underwriting guideline was dramatically different from existing. Some candidates answered as if company could not have any relevant & credible experience in either product type or underwriting. Some candidates emphasized the term aspects (Level Term with a steep premium increase) to the exclusion of assumption setting under PBR. Some candidates answered part (iii) “interest rate is not relevant because it is term” even though the reserve does have assets backing it and a need for an interest rate.
5. Continued

(i) Mortality (*Note: any four of these points were full credit on this section*)
- Use own company experience to the extent relevant and credible
- Grading to industry table is also prescribed
- Margin setting is prescribed based on credibility
- Cannot use mortality improvement past the valuation date
- Since we are trying a new underwriting approach, we may get punished by the prescriptions

(ii) Surrender (*Note: any two of these points were full credit on this section*)
- Use actual relevant company experience when available
- Margins are not prescribed, but should be more conservative when experience is uncertain
- Since we are working with 10-yr term, we have to satisfy the inflow and outflow PV test with our assumptions

(iii) Interest Rates
- These are prescribed by VM-20
- Single scenario for deterministic, and Academy generator for stochastic

(iv) Expenses (*Note: any four of these points were full credit on this section*)
- Shall use the same for deterministic and stochastic, except for inflation
- May spread capital/IT expenditures over several years
- Shall assume company is going-concern
- Shall align assumption with actual expense
- Shall reflect inflation in the projection
- May not reflect future expense improvements
- Shall not include federal income taxes
- Shall use assumptions consistent with other related assumptions
- Shall use fully allocated expenses
- Shall allocate consistently across lines of business
- Shall reflect expense efficiencies from merger/acquisition when costs also recognized
- Shall reflect direct costs and portion of indirect costs and overhead
- Shall include acquisition expenses and any non-recurring after valuation date
- Shall use an expense factor basis consistent with inforce block for new policy forms or new product lines
6. **Learning Objectives:**
2. The candidate will understand valuation principles and methods of individual life insurance and annuity products issued by U.S. life insurance companies.

**Learning Outcomes:**
(2a) Compare and apply methods for life and annuity product reserves.

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

**Sources:**

**Commentary on Question:**
*This question tested the candidates’ knowledge of statutory financial statements. The candidates were required to calculate reserves and related premium adjustments that are typically reported in statutory financial statements. In addition, the question tests the candidates’ ability to derive the CRVM reserve from the net level premium reserve, given the annual premium that amortizes the CRVM expense allowance.*

**Solution:**
(a) As of the valuation date, determine the following on a net level reserve basis:

(i) Mean Reserve

(ii) Deferred Premium Asset, assuming the company holds mean reserves

(iii) Unearned Premium Liability, assuming the company holds mean reserves

(iv) Mid-Terminal Reserve

(v) Deferred Premium Asset, assuming the company holds mid-terminal reserves

(vi) Unearned Premium Liability, assuming the company holds mid-terminal reserves

Show all work.

**Commentary on Question:**
*Candidates generally tended to confuse the interpolated mean reserve with the mean reserve, and the interpolated mid-terminal reserve with the mid-terminal reserve. Both the mean and mid-terminal reserves can be derived from interpolated reserve formulas by setting “h” equal to 0.5. The question asks for mean and mid-terminal reserves, not interpolated mean and mid-terminal reserves.*
6. Continued

Candidates demonstrated some understanding on how to calculate deferred premium assets and unearned premium liabilities, but candidates did not necessarily know when to calculate them. Deferred premium assets are needed only when mean reserves are calculated, and unearned premium liabilities are needed only when mid-terminal reserves are calculated.

The following items are needed to answer part a:

NP = annual net level premium
MP = modal net level premium
V(t) = net level premium reserve at end of policy year t

NP = PVFB(0) / ann_due(50+0,10-0) = 60,000 / 10 = 6,000
MP = NP / 12 = 6,000 / 12 = 500
V(5) = PVFB(5) - NP x ann_due(50+5,10-5) = 70,000 - 6,000 x 5 = 40,000
V(6) = PVFB(6) - NP x ann_due(50+6,10-6) = 73,000 - 6,000 x 4 = 49,000

(i)
Mean Reserve =
0.5 x (V(5) + NP + V(6)) = 0.5 x (40,000 + 6,000 + 49,000) = 47,500

(ii)
Deferred Premium Asset, assuming the company holds mean reserves, is the total amount of modal premium due after the valuation date and before the next policy anniversary

There are 4 monthly premiums due after the valuation date and before the next policy anniversary: the January 15th, February 15th, March 15th and April 15th premiums

Deferred Premium Asset = MP x 4 = 500 x 4 = 2,000

(iii)
Unearned Premium Liability, assuming the company holds mean reserves, is 0 since the use of mean reserves never results in an unearned premium liability

(iv)
Mid-Terminal Reserve =
0.5 x (V(5) + V(6)) = 0.5 x (40,000 + 49,000) = 44,500

(v)
Deferred Premium Asset, assuming the company holds mid-terminal reserves, is 0 since the use of mid-terminal reserves never results in a deferred premium asset
6. **Continued**

   (vi) Unearned Premium Liability, assuming the company holds mid-terminal reserves, is the portion of the last modal premium payment that is unearned as of the valuation date.

   As of the valuation date, the last monthly premium payment was the December 15 premium, which provides coverage until January 15; the portion providing coverage from January 1 to January 15, or one half of the premium, is unearned.

   \[
   \text{Unearned Premium Liability} = MP \times 0.5 = 500 \times 0.5 = 250
   \]

   (b) Assume the annual premium needed to amortize the CRVM expense allowance for this policy is 300.

   Calculate the CRVM reserve at the end of policy year 5. Show all work.

   **Commentary on Question:**
   Candidates generally did very well on this part of the question. A common mistake was to assume the annual premium was the unamortized CRVM expense allowance.

   \[
   \text{CRVM reserve at end of year 5} = \\
   \quad \text{Net level premium reserve at end of year 5} - \\
   \quad \text{Unamortized CRVM expense allowance at end of year 5}
   \]

   Net level premium reserve at end of year 5 = 40,000 (from part a)

   Unamortized CRVM expense allowance at end of year 5 = 300 \times 5 = 1,500

   CRVM reserve at end of year 5 = 40,000 - 1,500 = 38,500
7. **Learning Objectives:**
   1. The candidate will understand U.S. life insurance company financial statements and reports.

**Learning Outcomes:**

(1a) Construct, analyze and evaluate basic U.S. GAAP, Statutory, and Tax financial statements for a life insurance company.

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

**Sources:**
US GAAP for Life Insurers, Herget et al., 2nd Edition, 2006, Chapter 14

LFV-835-17_Overview of the FASBs Proposal for Long-Duration Contracts of Insurers.pdf

**Commentary on Question:**

*This question tested the candidates’ understanding of DAC, its impact on the Balance Sheet, and the theory behind the standard approximation to calculate the Shadow DAC Asset Adjustment.*

**Solution:**

(a) Calculate the Primary DAC Asset at December 31, 2018. Show all work.

**Commentary on Question:**

*Candidates generally did well calculating the DAC K factor and Primary DAC asset correctly. To receive full credit, candidates needed to demonstrate Deferrable Expense in 2018 is 0 either in the formula or in the calculation.*

\[
\text{DAC K factor} = \frac{\text{PV of Deferrable Expenses (2015)}}{\text{PV of Future Gross Profit (2015)}} = \frac{10,000}{14,255.06} = 0.7015
\]

\[
\text{Primary DAC Asset (2018)} = \text{DAC K factor} \times \text{PV of Future Gross Profit (2019)} - \text{PV of Future Deferrable Expense (2019)} = 0.7015 \times 9,306.51 - 0 = 6,528.56
\]

(b) 

(i) Calculate the Shadow DAC Asset Adjustment at December 31, 2018 assuming an annual 10% reduction in expected gross profits in years 2019 and later. Show all work.

(ii) Derive the debit/credit entries to record the Shadow DAC impact on Shareholder’s Equity in 2018.

(iii) Explain the rationale for the 10% reduction in projected gross profits mentioned in part (i).
Commentary on Question:
Candidates did poorly on parts (i) and (ii).
For part (i), most candidates included all prior years of unrealized capital gains and losses into their calculation. For shadow adjustment purposes, only unrealized capital gain and loss of the current statement date is used. All prior years unrealized capital gains and losses should be ignored.
Most candidates did not attempt to answer part (ii). When attempted, a common mistake was to assign the credit/debit entries incorrectly.

Part (i)

Note: Prior years (2015 to 2017) of Unrealised G/L are discarded in the calculation of Shadow DAC asset at year 2018.

2018 Unrealised capital gain discount back to year 2015
= 1000 x (1 + 5% credit rate) ^ (2019 – 2015) = 1000 x (1.05) ^ -4 = 822.70

Future gross profit reduction rate x PV future gross profit (2019) discount to 2015
= 10% x 9306.51 x (1.05) ^ -4 = 765.65

Adjusted PV of Future Gross Profit (2015)
= 14255.06 + 822.70 – 765.65 = 14312.11


Shadow DAC Asset (2019) = Shadow DAC K factor x Adjusted PV of Future Gross Profit (2019) = 0.6987 x 8375.88 = 5852.29


Part (ii)
Enteries for Shareholders’ Equity in 2018

Unrealised Holding Gains and Losses = 1000 as Debit
Shadow DAC Adjustment = 676.27 as Credit
Deferred Tax on balance @ tax rate 21% = Tax rate x (Unrealised Holding Gains and Losses – Shadow DAC Adjustment)
= 21% x (1000 – 676.27) = 67.98 as Credit

Other Comprehensive Income = Unrealised Holding Gains and Loss – Shadow DAC adjustment – Deferred Tax on Balance
= 1000 – 676.27 – 67.98 = 255.75 as Credit

Part (iii)
Unrealised Gains from assets implies interest rates are lowered. Projected gross profits are reduced to reflect lower future investment returns on reinvested proceeds had these assets been sold.

(c)
(i) Calculate the Shadow DAC Asset Adjustment at December 31, 2018 using the common approximation approach. Show all work.
(ii) Assess the validity of the common approximation approach and suggest when its use would and would not be appropriate.
(iii) Explain why Shadow DAC is irrelevant under FASB’s proposed targeted improvements for long-duration contracts.

Commentary on Question:
Most candidates did not calculate the common approximation in part (i) correctly. A common error was not to apply the negative sign to the approximation formula.
For part (ii), candidates generally answered that the common approximation approach is appropriate under a profit-neutral event. However, to get full credit candidates needed to elaborate on what is a profit-neutral event, list the conditions when it is not appropriate to use the common approximation method, and make a suggestion whether the approximation approach is appropriate. Candidates generally did well to identify the DAC amortization method under FASB Target Improvements in part (iii)

Part (i)
Common approximation for Shadow DAC adjustment (2018) = -1 x Primary DAC K factor x Unrealised Capital Gains = -70.15% * 1000 = -701.5
7. **Continued**

Part (ii)
The approach assumes a profit-neutral event, where present value of gross profit at issue are not impacted by unrealized capital gains and losses, or the present value of future gross profits at issue used in the calculation of the shadow DAC assets equals the present value of future gross profits at issued used in the primary DAC assets, or the Shadow DAC K factor equals the primary DAC K factor.

This approach may not be appropriate for unrealized capital gains on common stocks, depending on a company’s philosophy for passing these gains to policyholders.

It is also not appropriate for unrealized interest-related capital gains on assets backing any blocks of business for which the remaining DAC amortization period is short.

Since the Shadow DAC K factor is not equal to the Primary K factor in this question, it indicates that while this could be a profit-neutral event, the actuary will need to estimate the impacts in the future of this event.

Part (iii)
Under FASB’s proposed targeted improvements for long-duration contracts, DAC will be amortized on a ratable basis rather than using projected future profits. The amortization will either in proportion to the undiscounted amount of insurance in force or on a straight-line basis, if the amount of insurance in force cannot be estimated.
8. Learning Objectives:
1. The candidate will understand U.S. life insurance company financial statements and reports.
3. The candidate will understand and apply emerging financial and valuation standards, principles and methodologies.

Learning Outcomes:
(1b) Describe the major exhibits and schedules of the U.S. Annual Statement and explain the purpose of each.
(1c) Describe, apply and evaluate regulatory documentation and disclosure requirements.

Sources:

ASOP 41: Actuarial Communication (excluding Transmittal Memo and Appendices)

ASOP 52 - Principle-Based Reserves for Life Products under the NAIC Valuation Manual on PBR for Life Products, Section 3

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a) Critique the response with respect to each of the requirements for actuarial communications in Actuarial Standard of Practice 41.

Commentary on Question:
This part of the question tested the candidates’ knowledge on ASOP 41.

ASOP 41 requires:
- That the response time is reasonable (which it is in this case)
- The principle and scope of the engagement be noted (company is identified in the draft response letter)
- That the responding actuary be identified (valuation actuary is noted in the response but it should include an actual name and title)
- That the methods and assumptions are described
- That the form and content are clear (they are not in this case, listing the questions before the answers would add a lot of clarity for readers of the response).
8. Continued

- That reliances on other sources are identified (doesn’t do a good job in the memo as reliances aren’t noted)

(b) Critique the response with respect to the requirements for PBR for life products under the NAIC Valuation Manual.

**Commentary on Question:**
*Candidates generally did well on the product considerations. A common omission was not discussing the effects of VUL secondary guarantee on lapses.*

**Term:**
- Surrender assumption – need to consider things like premium level and other policyholder behavior possibilities
- Mortality assumption – to the extent automated underwriting is new and not in line with the experience of the past, a provision would need to be made for that or more credible data should be gathered.
- Mortality – oftentimes one cannot automatically pool mortality experience across all life products if underwriting requirements are not the same or if some products give rise to anti-selection.

**VUL**
- Lapse rates should vary with economic scenarios
- Secondary guarantee and “in the moneyness” of that guarantee should be considered in setting lapse assumptions
- Lapses should be lower after policy loan kicks in
- Premium payment – should study prior premium persistency experience for similar product
- Inflation – one would usually use the CPI as an index for inflation

**UL**
- You cannot under PBR assume mortality improvement after the valuation date
- Surrender rate should be lower when the cash value is zero
- There are many different funding pattern possibilities so more thought should be put into this assumption.
8. **Continued**

(c)  
(i) Describe how each of the following exhibits in the NAIC Annual Statement for life and annuity products would be affected by the values generated in the PBR calculation.

- Analysis of Increase in Reserves During the Year
- Exhibit 1 – Part 1 – Premiums and Annuity Considerations For Life and Accident and Health Contracts
- Exhibit 5 – Aggregate Reserve For Life Contracts
- Exhibit 8 – Claims for Life and Accident and Health Contracts
- Exhibit of Life Insurance
- Exhibit of Number of Policies

(ii) Explain whether the PBR would affect the Summary of Operations.

**Commentary on Question:**

*A common error was assuming the exhibit of life insurance exhibit contained reserve figures. Most candidates thought the NAIC report exhibits were based on projected results from a model rather than actual results.*

Analysis of increase in reserves – new and different PBR reserves would need to flow through the rollforward
Exhibit 5- basis of PBR reserves will be listed as rows in part A
Exhibit 1 part 1, exhibit 8, exhibit of life insurance and exhibit of number of policies all will remain essentially unchanged in form by PBR since those exhibits do not involve reserve figures

Summary of operations (the income statement) would be impacted as the change in reserve is a critical item and reserves will be different under PBR rules.
9. **Learning Objectives:**
1. The candidate will understand U.S. life insurance company financial statements and reports.
2. The candidate will understand valuation principles and methods of individual life insurance and annuity products issued by U.S. life insurance companies.

**Learning Outcomes:**
(1a) Construct, analyze and evaluate basic U.S. GAAP, Statutory, and Tax financial statements for a life insurance company.

(1b) Describe the major exhibits and schedules of the U.S. Annual Statement and explain the purpose of each.

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

**Sources:**
Valuation of Life Insurance Liabilities, Ch 3

US GAAP For Life Insurers, Second Edition, Ch 6

**Commentary on Question:**
*Commentary listed underneath question component.*

**Solution:**
(a) Prepare the Summary of Operations for calendar year 2017.

**Commentary on Question:**
*This part of the question tested the candidates’ knowledge of the structure and components of statutory annual statements. For full credit, candidates needed to include appropriate components for both revenue and the expense sections. Common mistakes include omitting premium and incorrectly including COI and expense charges in the revenue section; and omitting increase in stat reserves and incorrectly deducting AV release due to death or surrender in the costs section.*

Revenue
- Premium = 200
- Net Investment Income = \((\text{invested assets} \times \text{earned rate on investments}) = (2,000 \times 5.0\%) = 100\)
- Total Revenue = 200 + 100 = 300
9. Continued

Expenses
- Death benefits = 50
- Surrender benefits = 15
- Increase in reserves = 100
  - Subtotal, Benefit Costs = 50+15+100 = 165
- Commissions = 100
- General insurance expenses = (direct maintenance expenses + overhead expense) = 27
  - Total Costs = 165+100+27= 292

Net Gain = revenue - costs = 8
Net Income = Net Gain = 8 (ignoring FIT, dividend and realized capital gains)

(b)

(i) Calculate the net GAAP liability at EOY (as of 12/31/2017). Show all work.

(ii) Create the 2017 GAAP income statement.

Commentary on Question:
Part (i) tested the candidates’ understanding around components included in net GAAP liability as well as the candidates’ ability to calculate EGP and DAC & URL rollforward. Common mistakes include omitting AV or URL in the net GAAP liability calculation; omitting surrender charge margin (in EGP); using incorrect base for earned interest in interest margin calculation (in EGP); omitting AV release in mortality margin calculation (in EGP); incorrectly deducting overhead expense in expense margin calculation (in EGP); using incorrect interest rate for DAC & URL rollforward; and omitting or incorrectly crediting interest to the commission component in DAC rollforward.

Part (ii) tested the candidates’ understanding around which components are included for GAAP income statement and stat annual statements (section a). Common mistakes include omitting or incorrect signed applied to change in ULR and change in DAC; incorrectly including premium in the revenue section; and omitting interest credited in the benefits/deduction section.

(i) EGP = interest margin + death benefit margin + surrender margin + expense margin = 128.5
  - Interest margin = int. earned on AV - int. credited = (EOY balance * earned rate on inv.) - int. credited = (1,570 x 5.0% - 45) = 33.5; using BOY, or average of BOY and EOY AVs is acceptable.
  - Mortality margin = COI - death benefit + AV released on deaths = 100-50+10 = 60
9. Continued

Surrender margin = AV released on surrender - surrender benefit = 15-15 = 0
Expense margin = expense charges - direct maintenance expense = 50-15=35

DAC (t) = DAC (t-1) + interest accrued + Deferrals – Amortized
= DAC(t-1) + DAC(t-1) x crediting rate + commissions - (EGP x k-factor) = 200 + (200x3%) + 100 - (128.5 x 42%) = 252.03

URL (t) = URL (t-1) + interest accrued + Deferrals – Amortized = URL (t-1) + URL(t-1) x crediting rate + 0 - (EGP x k-factor) = 100 + (100x3%) + 0 - (128.5 x 19%) = 78.59

Net GAAP Liability = benefit reserve (account value) + URL - DAC = 1,570+78.59-252.03= 1,396.56

(ii) Revenue
Fee income (COI+ expense charges) = 150 (no surrender charges as surr. Benefits = AV Surrendered)
Net investment income = (invested assets x earned rate on investments) = (2,000 x 5.0%) = 100
Earned deferred revenue = URL(t-1)-URL(t) = 21.42 (from (i))
Total Revenues = 271.42

Benefits and Other Deductions
Death benefits in excess of AV = 50-10=40
Interest credited = 45
Commissions = 100
Other expenses = overhead and direct maint. expense = 27
Change in DAC = -52.03 (from (i))
Total Benefits and Other Deductions = 159.97

Earnings before income taxes = 111.45
10. **Learning Objectives:**

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

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

**Learning Outcomes:**

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


**Sources:**

US GAAP For Life Insurers, Second Edition, Ch 6

LFV-835-17: Overview of the FASB’s Proposal for Long-Duration Contracts of Insurers, PwC, Oct 17, 2016

**Commentary on Question:**

*This question tested the candidates’ knowledge of DAC and SOP 03-1 liability under current GAAP valuation and FASB’s proposed targeted improvement for long-duration contracts. Candidates generally showed better understanding of current GAAP valuation than FASB’s proposed targeted improvement. The most challenging part was the application of FASB’s proposed targeted improvement to the calculation.*

**Solution:**

(a) Describe considerations in determining an appropriate DAC amortization basis for this product.

**Commentary on Question:**

*This question tested the candidates’ knowledge of DAC amortization for universal life product under current GAAP valuation. Candidates generally did well on this part of the question. Most candidates were able to identify the issue of using negative EGP for amortization DAC and provide considerations in determining a reasonable amortization basis.*

Given that this product has significant negative EGPs in year 3 and 5, using the EGP as given would not be an appropriate amortization basis for this product.

One should consider if the negative EGP is long-term or temporary.
10. Continued

If the issue is temporary, there are a few ways to use modified EGP as the amortization basis when negative EGP occurs:

1) Floor EGP at zero.
2) Allow negative EGP but cap DAC balance at original deferred amount.
3) Allow negative EGP but cap DAC balance at original deferred amounts plus interest.

If the issue is long term, the present value of estimated gross revenues, gross costs, or the balance of insurance in force shall be substituted as a base for computing amortization. Based on the data given, the balance of insurance in force is an appropriate alternative method to use.

(b) Assess whether the information provided is sufficient to determine the necessity of establishing an SOP 03-1 liability.

Commentary on Question:
This part of the question tested the candidates’ knowledge of criteria for establishing the SOP 03-1 liability. Some candidates were able to draw the correct conclusion and identify the information missing. A common error was that the “profit follow by loss” test was based solely on EGP.

No, the information is not sufficient.

The projection of "profits followed by losses" test needs to be done for each benefit feature separately. The information provided does not indicate the profit & loss pattern for an insurance benefit feature, so the test cannot be performed.

Although for the contract overall would seem to suggest that there is a strong likelihood of needing a SOP03-1 liability, it is possible that the losses are unrelated to an insurance benefit feature.

(c) ORD Life is reviewing the impact of the accounting changes from the FASB’s proposed targeted improvements for long-duration contracts.

Calculate the DAC balance at the end of year 2 under the accounting standards proposed in 2016. Show all work.

Commentary on Question:
This part of the question tested the candidates’ understanding of emerging financial and valuation standards, principles and methodologies, more specifically the FASB’s proposed targeted improvement for long-duration contracts.
There are multiple ways to solve this question, as the FASB did not prescribe a single formula. Therefore, credit was received based on the degree to which the candidate demonstrated knowledge of the following principles:

1) DAC is amortized according to a constant level basis.
2) Interest should not be considered on the DAC balance.
3) There is no retrospective unlocking for DAC; amortization is based on the DAC at the beginning of the period.
4) Only deferrable expenses that have already occurred can be included in the calculation of current amortization.

Most candidates were able to demonstrate some level of understanding of upcoming change for a simplified approach for DAC. However only a few candidates were able demonstrate complete knowledge.

Common mistakes were using an amortization factor which considers future non-occurred deferrable expenses and/or interest.

Below is one solution for full credit. Other solutions which satisfied the principles also received full credit.

\[
\text{DAC}(1) = \text{DAE}(0) + \text{DAE}(1) - \frac{\text{Balance of Business IF (1)}}{\text{Sum of Balance of Business IF from t1}} \times (\text{DAE}(0) + \text{DAE}(1))
\]

\[
= 0 + 200 - \frac{100}{100+95+40+30+1} \times (0+200) = 200 + \frac{100}{266} \times 200 = 124.81
\]

\[
\text{DAC}(2) = \text{DAC}(1) + \text{DAE}(2) - \frac{\text{Balance of Business IF(2)}}{\text{Sum of Balance of Business IF from t2}} \times (\text{DAC}(1) + \text{DAE}(2))
\]

\[
= 124.81 + 10 - \frac{95}{95+40+30+1} \times (124.81+10) = 124.81 + 10 - \frac{95}{166} \times 134.81 = 57.66
\]