RET FRC Model Solutions
Spring 2019

1.

Learning Objectives:

3. The candidate will understand how to apply/synthesize the methods used to value pension benefits for various purposes.

7. The candidate will understand how to apply the standards of practice and professional conduct guidelines.

Learning Outcomes:

(3d) Analyze and communicate the impact on cost stability of a variety of asset valuation methods.

(7f) Recognize situations and actions that violate or compromise Standards or Professional Conduct Guidelines.

(7g) Recommend a course of action to repair a violation of the Standards or Professional Conduct Guidelines.

Sources:

FR-126-15

Guidance on asset valuation methods

Asset valuation methods under ERISA

CSOPs

Rules of professional conduct

Commentary on Question:

This question tested the candidates' understanding of acceptable asset valuation methods considering the Professional Conduct guidelines. Additional commentary for each part of the question is provided.

Solution:

(a) Critique the asset valuation method taking into account accepted actuarial practice.

1. Continued

Commentary on Question:
Many candidates were able to critique the asset valuation method by identifying at least some of the criteria for an acceptable asset valuation method and noting whether the asset value method satisfied the criteria. Note that not all of the points below were required to receive full credit.

Achieves objectives
- This asset valuation method achieves the objective of moderating volatility of contributions to the pension plan by moderating the volatility in assets through averaging

Tracks to market value/Does not unduly deviate from market value/Has a reasonable and logical relationship to market value
- The asset valuation method includes market value as a component
- The asset valuation method includes a corridor which limits the deviation from market value

Is generally free of any bias
- The asset valuation method is not free of bias since the corridor is unbalanced in favor of a higher smoothed value of assets
- By considering only the average of market value of assets at the valuation date, the method may be subject to bias resulting from the timing of significant cashflows

Has no undue influence on investment transaction decisions or vice versa
- The asset valuation method would not have undue influence on the investment transaction decisions or vice versa

Is consistent with the length of typical economic cycles
- The asset value method using an average period of 4 years is within the typical length of an economic cycle and would not result in intergenerational transfers of wealth (ED states period more than 5 years would not be appropriate)

(b) Recommend an appropriate course of action taking into consideration the rules of professional conduct.

Justify your recommendation.

Commentary on Question:
Many candidates incorrectly responded by recommending a different AVA method, but the question was asking for "course of action taking into consideration the rules of professional conduct".

1. Continued

- Since the asset valuation method is an apparent material noncompliance with the standards of practice, under Rule 13 you should attempt to discuss the situation with the prior actuary to resolve the apparent noncompliance.
- If the prior actuary admits to the noncompliance (AVA method is not acceptable), you and the prior actuary should resolve the noncompliance by agreeing on another AVA method that is acceptable.
- The work should be corrected to use the agreed upon AVA method and users of the work must be notified.
- Assuming reporting this noncompliance is not contrary to the law, you are obligated to report the noncompliance to the CPC:
  - o If the prior actuary does not agree to discuss
  - o The discussion does not result in agreement that the AVA method is noncompliant
  - o If there was no corrective action taken
- Consultation in confidence with the chairperson (or vice-chairperson) of the Practice Council or of an appropriate practice committee is also available.

2. Learning Objectives:
3. The candidate will understand how to apply/synthesize the methods used to value pension benefits for various purposes.

Learning Outcomes:
(3b) Perform periodic valuations of ongoing plans, calculating normal cost and actuarial liability, using a variety of cost methods.

Sources:
Pension Mathematics for Actuaries, Anderson, 3rd Edition

Commentary on Question:
A well-prepared candidate will be able to calculate accrued liability and normal cost using the two specified cost methods. They will also be able to correctly reflect the applicable pre-retirement decrements.

Solution:
(a) Calculate the normal cost of the plan as a percentage of earnings at January 1, 2018.

Commentary on Question:
Candidates generally performed well calculating the normal cost using the Aggregate method. Quite a few candidates had some difficulty properly reflecting the multiple decrements. In particular, the most common problem was difficulty in calculating the present value of future salaries.

$NC_t = (\sum PVFB_t - F_t)/ \sum PVFS_t \times \sum S_t$ where
$PVFB_x = \sum l_y \times q_y \times B_y \times \ddot{a}_y^{(12)} \times v^{(y-x)}$ for each member &
$PVFS_x = \sum l_y \times q_y \times S_x \times v^{(y-x)}$ for each member

Member A:
$PVFB_{2018}$ $= [.02 \times 100,000 \times 1.04^{(60-59)} \times 5 \times \ddot{a}_{60}^{(12)} \times v^{(60-59)}]$
$= .02 \times 100,000 \times 1.04 \times 5 \times 14.8 \times .9524$
$= 146,590$
$PVFS_{2018}$ $= 100,000 \times 1.04 = 104,000$

Member B:
$PVFB_{2018}$ $= [.02 \times 80,000 \times 1.04^{(60-54)} \times 7 \times \ddot{a}_{60}^{(12)} \times v^{(60-54)}] \times (1 -.05)$
$+ [.02 \times 80,000 \times 1.04^{(54-54)} \times 1 \times \ddot{a}_{60}^{(12)} \times v^{(60-54)}] \times .05$
$= [.02 \times 80,000 \times 1.04^6 \times 7 \times 14.8 \times .7462] \times 0.95$
$+ [.02 \times 80,000 \times 1 \times 14.8 \times .7462] \times 0.05$
$= 148,685 + 884 = 149,569$
$PVFS_{2018}$ $= 80,000 \times 1.04 \times .95 \times \ddot{a}_{\overline{6}|j}$ where $j = 1.05/1.04 - 1$
$= 463,087$
Total PVFB $= 146,590 + 149,569 = 296,159$
Total PVFS $= 104,000 + 463,087 = 567,087$
NC_{2018} % **$= (296,159 - 200,000) /567,087 = 16.96\%$**

2. **Continued**

(b) Calculate the accrued liability of the plan at January 1, 2019.

Commentary on Question:
Many candidates were able to correctly identify the fact that the accrued liability equals the value of assets under the Aggregate method.

AL_t = F_t (Aggregate Method)
F = $200,000 x 1.05 + 30,000
= $240,000
AL_{2019} = $240,000

(c) Calculate the accrued liability at January 1, 2019 using the Entry Age Normal, level percent of pay method.

Show all work.

Commentary on Question:
Candidates did not perform as well in this section of the question. In particular, many candidates did not reflect the multiple decrements.

AL EAN = $\sum$ (PVFB – PVFNC) (level % of pay)
where $NC\%_w$ = $PVFB_w$/ $PVFS_w$, and NC_x = $NC\%_w$ x Sal_x for each mbr at age x
<u>Member A:</u>
Member is retired
$PVFNC_x$ = 0 (no future service)
AL_{2019} = $PVFB_{2019}$ = .02 x 100,000 x 1.10 x 5 x $ä_{60}^{(12)}$ = 162,800
<u>Member B:</u>
$PVFB_w$ = [.02 x 88,000 x $1.04^{(60-55)}$ x 7 x $ä_{60}^{(12)}$ x $v^{(60-53)}$] x $(1-.05)^{(55-53)}$
+ [.02 x 88,000 x $1.04^{(53-55)}$ x 0 x $ä_{60}^{(12)}$ x $v^{(60-53)}$] x .05
+ [.02 x 88,000 x $1.04^{(54-55)}$ x 1 x $ä_{60}^{(12)}$ x $v^{(60-53)}$] x (1-.05) x .05
= .02 x 88,000 x 1.04^5 x 7 x 14.8 x .7107 x $.95^2$
+ 0
+ .02 x 88,000 x 1.04^{-1} x 1 x 14.8 x .7107 x .95 x .05
= 142,286 + 845 = 143,131
$PVFS_w$ = 88,000 x $1.04^{(54-55)}$ x .95 + 88,000 x $1.04^{(55-55)}$ x $.95^2$ x $v^{(54-53)}$ x $ä_{\overline{6}|j}$
where j = 1.05/1.04 – 1
= 523,541
NC_w % = 143,131 /523,541 = 27.34%

2. **Continued**

$PVFB_{2019}$ = $[.02 \times 88{,}000 \times 1.04^{(60-55)} \times 7 \times \ddot{a}_{60}^{(12)} \times v^{(60-55)}]$
= $.02 \times 88{,}000 \times 1.04^5 \times 7 \times 14.8 \times .7835$
= 173,817

$PVFNC_{2019}$ = $s_{2019} \times NC_w \% \times \ddot{a}_{\overline{5}|j}$ where j = 1.05/1.04 − 1
= $88{,}000 \times 1.04 \times 27.34\% \times 4.9057$
= 122,742

AL_{2019} = 173,817 − 122,742 = 51,075

AL-EAN = **162,800 + 51,075** = **213,875**

3. **Learning Objectives:**

2. The candidate will understand how to analyze/synthesize the factors that go into selection of actuarial assumptions for funding purposes.

7. The candidate will understand how to apply the standards of practice and professional conduct guidelines.

Learning Outcomes:

(2b) Evaluate and recommend appropriate assumptions for funding purposes.

(7c) Explain and apply relevant qualification standards.

Sources:

Selection of Mortality Assumptions for Pension Plan Actuarial Valuations, CIA Educational Note, December 2017

Task Force Report on Mortality Improvement

Selecting and Documenting Mortality Assumptions, AAA (Appendix for background only)

ASOP 35, Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations

Commentary on Question:
This question tested the candidates' understanding of how to set a mortality improvement assumption. Additional commentary is provided for each part of the question.

Solution:

(a) Describe the considerations for setting an appropriate mortality improvement assumption.

Commentary on Question:
Many candidates described the considerations for setting a base mortality table assumption; however, the question was specifically asking for an appropriate mortality improvement assumption.

Short-term mortality improvement rates based on recently observed improvement rates (experience)
Long-term mortality improvement rates based on expert opinion and analysis of longer-term mortality patterns (highly uncertain)
A transition from the short-term to the ultimate improvement rates should blend smoothly over an appropriate transition period

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3. **Continued**

Other considerations:
Mortality improvement varies by gender, age, and year of birth

3 methods for providing adjustments for future improvements in mortality
- 2-D generational mortality scales – vary by year and age
- 1-D generational mortality scales
- Static mortality scales with a fixed projection period

Adjustment for future improvements in mortality is normally considered separately from the current level of mortality

Actuary should reflect the effect of mortality improvement both before and after the measurement date
- No adjustment before measurement date necessary if published mortality table reflects expected mortality as of the measurement date

Existence of uncertainty about the occurrence or magnitude of future mortality improvement does not by itself mean that an assumption of zero future improvement is a reasonable assumption

(b) Describe the relevant guidance and professional standards that apply when considering updating the mortality improvement scale valuation assumption from CPM-B to MI-2017.

Commentary on Question:
Some candidates responded with many technical details about the two mortality improvement scales, but failed to describe the guidance and professional standards that apply.

For a going concern valuation the actuary should select either best estimate assumptions or best estimate assumptions modified to incorporate margins for adverse deviations to the extent, if any, required by law or by the terms of an appropriate engagement. The actuary would give consideration to emerging mortality improvement trends and studies on a regular basis, particularly those relevant to Canadian pensioners.

The Task Force Report on Mortality Improvement recommends that Canadian actuaries consider the selection of MI-2017 for use in actuarial work in Canada.

Given the recent publication of both scales and the similar data sets used in their development, it may be appropriate to use either scale in the absence of credible information to the contrary, such as the publication of a successor scale by the CIA.

4.

Learning Objectives:
6.   The candidate will understand how to apply the regulatory framework in the context of plan funding.

Learning Outcomes:
(6b)   Evaluate funding restrictions imposed by regulations.

Sources:
Reference: FR-119-14: CAPSA Guideline No. 7: Pension Plan Funding Policy Guideline

Commentary on Question:
Commentary listed underneath question component.

Solution:
(a)   Describe the typical components of a funding policy for a single-employer defined benefit pension plan.

Commentary on Question:
Candidates were expected to provide a short description of the components of a funding policy. Many candidates simply listed correct components and did not provide a description of the components.

1. Plan Overview: overview of the plan provisions, financial information and characteristics of the plan sponsor that are relevant to the funding policy.
2. Funding Objectives: description of the funding objectives, how the plan's investment policy and the plan sponsor's objectives are integrated and related to benefit/contribution levels.
3. Key Risks Faced by the Plan: description of the key risks faced by the plan from different stakeholders and impact on benefit security.
4. Funding Volatility Factors and Management of Risk: description of how the key risks are addressed and managed, the plan's tolerance for volatility in funding requirements, and any scenario testing practices that are used as a tool to evaluate the effect of different hypothetical situations on the plan's funding position and requirements.
5. Funding Target Ranges: description of the funding targets (can be expressed in relation to going concern, solvency, or wind-up liabilities), contribution target levels, cost sharing arrangements, and any mechanisms that would allow flexibility in funding, as applicable.
6. Cost Sharing Mechanisms: as applicable, description of cost sharing mechanisms between plan sponsor and members.
7. Utilization of Funding Excess: description of use of funding excess for contribution holidays and benefit improvements, including when and how to use funding excess, including in the event of the plan termination, as applicable.

4. Continued

8. Actuarial Methods, Assumptions and Reporting: guidance in the selection of the actuarial methods and assumptions that are appropriate for the plan sponsor's risk management approach, e.g. provisions for adverse deviation.
9. Frequency of Valuations: description of frequency of valuations, subject to legislation.
10. Monitoring: description of maintenance of the funding policy, including triggers for a review or amendment of the policy, roles and responsibilities, and frequency of review.
11. Communication Policy: description of what, to whom and when information would be communicated (e.g. a summary of plan's funding policy available to members).

(b)   Construct a funding policy for three of the components described in a) that address the objective of providing security to plan members.

Commentary on Question:
A candidate needed to identify 3 components of a funding policy listed in (a) that were applicable to the objective of providing security to plan members and provide an appropriate example of funding policy wording for each component. However, many candidates did not pick 3 appropriate components and/or did not provide appropriate funding policy wording based on the objective of providing security to plan members.

1. Plan Overview - not relevant
2. Funding Objectives - Example:
   The objective is to ensure that the assets of the pension plan are sufficient to meet the benefits promised. In order to achieve this goal, the following specific objectives will be followed in priority:
   - Security of accrued benefits on a wind-up basis
   - Security of accrued benefits on a going concern basis

3. Key Risks Faced by the Plan - Example:
   Key risks faced by the pension plan that could impact the benefit security of the pension plan members are outlined below
   - Investment Risk: relates to the risk that investment returns achieved by the pension plan are less than the assumed return required over the long term to support the benefits.
   - Asset/Liability Mismatch Risk: relates to the implied mismatch between the pension benefits and the underlying assets. If the value of the assets changes in different magnitude and/or direction to the change in value of liabilities, resulting from a change in interest rates, volatility in the funded status is experienced due to this asset/liability mismatch.

4. **Continued**

- Mortality/Longevity Risk: relates to the risk that the pattern of mortality actually experienced by the pension plan members differs from that assumed in a way that adversely impacts the funded position of the pension plan.
- Demographic Risk: relates to the risk that member demographics evolve in a way that adversely impacts the funded position of the pension plan.
- Regulatory Risk: relates to the risk of future legislative or regulatory changes which impact adversely the benefit levels of the pension plan.
- Inflation Risk: relates to the risk of inflation experience being higher than the inflation assumption for pension indexation purposes.

4. Funding Volatility Factors and Management of Risk - Example:
   Company should evaluate and implement risk mitigation strategies.
   a) Risk assessment and mitigation approaches might include, but are not limited to, the following:
   - Review and make changes to Statement of Investment Policies and Procedures, as applicable, and make resulting changes to the investment of the assets
   - Asset/liability studies and resulting changes to investment of the assets if applicable
   - Demographic experience studies and subsequent changes to mortality and other demographic assumptions, as applicable
   - Monitoring and responding to regulatory changes, as applicable
   - Review and monitoring performance of investment managers of plan assets
   - Inflation hedging investments or inflation swaps
   b) The Plan's tolerance for volatility due to risk exposure is a change to the wind-up financial position by no more than 15% in a year
   c) Scenario testing on the plan going concern and wind-up positions will be made annually to evaluate the effect of discount rate and asset return changes

5. Funding Target Ranges - Example:
   To increase benefit security, subject to regulatory minimum funding, the company's policy is to fund the pension plan such that accrued benefits would be funded at a target ratio of:
   - 115% on a going concern basis; and
   - 100% on a wind-up basis
   Company' policy is to include in its solvency funding all solvency excludable benefits, such as post-retirement pension indexation.
   The Company will defer the start date of all new solvency special payments by one year.

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4.   Continued

6. Cost Sharing Mechanisms - not relevant

7. Utilization of Funding Excess - Example:
    * In the event that the pension plan has both a going concern and solvency surplus, the company will cease contributions to the pension plan to the extent required under the ITA. Otherwise, the company may not use any surplus to suspend contributions.
    * The company may use surplus to improve benefits in the pension plans subject to a level of surplus that can provide a prudent buffer against adverse experience: benefits may not be improved unless surplus on both a going concern and wind-up basis would remain at or above 15% of liabilities after the improvement is effective.

8. Actuarial Methods, Assumptions and Reporting - Example:
    * The actuarial methods and assumptions are to be in accordance with accepted actuarial practice and must comply with applicable legislation.
    * The company will use a margin for adverse deviation in the going concern discount rate as recommended by the actuary based on the plan's current asset mix.
    * The company will not use not use any smoothing technique in determining the plan asset and liabilities for funding purposes.

9. Frequency of Valuations - Example:
    * Actuarial valuations of the pension plan will occur on January 1st of every calendar year regardless of whether the valuation is required by law or not. At each valuation, the going concern, solvency and wind-up status of the pension plan will be determined in order to monitor regularly the pension plan's funding status as it relates to the members' benefit security.
    * When an optional valuation reveals increased funding requirement, the company may choose not to file the valuation, but subject to contribution limits, will fund for 1/2 of the difference between minimum contributions based on the new valuation and the actual contributions the company is currently remitting based on the latest filed valuation.

10. Monitoring - not relevant

11. Communication Policy - not relevant

5. **Learning Objectives:**

6.   The candidate will understand how to apply the regulatory framework in the context of plan funding.

Learning Outcomes:

(6b)   Evaluate funding restrictions imposed by regulations.

Sources:

FR-114-17: Ontario Pension Benefits Act R.R.O. 1990, Reg 909

FR-115-17: Ontario Pension Benefits Act, R.S.O. 1990, Ch. P.8

Commentary on Question:

Successful candidates were able to apply the new Ontario funding rules for an indexed plan, including calculation of the Provision for Adverse Deviation ("PfAD"), funded positions, and minimum and maximum contribution requirements.

The following are common areas where unsuccessful candidates erred:

- Specified alternative assets should be treated as 50% fixed income for PfAD and related interpolation is needed.
- PfAD should be applied only to non-indexed going concern liability and normal cost
- Solvency special payments should be based on 85% of solvency liability

Solution:

Calculate the minimum required employer contributions for 2019 and 2020 and the maximum permissible employer contributions for 2019 as per the December 31, 2018 valuation report.

Show all work.

PfAD

1. Fixed component: 5% for closed plan
2. Asset mix component:
   - Non-fixed income asset allocation 50% + 10% * 50% = 55%
   - Interpolate PfAD of 50% and 60% non-fixed income asset allocation for closed plans
     (5% + 7%) / 2 = 6%
3. Discount rate component: 0%, discount rate is lower than benchmark discount rate.
4. PfAD = 5% + 6% + 0% = 11%

5. Continued

December, 31, 2018 Funded Position

Going concern Financial Position

Market Value of Assets	$800,000	
Going concern Liability (including indexation)	$900,000	
Provision for adverse deviations in respect of going concern liabilities (excluding indexation)	$88,000	=$800,000 * 11%
Going concern excess / (unfunded liability)	($188,000)	=$800,000 - $900,000 - $88,000

Solvency/Hypothetical Wind-up Financial Position

Market Value of Assets	$800,000	
Provision for Wind-up Expenses	($50,000)	
Solvency / Wind-up assets	$750,000	= $800,000 - $50,000
Solvency liability (excluding indexation)	$1,050,000	
Wind-up liability (including indexation)	$1,200,000	
Solvency excess/(shortfall)	($300,000)	= $750,000 - $1,050,000
Wind-up excess /(shortfall)	($450,000)	= $750,000 - $1,200,000

Transfer ratio	66.7%	= $800,000 / $1,200,000
Solvency ratio	76.2%	= $800,000 / $1,050,000
(if <85%, need to fund solvency shortfall)		

Special Payment Calculation

Going concern special payment January 1, 2020 – December 31, 2029	$24,737	= $188,000 / 7.6
85% of solvency liability	$892,500	= $1,050,000 * 85%
Present value of going concern special payments scheduled for payment within 6 years following the valuation date	$111,317	= $24,737 *4.5
Reduced solvency deficiency	$31,183	= $892,500 - $750,000 - $111,317
Solvency special payment January 1, 2020 – December 31, 2024	$6,930	= $31,183 / 4.5

Minimum Required Contribution

2019

2019 current service cost (including indexation)	$60,000	
Provision for adverse deviation in respect of current service cost (excluding indexation)	$5,500	= $50,000 * 11%
2019 current service cost and provision for adverse deviation in respect of current service cost	$65,500	
2019 Going concern special payment	$0	
2019 Solvency special payment	$0	
Minimum required 2019 contribution	$65,500	$65,500 + $0 + $0

5. **Continued**

2020

2020 current service cost (including indexation)	$65,000	
Provision for adverse deviation in respect of current service cost (excluding indexation)	$6,050	= $55,000 * 11%
2020 current service cost and provision for adverse deviation in respect of current service cost	$71,050	
2020 Going concern special payment	$24,737	
2020 Solvency special payment	$6,930	
Minimum required contribution	$102,717	= $71,050 + $24,737 + $6,930

Maximum 2019 employer contribution
$450,000 + $65,500 = $515,500

6.

Learning Objectives:
2. The candidate will understand how to analyze/synthesize the factors that go into selection of actuarial assumptions for funding purposes.

Learning Outcomes:
(2a) Describe and apply the techniques used in the development of economic assumptions for funding purposes.

(2b) Evaluate and recommend appropriate assumptions for funding purposes.

Sources:

Determination of Best Estimate Discount Rates for Going Concern Funding Valuations;

ASOP 27: Selection of Economic Assumptions for Measuring Pension Obligations;

Provisions for adverse deviations in Going Concern Actuarial Valuations;

CIA Revised Educational Note: Expenses in Funding Valuations for Pension Plans.

Commentary on Question:
Most candidates performed well on part (a), and the majority of candidates performed poorly on part (b).

Solution:
(a) Describe the two approaches under the CIA Standards of Practice for determining the best estimate going concern discount rate.

Two approaches to setting the best estimate assumption going concern discount rate:

1. <u>Based on expected future investment returns on the assets of the pension plan</u>

One accepted methodology for establishing a best estimate discount rate that reflects expected future investment returns is a building block approach:
- Determine best estimate long-term return for each asset class;
- Combine best estimate long term returns (with consideration for effect of diversification and investment strategy);
- Consider inclusion of an allowance for additional return from active management, where appropriate (however, this additional return cannot be greater than the expenses for active management); and
- Make appropriate provision for expenses.

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6. **Continued**

2. <u>Based on the yields of investment grade debt securities, considering the expected future benefit payments of the pension plan</u>

The plan's target asset mix is irrelevant under this approach. The yields of investment grade debt securities would reasonably match the projected benefit cash flows and reflect an appropriately low level of risk.

(b) Compare and contrast how you would set the best estimate going concern discount rate for each of the Plans above.

Commentary on Question:
Many candidates did not compare and contrast the different components of the discount rate.

Plan 1
I would set the discount rate using the building block approach (expected future investment returns) to reflect the significant level of risk premium in the ongoing asset mix.

A rebalancing and diversification of 0.3% to 0.5% would typically be included as determined by the diversification of the plan assets

<u>As in Plan 2</u>:
- Returns from active management would only be reflected if the investment strategy includes active management and:
  - Investment expenses equal to the additional return are included below; or
  - the actuary has reason to believe, based on relevant supporting data, that such additional returns will be consistently and reliably earned over the long term
- The expected return would be reduced by an allowance for future plan expenses, including investment-related expenses (active, if applicable, and passive) and administration-related expenses if there is not an explicit allowance for expenses in the normal cost
- Margins for adverse deviation would be reflected to the extent, if any, required by law or by the terms of an appropriate

6. Continued

Plan 2

Under this approach, we will need to determine two best estimate discount rates that reflect expected future investment returns, one for the period up to the expected date the plan is to be 100% funded on a wind-up basis (the "select discount rate"), and the other for the period thereafter (the "ultimate discount rate").

The best estimate discount rate for the select period (the "select discount rate") would be based on the current target asset mix (50% equity, 50% fixed income).

An assumption of the select period is required. The actuary would estimate the select period by modelling the evolution of the wind-up ratio, taking into account:
- The expected returns of the pension fund;
- The regulatory funding requirements;
- The plan's funding policy;
- The expected growth in solvency liabilities;

The best estimate discount rate following the select period (the "ultimate discount rate") would be based on the 100% funded wind-up basis target asset mix (10% equity, 90% fixed income). Consider expected rates of return for each asset class following the end of the select period for the expected remaining time horizon.

Compared to Plan 1
- The rebalancing and diversification effect would be lower to reflect the expected shift to a less diversified portfolio over time.
- The allowance for expenses and margins for adverse deviation would be adjusted (most likely lowered) to reflect the expected shift to a less costly portfolio over time.

Plan 3

I would set the discount rate using the yields of investment grade securities considering the plan's assets are fully immunized and value the liabilities using the same methodology as the assets will help ensure that yield changes affect assets and liabilities similarly

It may be appropriate to base the discount rate on the assumption on the yield on the immunized portfolio as opposed to comparable investment grade securities

Compared to Plans 1 and 2
- Similarly, an allowance for future plan expenses (not explicitly included in the normal cost) and margins for adverse deviation would be reflected to the extent, if any, required by law or by the terms of an appropriate engagement
- No provision for active management

- There will be **no** additional return related to rebalancing and diversification

7. **Learning Objectives:**
7.   The candidate will understand how to apply the standards of practice and professional conduct guidelines.

Learning Outcomes:
(7a)   Apply the standards related to communications to plan sponsors and others with an interest in an actuary's results (i.e., participants, auditors, etc.).

(7d)   Demonstrate compliance with requirements regarding the actuary's responsibilities to the participants, plans sponsors, etc.

(7e)   Explain and apply all of the applicable standards of practice related to valuing pension benefits.

Sources:
CIA Consolidated Standards of Practice - 1000-1800, Effective June 9, 2015

CIA Consolidated Standards of Practice - Pension Plans 3100-3500 ,Effective June 9, 2015

CIA Qualification Standards

CIA Rules of Professional Conduct

SOA Code of Professional Conduct

SOA Qualification Standards

CIA Guidance Document: General Advice on the Application of Rule 13

CIA Revised Educational Note: Events Occurring After the Calculation Date of an Actuarial Opinion for a Pension Plan

Commentary on Question:
As opposed to critiquing the email and its lack of clarity or purpose, many candidates suggested that the memo should disclose additional items, which were not necessary unless they were needed as part of the purpose of the memo (e.g. if the client asked for an accounting impact, it is not necessary to provide solvency results, whereas some students suggested solvency results were mandatory). Many candidates also listed the SOA Code of Professional Conduct and the CIA rules of Professional Conduct, which did not addressing the question.

Solution:
Critique the above email with respect to compliance with the Canadian Institute of Actuaries' Standards of Practice.

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7. Continued

The communication should include any disclosures applicable to the work (even though the results are communicated by e-mail).

Audience and Purpose: The purpose for the work should be clear and the audience better identified. While this it is clear in the email that this is an estimate, the purpose of the work is not clear. Also, the intended audience of the work is not as clear. For example, how will the results be used by Ms. Jones? Does Ms. Jones work for the plan sponsor and they are exploring benefit improvements and want to understanding implications on funding? Is Ms. Jones a labour representative that is planning on using these costings as part of labour negotiations?

Plan provision and member data: With regards to the data, the ad-hoc pension increase to be granted to current pensioners is unclear (e.g., what is the increase?). Also, the treatment of membership movement in the extrapolation from active to pensioner from January 1, 2018 to January 1, 2019 is unclear.

Assumptions: Regarding the assumptions, while the assumptions used for the extrapolation are disclosed via reference to the prior report, it is noted that the assumptions were updated for "current market conditions". Which assumptions were updated and what were the updates to those assumptions. Also, what support for the changes to the assumptions?

Similarly, some of the proposed plan changes may result in changes to assumptions in addition to updates as a result of current market conditions (e.g., removal of portability once a member is eligible to retire may change portability assumption and change to unreduced pension may change the retirement assumption). The impact on assumptions for these plan changes is not identified.

Methods: The extrapolation method does make reference to the most recent actuarial valuation as at January 1, 2018 using expected accruals and actual benefit payments over the projection period, and have been adjusted to reflect current market conditions.

However, what is the actuarial basis for the liabilities?
- o Going concern funding?
- o Solvency?
- o Accounting?
- o Other?

Events during extrapolation period: The email should disclose whether there were any events of which the actuary is aware from January 1, 2018 to January 1, 2019), that would have affected the work,

Subsequent Events: The email should also disclose whether there were any events subsequent to January 1, 2019 and the date of the email (April 30, 2019) that would have affected the results as at January 1, 2019 of which the actuary is aware, whether or not the events are taken into account in the work

7.   **Continued**

Disclosure: The email states that "we have estimated the impact of the proposed plan changes to the XYZ Company Registered Pension Plan (the "Plan") as at January 1, 2019" and the result shown is "We estimate the combined impact of these changes to be $1,500,000"

- o   Is this an increase or decrease?

- o   Is this on liabilities? Or service cost?

8. **Learning Objectives:**

3. The candidate will understand how to apply/synthesize the methods used to value pension benefits for various purposes.

5. The candidate will understand how to evaluate and apply regulatory policies and restrictions for registered retirement plans.

Learning Outcomes:

(3f) Calculate actuarially equivalent benefits

(5i) The candidate will be able to describe and apply regulation pertaining to contributions and benefits.

Sources:

Reference: FR-133-17: Actuarial Equivalence Calculations

Canadian and Pension Retirement Income Planning Book, Willis Towers Watson, 6th edition

Commentary on Question:

Successful candidates demonstrated their ability to calculate the lifetime and bridge pensions payable under normal and options forms under the Income Tax Act. Candidates did generally well on this question.

Solution:

Calculate the lifetime and bridge pensions payable at January 1, 2018 for the CFO's elected form of pension.

Show all work.

Step 1) Pension payable under the plan's normal form

Accrued lifetime benefit at Normal Retirement Date	
Annual benefit payable at age 65	= 1.5% * 30 * $560,000
	= $252,000.00

At selected retirement age 57:	
Months that retirement precedes age 62	60
Reduction factor	= 0.25% * 60
	= 15%
Annual benefit payable at age 57	= $252,000.00 * (1 - 15%)
	= $214,200.00

8.   **Continued**

Bridge benefit at selected retirement age 57:

Points at retirement date	= 57 + 30
	= 87
	Points exceed 85, so the CFO is entitled to bridge benefit at selected retirement age.
Annual bridge benefit:	= $20 * 12 * 30
	= $7,200.00

Step 2) Calculate maximum lifetime and bridge benefits under ITA

(a) Determine maximum lifetime benefit under the plan's normal form

Maximum annual benefit at 30/60/80	= MIN (2% * 575,000 , $2,944.44) * 30
	= $2,944.44 * 30
	= $88,333.20
Points at retirement date	87
	The maximum pension under the ITA is unreduced since the CFO has over 80 points at the selected retirement date (30/60/80 rule)

(b) Determine maximum bridge benefit

Maximum annual bridge benefit at age 60 and 10 years of service	= 12 * ($586.66 + $1,134.17)
	= $20,649.96
Months between age 60 and pension commencement	= (60 – 57) *12
	= 36
Reduction	= 36 * 0.25%
	= 9%
	The CFO has over 10 years of service so no further adjustment is required.

8. **Continued**

Maximum bridge benefit (annual)	= $20,649.96 * (1 – 9%)
	= $18,791.46

The bridge benefit payable under the plan ($7,200.00) is less than $18,791.46 annually. The CFO's pension is not limited by this rule.

(c) Limit on total annual benefit

Limit on combined benefit	= 30 * ($2,944.44 + 25% * 54,600 / 35)
	= $100,033.20

Maximum bridge benefit	= Combined benefit - lifetime maximum pension
	= $100,033.20 – $88,333.20
	= $11,700.00

The maximum bridge benefit isn't limited by the combined maximum benefit.

Step 3) Pension payable under elected normal form

8. **Continued**

Lifetime pension as a JS100%:   = $88,333.20 * (16.5 / 17.3)
         = $84,248.43

Bridge benefit   = MIN($7,200, $18,791.46, $11,700)
         = $7,200

The limit on lifetime retirement benefits is an absolute amount without regard to the form in which the benefit is paid. However, if the form of payment includes a post-retirement benefit in excess of 66 2/3 % or if the form of payment includes both a post-retirement benefit to the spouse and a guarantee of payments for more than five years, an adjustment is required. In this case, the CFO has elected a joint and 100% survivor pension so the maximum benefit permitted by the ITA must be adjusted.

9.

Learning Objectives:

5.	The candidate will understand how to evaluate and apply regulatory policies and restrictions for registered retirement plans.

6.	The candidate will understand how to apply the regulatory framework in the context of plan funding.

Learning Outcomes:

(5a)	The candidate will be able to describe and apply regulation pertaining to plan design.

(5b)	The candidate will be able to describe and apply regulation pertaining to plan establishment.

(6a)	Evaluate retirement funding alternatives for the plan sponsor, shareholders and the participants, and, for public pension plans, taxpayers.

Sources:

Canadian Pensions and Retirement Income Planning, Willis Towers Watson, 6th edition.

- Section 105 of Ch. 1
- Ch. 3
- Ch. 17, 18

Commentary on Question:

Successful candidates picked 5 features out of all possible features of Canadian pension legislation and justified how they contributed to some, or all, of the objectives. Most candidates were able to identify five features; however, the majority of candidates did not provide justifications for the objective(s) it met.

Solution:

Recommend five features from the Pension Benefits Act (Ontario) or the Income Tax Act that the Government of Country XYZ could adopt in order to meet these objectives.

Justify your recommendation.

9. Continued

Feature 1
Objective: Encouragement of retirement savings
Feature: PBA sets eligibility requirements for plan membership. Helps to encourage retirement savings by:
- Setting requirement for employees of corporate entity to join pension plan after specific period of employment
- Setting requirements for eligibility of members with part-time employment status
- Allowing benefit to accrue and contributions to be remitted for a longer time over the career of an employee

Feature 2
Objective: Encouragement of retirement savings
Feature: Modification of tax codes to provide tax advantages on retirement savings.
- Identify employer/employee contributions as tax deductible
- Investment income tax-free until withdrawn
- Unused tax-free contribution room can be carried over to future years

Feature 3
Objective: Protection of accrued benefits
Feature: Implement funding rules regarding employer minimum required contributions.
- Encourage benefit security in the case of corporate insolvency by establishing rules surrounding the timing and quantum of funding contributions
- Funding rules consider both benefit security and long-term sustainability of cost of maintaining the pension plans.

Feature 4
Objective: Protection of accrued benefits
Feature: Formalize investment rules/constraints.
- Investment Rules to ensure assets invested appropriately ("prudent portfolio approach")
- Plan sponsor has a fiduciary responsibility to monitor the performance of investment managers where plan assets are invested.
- Requirement to file a Statement of Investment Policies and Procedures

Feature 5
Objective: Reasonable, but limited, tax sheltering
Feature: Limitations on the accrual of benefits
- Set limits on lifetime pension benefit accruals
- Set limit on the maximum tax-deductible employer contribution and maximum employee contributions
- Set limits on maximum tax deferral room/RRSP room (PAs reduce RRSP room)

10. **Learning Objectives:**

3.   The candidate will understand how to apply/synthesize the methods used to value pension benefits for various purposes.

Learning Outcomes:

(3b)   Perform periodic valuations of ongoing plans, calculating normal cost and actuarial liability, using a variety of cost methods.

Sources:

Pension Mathematics for Actuaries, Anderson, 3rd Edition

FR-132-17: Chapter 5 of A Problem-Solving Approach to Pension Funding and Valuation, Second Edition.

Solution:

(a)   Calculate the actuarial liability and normal cost as at January 1, 2019.

Commentary on Question:

Candidates performed well on this part; however, some candidates did not realize the decrement is at the beginning of the year.
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Member A:

Termination Benefit at age 53 = 1.0% * 50,000 * 6 = 3,000
Termination Benefit at age 54 = 1.0% * 50,000 * 1.025 * 6 = 3,075
AL Termination = Termination benefit at age 53 * q^w_{53} * v^{65-53} * $\ddot{a}_{65}^{(12)}$ + (Termination benefit at age 54 * p^w_{53} $_*$ q^w_{54} * v^{65-54} * $\ddot{a}_{65}^{(12)}$)*v
= 3,000*.02*v^{12} *13.5 + 3,075*.98*.02*v^{12} * 13.5 = 451.04 + 453.07 = 904.11
NC Termination = 453.07/6 = 75.51

Retirement Benefit @ 60 = 1.0% * 50,000 * (1.025)^7 * 6 * (1-2*.03) = 3,352.10
Member A will be unreduced at age 62
Retirement Benefit @ 62 = 1.0% * 50,000 * (1.025)^9 * 6 = 3,746.59
Retirement Benefit @ 65 = 1.0%* 50,000 * (1.025)^12 * 6 =4,034.67

AL Retirement @ 60 = p^w_{53} $_*$ p^w_{54} $_*$ (50% $_*$ Retirement Benefit @ 60 * v^7* $\ddot{a}_{60}^{(12)}$)
        = .98^2 * (50% * 3,352.10 * v^7 * 15.0)
        = 17,159.53
AL Retirement @ 62 = p^w_{53} $_*$ p^w_{54} $_*$ (50% $_*$75% $_*$ Retirement Benefit @ 62 * v^9* $\ddot{a}_{62}^{(12)}$)
        = .98^2 * .50 * (75%* 3,746.59 * v^9 * 14.5)
        = 12,612.00

AL Retirement @ 65 = p^w_{53} * p^w_{54} * (80% * 60%*40% * Retirement Benefit @ 65 * v^{12}* $\ddot{a}_{65}^{(12)}$)

$\qquad\qquad$ = .98^2 * .50 * .25 * (100% * 4,034.67 * v^{12} * 13.5)

$\qquad\qquad$ = 3,641.10

AL Retirement = 33,412.63

NC Retirement = AL Retirement / 6 = 5,568.77

AL for member A = AL Termination + AL Retirement = 34,316.74

NC for member A = NC Termination + NC Retirement = 5,644.28

Member B:

Unreduced retirement age @ 62

AL for member B = 75%* (.01*85,000*15.0 * $\ddot{a}_{62}^{(12)}$)+

25%*100%*(.01*85,000*1.025^3*15.0 * v^3 * $\ddot{a}_{65}^{(12)}$)

$\quad$ = 75%*184,875 + 25%*100%*160,120.76 = 138,656.25 + 40,030.19 = 178,686.44

NC for member B = 40,030.19/15 = 2,668.68

Total for Members A and B:

Total AL at Jan 1, 2019 = 213,003.18

Total NC at Jan 1, 2019 = 8,312.96

(b)$\qquad$Calculate the actuarial liability as at January 1, 2020.

Commentary on Question:

Candidates performed well on this part.

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Member A:

AL = .01 * 51,250 * 7.0 * v^{11} * $\ddot{a}_{65}^{(12)}$ = 28,316.75

Member B:

AL = .01 * 92,000 * 16 * $\ddot{a}_{63}^{(12)}$ = 209,024.00

Total for Members A and B:

Total AL Jan 1, 2020 = 237,340.75

10. Continued

(c) Calculate the gains and losses by source for 2019.

Commentary on Question:
Candidates were awarded full credit if they listed, calculated, and reconciled each source of gain/loss correctly for each member. Most candidates were able to identify the sources of gain and loss, but less were able to calculate each gain/loss correctly.

Expected AL_A Jan 1, 2020 = (Jan 1, 2019 AL + NC at Jan 1, 2019) * 1.05 = 41,959.07

Expected AL_B Jan 1, 2020 = (AL Jan 1, 2019 + NC Jan 1, 2019) * 1.05 = 190,422.88

Total Expected Liability at Jan 1, 2020 = 232,381.95

Total Loss/(Gain) = 237,340.75 – 232,381.95 = 4,958.80

Member A – Termination Loss:

Salary Loss/(Gain) = 0

Termination Loss/(Gain) = Actual Liability – Expected Liability = 28,316.75 – 41,959.07 = -13,642.32

Member B – Retirement & Salary Loss:

Actual AL Jan 1, 2020 using expected Salary = .01 * 85,000 * 1.025 * 16 * $\ddot{a}_{63}^{(12)}$
$$= 197,948.00$$

Retirement Loss (gain) = 197,948.00 – 190,422.88 = 7,525.12

Salary Loss (Gain) = 209,024.00 – 197,948.00 = 11,076.00

Loss/(Gain) Sum Check:

Termination $_A$ Loss/(Gain) + Retirement $_B$ Loss/(gain) + Salary $_B$ Loss/(Gain) = -13,642.32 + 7,525.12 + 11,076.00 = 4,958.80

11. **Learning Objectives:**
7.   The candidate will understand how to apply the standards of practice and
       professional conduct guidelines.

Learning Outcomes:
(7d)   Demonstrate compliance with requirements regarding the actuary's
       responsibilities to the participants, plans sponsors, etc.

Sources:
CIA Educational Note – Use of Models

CIA Consolidated Standards of Practice

Commentary on Question:
*The question was a two-part question. The first part tested candidates understanding of
what is considered a model under the Standards of Practice, and explain how a valuation
software system fits this definition of a model.*

*The second part of the question tested the candidates understanding of the key
considerations, objectives of, and steps to be taken in reviewing a third party's model
(software system), to ensure its validity and appropriateness.*

Candidates generally performed poorly on both parts of this question

Solution:
(a)   Explain why the valuation software system is considered a model according to
       actuarial standards of practice.

       A model is defined by the following characteristics, which are exhibited by
       valuation software:
       - A Model is a **practical representation of relationships** among entities or
         events using statistical, financial, economic, or mathematical concepts.
       - A model uses methods, assumptions, and data that **simplify a more complex
         system** and produces results that are intended to provide useful information on
         that system.
       - A model is composed of a **model specification**, **a model implementation**,
         and one or more **model runs**.
         o A model specification is the description of the components of a model and
           the interrelationship of those components with each other
         o A model implementation is one or more systems developed to perform the
           calculations for a model specification (i.e. computer programs,
           spreadsheets, database programs)
         o A model run is a set of inputs and the corresponding results produced by a
           model implementation

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11. Continued

(b)   Describe the objectives, considerations and steps that should be taken to review and approve the valuation software system in accordance with actuarial standards of practice.

Commentary on Question:
Candidates needed to apply the considerations, objectives, and process for testing a model's validity and appropriateness outlined in the Standards of Practice to a situation in which they are the lead on a targeted committee tasked with assessing a third party valuation system.

Most candidates provided general objectives, such as "ensure the system's calculations are accurate", and general thoughts as to what should be considered, and what the process should be for testing. Most candidates did describe the objectives, considerations and process put forth in the Educational Note.

Objective: Determine whether the software is appropriate for the firm's intended use (valuations/projections):

I.   Assess the risk rating of the model – High (financial, regulatory, reputational risk). Given the high risk rating a very detailed and thorough vetting process is required to determine if the model is acceptable.

II. Review the specification of the software system

    i.   Determine whether embedded assumptions and methods and are appropriate.
    ii. Ensure inputs (data, assumptions) conform to the software's requirements.
    iii. Assuming full specification is not provided by the third party provider the task force should conduct extensive testing to asses areas not covered in the software's user documentation.

III. Validate the implementation

    i.   Test the software and compare results to prior valuation software (that has been fully tested/vetted) to verify the software's calculations. **given the high risk rating, testing should be extremely thorough.
    ii. Document all testing that occurs.
    iii. There should be an open dialogue with the developer to ensure code and hard coded parameters are correct.
    iv. Sensitivity Testing

11. Continued

IV. Understand the Limitations

    i. Understand how the software works in terms of which events are independent are which are correlated.
    ii. Understand what assumptions are fixed and embedded in the model
    iii. Understand the range of circumstances the software was designed and tested for.

V. Documentation

    i. Document all testing that occurs
    ii. Document the decision process on how/why a model was determined to be suitable and appropriate and what the limitations are.

Objective: Prepare the model for use by the firm following approval by the task force

Given the high-risk rating of the model, a **documented process** to be followed by consultants/analysists when using the software should be developed:

I.   Instructions on obtaining data to be used by the model
II.   Describing authorization required for setting assumptions
III.   Instructions on how to run the model
IV.   Checks for inputs and output
V.   Reconciliations required from prior runs
VI.   A flow chart of the process

12. **Learning Objectives:**
1. The candidate will understand how to analyze data for quality and appropriateness.

7. The candidate will understand how to apply the standards of practice and professional conduct guidelines.

Learning Outcomes:
(1a) Identify data needed.

(1b) Assess data quality.

(1c) Make and/or recommend appropriate assumptions where data cannot be provided.

(1d) Comply with regulatory and professional standards pertaining to data quality.

(7a) Apply the standards related to communications to plan sponsors and others with an interest in an actuary's results (i.e., participants, auditors, etc.).

(7b) Explain and apply the Professional Conduct Guidelines.

(7c) Explain and apply relevant qualification standards.

(7d) Demonstrate compliance with requirements regarding the actuary's responsibilities to the participants, plans sponsors, etc.

(7e) Explain and apply all of the applicable standards of practice related to valuing pension benefits.

(7f) Recognize situations and actions that violate or compromise Standards or Professional Conduct Guidelines.

(7g) Recommend a course of action to repair a violation of the Standards or Professional Conduct Guidelines.

Sources:
ASOP 23, CSOP 1530, 1610, 1640, CSOP – 3100 - 3500

Solution:
(a) Identify the data required to perform the valuation.

Commentary on Question:
Most candidates identified almost all necessary data elements, however, two items were often missed: the need for active members' salary history to determine best 60 month average earnings, and pensioners' bridge pension amounts and/or end dates.

12. Continued

- age or date of birth
- gender
- marital status and spouse date of birth, if applicable lifetime pension amount for deferred vested members and pensioners

Actives:
- service or date of hire
- current base pay
- highest 60 months of base pay

Pensioners and beneficiaries:
- form of pension
- bridge pension and bridge pension end date, if applicable

(b) Describe how you would reflect the inclusion of bonuses in pensionable earnings for the valuation.

Commentary on Question:
While many candidates identified the need to discuss historical bonuses with DPC, understanding future expectations was often not mentioned. A well-prepared candidate would also identify additional disclosures needed in the valuation report with respect to membership data assumptions relating to bonus/pensionable earnings.

- discuss historical bonus payments, and future expectations, with DPC to determine a reasonable assumption for bonuses
- In report, describe:
  - The membership data and any limitations (historical bonuses unavailable)
  - Assumptions and methods used in respect of insufficient or unreliable data (how bonuses were estimated)
  - Any significant terms of the appropriate engagement that are material to the actuary's advice
- Going concern valuations – select best estimate assumption for target bonus and salary scale
- Hypothetical wind-up/Solvency valuation – The precision of membership data is less critical for a hypothetical wind-up valuation than for an actual wind-up valuation.
  - It may be appropriate to retroject current earnings based on aggregate historical pay increases and target bonus in order to estimate final average earnings