# RET FRC Model Solutions
# Spring 2021

**1.**

**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.).

(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, Experience Data Quality: How to Clean and Validate Your Data, CIA Consolidated Standards of Practice – Sections 1440, CIA Rules of Professional Conduct, SOA Code of Professional Conduct

**1.** **Continued**

**Commentary on Question:**
*Candidates generally did well on this question. In part a) candidates were able to identify the data issues quite well. However, most candidates did not point out that deferred vested data was missing and lost points. Part b) was answered well by most of the candidates. In Part c) some candidates lost points by incorrectly proposing to modify data for wind-up valuations using assumptions.*

**Solution:**
(a)     Identify potentially incorrect, missing, or incomplete data required for the actuarial valuation.

The following items are missing or be investigated:
**Active members:**
1.   Date of birth that is in the future (25012)
2.   Missing date of participation (65024)
3.   Date of participation doesn't align with credited service (25012)
4.   Missing credited service information (23012)

**Inactive members:**
1.   Missing date of retirement to value pensions with guarantee period
2.   Missing spouse date of birth information
3.   Missing J&S percentage
4.   Pension value is much higher for one of the retirees given flat benefit and age – should verify with plan sponsor
5.   One retiree is very old – should verify with plan sponsor

Confirm if there are any deferred vested members or point out that they are missing.

(b)     Describe how you would proceed with a funding valuation, taking into consideration the Standards of Practice.

We can proceed with the funding valuation in one of the following ways:

- Rectify data by obtaining corrected, more complete, alternative, additional, or supplementary data from plan sponsor
- If sponsor is unable to provide sufficient and reliable data, consider making assumptions with respect to incomplete data; or by making adjustments to the data. If assumptions or adjustments applied to data by the actuary may cause material uncertainty or bias in the results of the work, the actuary would so report and would report any limitations on the use of the work product where appropriate.
- If unable to make assumptions, decline to perform the work

# 1.    Continued

(c)    Describe how you would proceed with the plan wind-up valuation, taking into consideration the Standards of Practice.

The finality of wind-up would call for the actuary to obtain precise membership data.

The standard of materiality for data is more rigorous for calculating an individual benefit (such as in a pension plan wind-up) than for a going concern valuation of a pension plan.

If the data are so inadequate that the data cannot be used to satisfy the purpose of the assignment, then the actuary should 1) obtain different data, 2) complete, with the consent of the principal, any parts of the assignment for which the actuary determines the data are suitable, or 3) decline to complete the assignment.

**2.**  **Learning Objectives:**

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

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

**Learning Outcomes:**

(2c)   Evaluate actual experience, including comparisons to assumptions.

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

**Sources:**

Pension Mathematics for Actuaries – Arthur W Anderson, 3rd Edition, 2006  Ch. 1-4 and 7

FR-132-17: A Problem-Solving Approach to Pension Funding and Valuation, 2nd Ed., Ch. 5

**Commentary on Question:**

*The candidate will be able to perform periodic valuations of ongoing plans, calculating normal cost and actuarial liability, using aggregate method. Further, candidate will be able to evaluate actual experience, including comparisons to assumptions (i.e., gain/loss analysis).*

*Candidate provided answer to this question in excel format, where the 'calculations' are done within the various cells. In order to get full points, candidate is still expected to show intermediate 'steps' to get to the final answers.*

**Solution:**

(a)   Calculate the accrued liability and estimated normal cost of the plan, in dollars, as at December 31, 2020.

**Commentary on Question**:
*Candidate is expected to show the following steps to get full points:*

| Correct formulas or methodology for aggregate method | | | |
|---|---|---|---|
| Calculation of PVFB | | | |
| Calculation of PVFS | | | |
| Calculation of AL | | | |
| Calculation of NC (% or $ or both) | | | |

## 2. Continued

ALt = Ft (Aggregate Method)
NCt = ($\sum$PVFBt – Ft)/ $\sum$PVFSt x $\sum$St where
PVFBx = $\sum$ ly × qy × By × äy(12) × v(y-x) for each member
PVFSx = $\sum$ ly × qy × Sx× v(y-x) for each member

| i | | 5% | v | =1/(1+i) | 0.9524 |
|---|---|---|---|---|---|
| ss | | 3% | j | = (1+i)/(1+ss) | 1.94% |

Benefit at Retirement = 2% x salary x service

Member A:

| Age | Year | Salary | Benefit @ Ret | Svc | Red | Annuity | Deferral v (65 to | tpx | v | qt | qr | PVFB | PVFS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 0 | $55,000 | $1,100 | 10 | 0.0% | 13.3 | 0.2953 | 100.0% | 1.00 | 3% | 0% | $1,296 | |
| 45 | 5 | $63,760 | $1,275 | 15 | 0.0% | 13.3 | 0.2953 | 97.0% | 0.78 | 2% | 0% | $1,457 | $48,459 |
| 60 | 20 | $99,336 | $1,987 | 30 | 25.0% | 14.8 | | 95.1% | 0.38 | 0% | 25% | $59,256 | $35,589 |
| 63 | 23 | $108,547 | $2,171 | 33 | 10.0% | 14.1 | | 71.3% | 0.33 | 0% | 50% | $105,511 | $25,196 |
| 65 | 25 | $115,158 | $2,303 | 35 | 0.0% | 13.3 | | 35.6% | 0.30 | 0% | 100% | $112,860 | $12,122 |
| | | | | | | | | | | | | $280,381 | $989,964 |

PVFS(A) = $\sum$ ly × qy × Sx× v(y-x) = $989,984 (see member B for sample calculation of PVFS)

Member B:

**Member B**

| Age | Year | Salary | Benefit @ Ret | Svc | Red | Annuity | tpx | v | qt | qr | PVFB | PVFS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 55 | 0 | $65,000 | $1,300 | 10 | 50.0% | 15.6 | 100.0% | 1.00 | 0% | 0% | $0 | |
| 56 | 1 | $66,950 | $1,339 | 11 | 45.0% | | 100.0% | 0.95 | 0% | 0% | $0 | $63,762 |
| 57 | 2 | $68,959 | $1,379 | 12 | 40.0% | | 100.0% | 0.91 | 0% | 0% | $0 | $62,547 |
| 58 | 3 | $71,027 | $1,421 | 13 | 35.0% | | 100.0% | 0.86 | 0% | 0% | $0 | $61,356 |
| 59 | 4 | $73,158 | $1,463 | 14 | 30.0% | | 100.0% | 0.82 | 0% | 0% | $0 | $60,187 |
| 60 | 5 | $75,353 | $1,507 | 15 | 25.0% | 14.8 | 100.0% | 0.78 | 0% | 25% | $49,152 | $59,041 |
| 61 | 6 | $77,613 | $1,552 | 16 | 20.0% | | 75.0% | 0.75 | 0% | 0% | $0 | $57,916 |
| 62 | 7 | $79,942 | $1,599 | 17 | 15.0% | | 75.0% | 0.71 | 0% | 0% | $0 | $42,610 |
| 63 | 8 | $82,340 | $1,647 | 18 | 10.0% | 14.1 | 75.0% | 0.68 | 0% | 50% | $95,476 | $41,798 |
| 64 | 9 | $84,810 | $1,696 | 19 | 5.0% | 13.6 | 37.5% | 0.64 | 0% | 0% | $0 | $41,002 |
| 65 | 10 | $87,355 | $1,747 | 20 | 0.0% | 13.3 | 37.5% | 0.61 | 0% | 100% | $106,988 | $20,111 |
| | | | | | | | | | | | $251,615 | $510,331 |

PVFS(B) = $\sum$ ly × qy × Sx× v(y-x) = $510,331

Member C:

| Age | Year | Salary | Benefit @ Ret | Svc | Red | Annuity | tpx | v | qt | qr | PVFB |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 65 | 1 | $82,400 | $1,648 | 14 | 0.0% | 13.3 | 100.0% | 0.95 | 0% | 100% | $292,245 |

PVFS(C) = 1 x 80,000 x (1.03) x 0.9524 = $78,476

**2.** **Continued**

| Total PVFB | $824,242 | = sum of PVFB | |
|---|---|---|---|
| Total PVFS | $1,578,771 | = sum of PVFS | |
| ALt = Ft | 450,000 | | |
| NC (%) = | (PVFB - Ft)/PVFS = | | 23.7% |
| NC ($) = | NC (%) x sum of Sal 2021 | | $48,831 |

(b)     Calculate the gains and losses by source for 2021.

**Commentary on Question**:
*Candidate is expected to show the following steps to get full points*

Calculation of investment gain (assets only)
Calculation of termination gain (PVFB and PVFS)
Calculation of salary loss (PVFB and PVFS)
Calculation of GL on retirement
Capture impacts on total PVFB and PVFS
Impact of contributions
Gain/loss on NC (% or $ or both)

**Member A:**
PVFB (2020) = 280,381 (from part (a))
PVFB (2021 – expected) = 280,381 x (1+i) = 294,400  where i = 5%
PVFB (2021 – expected sal) = 302,102 (see "expected salary" calculation below)
PVFB (2021 – actual sal)  = 298,636 (see "actual" calculation below)

**Termination gain/loss PVFB = 302,102 – 294, 400 = 7,702 (loss)**
**Salary gain/loss PVFB = 298,636 – 302,102 = -3,466 (gain)**

Similarly,

| | 2020 | 2021 | 2021 | | | |
|---|---|---|---|---|---|---|
| PFVS | Actual | Expected | Actual | | | |
| Member A | 989,964 | 982,812 | 1,013,209 | 30,396 | Termination | |
| | | 1,013,209 | 1,001,583 | - 11,626 | Salary | |

Where PVFS(2021) = 982,812 = 989,964 x (1+ss) – expected 2021 sal
ss = 3%  and expected 2021 sal = 55,000 x (1.03)

**Actual- Member A (expected salary)**

| Age | Year | Salary | Benefit @ Ret | Svc | Red | Annuity | Deferral v (65 to current age) | tpx | v | qt | qr | PVFB | PVFS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41 | 0 | $56,650 | $1,133 | 11 | 0.0% | 13.3 | 0.31007 | 100.0% | 1.00 | 0% | 0% | $0 | |
| 45 | 4 | $63,760 | $1,275 | 15 | 0.0% | 13.3 | 0.31007 | 100.0% | 0.82 | 2% | 0% | $1,578 | $52,456 |
| 60 | 19 | $99,336 | $1,987 | 30 | 25.0% | 14.8 | | 98.0% | 0.40 | 0% | 25% | $64,143 | $38,524 |
| 63 | 22 | $108,547 | $2,171 | 33 | 10.0% | 14.1 | | 73.5% | 0.34 | 0% | 50% | $114,213 | $27,274 |
| 65 | 24 | $115,158 | $2,303 | 35 | 0.0% | 13.3 | | 36.8% | 0.31 | 0% | 100% | $122,168 | $13,122 |
| | | | | | | | | | | | | $302,102 | $1,013,209 |

## 2. Continued

**Member A (actual)**

| Age | Year | Salary | Benefit @ Ret | Svc | Red | Annuity | Deferral v (65 to current age) | tpx | v | qt | qr | PVFB | PVFS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41 | 0 | $56,000 | $1,120 | 11 | 0.0% | 13.3 | 0.31007 | 100.0% | 1.00 | 0% | 0% | $0 | |
| 45 | 4 | $63,028 | $1,261 | 15 | 0.0% | 13.3 | 0.31007 | 100.0% | 0.82 | 2% | 0% | $1,560 | $51,854 |
| 60 | 19 | $98,196 | $1,964 | 30 | 25.0% | 14.8 | | 98.0% | 0.40 | 0% | 25% | $63,407 | $38,082 |
| 63 | 22 | $107,302 | $2,146 | 33 | 10.0% | 14.1 | | 73.5% | 0.34 | 0% | 50% | $112,903 | $26,961 |
| 65 | 24 | $113,836 | $2,277 | 35 | 0.0% | 13.3 | | 36.8% | 0.31 | 0% | 100% | $120,766 | $12,972 |
| | | | | | | | | | | | | **$298,636** | **$1,001,583** |

### Member B:
PVFB (2020) = 251,615 (from part (a))
PVFB (2021 – expected sal) = 251,615 x (1+i) = 264,195  where i = 5%
PVFB (2021 – actual sal)  = 311,747 (see calculation below)

**Salary gain/loss PVFB = 311,747 –  264,195  = 47,552 (loss)**
No termination gain/loss because no termination decrement

| PFVS | 2020 Actual | 2021 Expected | 2021 Actual | | |
|---|---|---|---|---|---|
| Member B | 510,331 | 468,897 | 553,292 | 84,394 | Salary |

**Member B**

| Age | Year | Salary | Benefit @ Ret | Svc | Red | Annuity | tpx | v | qt | qr | PVFB | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 56 | 0 | $79,000 | $1,580 | 11 | 45.0% | | 100.0% | 1.00 | 0% | 0% | $0 | |
| 60 | 4 | $88,915 | $1,778 | 15 | 25.0% | 14.8 | 100.0% | 0.82 | 0% | 25% | $60,898 | $73,151 |
| 63 | 7 | $97,160 | $1,943 | 18 | 10.0% | 14.1 | 75.0% | 0.71 | 0% | 50% | $118,293 | $51,787 |
| 65 | 9 | $103,077 | $2,062 | 20 | 0.0% | 13.3 | 37.5% | 0.64 | 0% | 100% | $132,557 | $24,917 |
| | | | | | | | | | | | **$311,747** | **$553,292** |

### Member C:
PVFB (2020) = 292,254 (from part (a))
PVFB (2021 – expected sal) = 292,254 x (1+i) = 306,858  where i = 5%
PVFB (2021 – actual)  = 262,808 (see calculation below)

Retirement gain/loss = 262,808 – 306,858 = -44,050 (retirement gain)

| PFVS | 2020 Actual | 2021 Expected | 2021 Actual |
|---|---|---|---|
| Member C | 78,476 | - | - |

**Member C**

| Age | Year | Salary | Benefit @ Ret | Svc | Red | Annuity | tpx | v | qt | qr | PVFB |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 65 | 0 | $80,000 | $1,600 | 13 | 5.0% | 13.3 | 100.0% | 1.00 | 0% | 100% | $262,808 |

Member C annual retirement benefit = $80,000 x 13 x 2% x .95 = 19,760

**2.** **Continued**

**Investment Gain/loss:**

Fund (expected)

= Fund (2020) x (1 + i) + contribution (end of year) – payment x (1+i/2)

= 450,000 x (1+5%) +50,000 – 19,760 x(1+5%/2)

= $502,246

Fund (actual)

= Fund (2020) x (1 + ROR) + contribution (end of year) – payment x (1+ROR/2)

= 450,000 x (1+10%) +50,000 – 19,760 x(1+10%/2)

= $524,252

Investment Gain = 524,252 – 502,246 = **$22,006**

In summary,

|  | 2020 | 2021 | 2021 |  |  |  |
|---|---|---|---|---|---|---|
|  | Actual | Expected | Actual | Diff | Source |  |
| Ft | 450,000 | 502,246 | 524,252 | 22,006 | Investment |  |
|  |  |  |  |  |  |  |
| PFVB |  |  |  |  |  |  |
| Member A | 280,381 | 294,400 | 302,102 | 7,702 | Termination |  |
|  |  | 302,102 | 298,636 | - 3,466 | Salary |  |
| Member B | 251,615 | 264,196 | 311,747 | 47,551 | Salary |  |
| Member C | 292,245 | 306,858 | 262,808 | - 44,050 | Retirement |  |
|  |  |  |  |  |  |  |
| PFVS |  |  |  |  |  |  |
| Member A | 989,964 | 982,812 | 1,013,209 | 30,396 | Termination |  |
|  |  | 1,013,209 | 1,001,583 | - 11,626 | Salary |  |
| Member B | 510,331 | 468,897 | 553,292 | 84,394 | Salary |  |
| Member C | 78,476 | - | - | - |  |  |
|  |  |  |  |  |  |  |
| NC(%) | 23.7% | 25.0% | 22.4% |  |  |  |
| NC($) | 48,831 | 31,852 | 31,205 |  |  |  |

Each of the NC% and NC($) calculated using the corresponding formula of $(\sum PVFBt – Ft)/ \sum PVFSt \times \sum St$

**2.** **Continued**

|  | NC(%) | NC ($) | |
|---|---|---|---|
| 31-Dec-20 | 23.70% | 48,831 | |
| Contributions | 1.31% | - 16,980 | =25.0% - 23.7% |
| Investment | -1.52% | - 1,930 | |
| Termination | 0.04% | 48 | |
| Salary | 1.73% | 5,175 | |
| Retirement | -2.83% | - 3,939 | |
| 31-Dec-21 | 22.44% | 31,205 | |
| | TRUE | TRUE | |

**3.**  **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.

(3e)  Perform valuations for special purposes, including:
  (i)    Plan termination/wind-up/conversion valuations
  (ii)   Hypothetical wind-up and solvency valuations
  (iii)  Open group valuations
  (iv)   Share risk pension plan valuations

**Sources:**
Pension Benefits Act
Canadian Pensions and Retirement Income Planning, Willis Towers Watson, 6th Edition Ch. 15, 18
Morneau Shepell Handbook of Canadian Pension and Benefit Plans – Ch. 8, 9

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

**Solution:**
(a)  Calculate the minimum required and maximum permissible employer contributions in 2021.

  **Commentary on Question**:
  *Candidates were required to correctly identify the derivation of the formulas for minimum required and maximum allowable employer contributions. Successful candidates provided sufficient numerical and written descriptions of their work.*

  Present value of special payments previously established in respect of any past service unfunded actuarial liability on a going concern basis =
  = 200,000 x (1 + 6%)^(-0.5) = 194,257

  PfAD on going concern liabilities =
  = 16.04% x (30,000,000 – 10,000,000) = 16.04% x 20,000,000 = 3,208,000
  PfAD is not required to be applied on the buy-in annuity liability.

  Going concern excess / (unfunded liability) =
  = going concern assets + present value of special payments previously established in respect of any past service unfunded actuarial liability – going concern liabilities – PfAD
  = 25,600,000 + 194,257 – 30,000,000 – 3,208,000
  = (7,413,743)

**3.**     **Continued**

Hypothetical wind-up excess / (deficit) =
= solvency assets (excluding present value of special payments; including buy-in annuity before wind-up expenses) – wind-up expenses – solvency liabilities =
= 31,400,000 – 200,000 – 38,800,000
= 31,200,000 – 38,800,000
= (7,600,000)

-There is a going concern unfunded liability: the $200,000 going concern special payment is payable in 2021. Any new going concern special payments resulting from the $7,413,743 unfunded liability are deferred by 1 year and payable from 2022.

-As there is a going concern unfunded liability, there is no excess surplus as defined under the Income Tax Act.

- As there is a going concern unfunded liability, there is no actuarial available surplus.

- Any solvency special payments payable, if any, are deferred by 1 year and not payable in 2021.

Minimum required employer contributions for 2021 =
= employer current service cost + PfAD on current service cost + provision for administrative expenses + PfAD on provision for administrative expenses + going concern special payments + solvency special payments
= 120,000 + 120,000 x 16.04% + 50,000 + 50,000 x 16.04% + 200,000 + 0
= 120,000 + 19,248 + 50,000 + 8,020 + 200,000
= 397,268


Maximum permissible employer contributions for 2021 =
= greater of going concern unfunded liability and hypothetical wind-up deficit + employer current service cost (provision for administrative expenses and PfAD)
= max (7,413,743; 7,600,000) + 120,000 + 120,000 x 16.04% + 50,000 + 50,000 x 16.04%
= 7,600,000 + 120,000 + 19,248 + 50,000 + 8,020
= 7,797,268

(b)     Calculate the minimum required and maximum permissible employer contributions for 2022, rolling forward liabilities and current service costs using extrapolation techniques.

**3.** **Continued**

**Commentary on Question**:
*Candidates were required to show sufficient detail to show the numerous steps required to calculate 2022 minimum required and maximum permissible employer contributions. Partial marks were given to candidates that had documented the correct formulas, but made an error in the calculation of one of the question's components.*

Going concern annual special payments payable from 2022 to 2031 =
= going concern unfunded liability / 10-year amortization factor at 6.0% (with 1-year deferral)
= 7,413,743 / 7.15
= 1,036,887

Solvency assets (including present value of special payments) =
= solvency assets + present value of special payments previously established in respect of any past service unfunded actuarial liability on a solvency basis + going concern annual special payments payable from 2022 to 2031 x  5-year amortization factor at 3.2% (with 1-year deferral)
= 31,400,000 – 200,000 + 200,000 x $(1 + 3.2\%)^{(-0.5)}$ + 1,036,887 x 4.48
= 31,200,000 + 196,875 + 4,645,254
= 36,042,129

Reduced solvency excess / (deficit) =
= solvency assets (including present value of special payments) – 85% x solvency liabilities
= 36,042,129 – 85% x 38,800,000
= 3,062,129

-As there is a reduced solvency excess, there is no solvency special payments payable from the Dec. 31, 2020 valuation.

<u>PfAD calculation:</u>
[1 point] A = 5% since plan is closed

J = Target asset allocation for fixed income assets = 45%
K = Target asset allocation for non-fixed income assets = 55%

B = from table for closed plans = (5% + 7%) / 2 = 6%

D = best estimate discount rate = going concern discount rate + passive investment expenses
= 6.00% + 0.05% = 6.05%

**3.** **Continued**

H = CANSIM V39056 = 2.00% (given)

E = 0.5% + H + (1.5% x J) + (5% x K) = 0.5% + 2.00% + (1.5% x 45%) + (5% x 55%) = 5.925%

C = duration x max (0, D – E) = 16 x max (0, 6.05% - 5.925%) = 2.00%

PfAD = A +B + C = 5% + 6% + 2.00% = 13.00%

Rolled forward Dec. 31, 2021 results – Going Concern:

Annuity buy-in value included in going concern assets and liabilities =
= 10,000,000 x (1+6%) – 600,000 x (1+6%)^0.5
= 9,982,262

Going concern liabilities excluding annuity buy-in value and PfAD =
= (30,000,000 – 10,000,000 + 120,000) x (1+6%)^1 – 200,000 x (1+6%)^0.5
= 21,121,287

PfAD on going concern liabilities =
= 13%% x 21,121,287 = 2,745,767

(PfAD is not required to be applied on the buy-in annuity liability.)

Going concern liabilities including PfAD =
= Annuity buy-in value included in going concern liabilities + going concern liabilities excluding annuity buy-in value and PfAD + PfAD on going concern liabilities
= 21,121,287 + 9,982,262 + 2,745,767
= 33,849,316

Present value of special payments previously established in respect of any past service unfunded actuarial liability on a going concern basis =
= 1,036,887 x (1 + 6%)^(-0.5) = 1,007,114

Going concern assets (excluding present value of special payments previously established in respect of any past service unfunded actuarial liability) =
= Pension fund assets at December 31, 2021 excluding the value of the buy-in annuity + Annuity buy-in value included in going concern assets
= 14,400,000 + 9,982,262
= 24,382,262

**3.    Continued**

Going concern excess / (unfunded liability) =
= going concern assets + present value of special payments previously established in respect of any past service unfunded actuarial liability – going concern liabilities including PfAD
= 24,382,262 + 1,007,114 – 33,849,316
= (8,459,940)

-There is a going concern unfunded liability: the $1,036,887 going concern special payment is payable in 2022. Any new going concern special payments resulting from the $8,459,940 unfunded liability are deferred by 1 year and payable from 2023.

- As there is a going concern unfunded liability, there is no excess surplus as defined under the Income Tax Act.

- As there is a going concern unfunded liability, there is no actuarial available surplus.

Rolled forward Dec. 31, 2021 results – Hypothetical wind-up/solvency:

Annuity buy-in value included in solvency assets and liabilities =
= 15,800,000 x (1+3.2%)^1 – 600,000 x (1+3.2%)^0.5
= 15,696,076

Solvency liabilities excluding annuity buy-in value =
= (38,800,000 – 15,800,000 + 250,000) x (1+3.2%)^1 – 200,000 x (1+3.2%)^0.5
= 23,790,825

Solvency assets (excluding present value of special payments; including buy-in annuity before wind-up expenses) =
= Pension fund assets at December 31, 2021 excluding the value of the buy-in annuity + Annuity buy-in value included in solvency assets
= 14,400,000 + 15,696,076
= 30,096,076

Hypothetical wind-up excess / (deficit) =
= solvency assets (excluding present value of special payments; including buy-in annuity before wind-up expenses) – wind-up expenses – solvency liabilities =
= 30,096,076 – 200,000 – (Annuity buy-in value included in solvency liabilities + Solvency liabilities excluding annuity buy-in value)
= 29,896,076 – (15,696,076 + 23,790,825)
= 29,896,076 – 39,486,901
= (9,590,825)

**3.** **Continued**

- Any solvency special payments payable based on the Dec. 31, 2021 results, if any, are deferred by 1 year and not payable in 2022.

Minimum and maximum contributions for 2022:

Minimum required employer contributions for 2022 =
= employer current service cost + PfAD on current service cost + provision for administrative expenses + PfAD on provision for administrative expenses + going concern special payments + solvency special payments
= 150,000 + 150,000 x 13% + 50,000 + 50,000 x 13% + 1,036,887 + 0
= 150,000 + 19,500 + 50,000 + 6,500 + 1,036,887
= 1,262,887

Maximum permissible employer contributions for 2022 =
= greater of going concern unfunded liability and hypothetical wind-up deficit + employer current service cost (provision for administrative expenses and PfAD)
= max (9,102,027; 9,590,825) + 150,000 + 150,000 x 13% + 50,000 + 50,000 x 13%
= 9,590,825 + 150,000 + 19,500 + 50,000 + 6,500
= 9,816,825

**4.**   **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.

(2c)     Evaluate actual experience, including comparisons to assumptions.

**Sources:**
ASOP 35 3.3 and 3.5

**Commentary on Question:**
*Candidates were expected to understand the assumption setting process in the context of credible and non-credible experience. Marks were not given for non-relevant lists – successful candidates applied their knowledge to the specifics of the question.*

**Solution:**
(a)      Assess the appropriateness of the current retirement and termination assumptions.

- The actuary should use professional judgment to estimate possible future outcomes based on past experience and future expectations and select assumptions based upon application of that professional judgment.

- The actuary should select a reasonable assumption by ensuring it is appropriate for the purpose of the measurement.

    **Retirement Assumption:**

- Given that the retirement assumption is credible, plan experience could be used. The plan specific experience shows that the retirement rates increase closer to normal retirement age.

- The retirement rates are much higher for age 62 – 65 based on plan experience. The plan provides unreduced pension for members with 20 years of service, therefore should be reflected in the assumptions.

- The assumption should take into consideration of plan design. Given the early retirement subsidies, the assumption may need to be revised to an age and service base table.

**4.** **Continued**

- The actuary may want to consider other factors when setting the assumptions, such as the availability of other employer-sponsored postretirement benefit programs available and the design of, and date of anticipated payment from, social insurance programs.

**Termination Assumption:**

- Given that the plan experience is not credible for termination scale, the actuary should consider all the relevant assumption universe. This could be experience studies or published tables based on experience under uninsured plans and annuity contracts, or based on any other populations considered representative of the group at hand;

- The actuary may want to consider the significance and materiality of having a refined termination assumption table taking into consideration plan provisions, such as early retirement benefits, vesting schedule, or payout options.

- The actuary may want to consider other relevant factors that may affect future experience, such as the economic conditions of the area or industry, availability of alternative employment, or the human resources policy or practices of the employer.

- Job-related factors should be considered when setting the assumptions such as occupation, work environment, unionization, hazardous conditions, and location of employment.

(b) Recommend changes to the current retirement assumption. Justify your recommendation.

- Recommend updating the retirement assumption to an age and service based table.

- This is a significant service-based change to the early retirement subsidies, therefore should be reflected accordingly as this factor is anticipated to affect experience. The assumption format has the potential to model plan experience and will affect the results of the valuation.

- Retirement rates should increase for members who have 30 or more years of credited service. In the absence of plan specific experience, rates from published tables based on experience under uninsured plans and annuity contracts, or based on any other populations considered representative of the group at hand.

**4.**    **Continued**

- This change in plan provision would encourage members to retire early and the retirement rates are expected to increase based on actuarial judgement. It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data

**5.**   **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:**

(3a)   Differentiate between the various purposes for valuing pension plans:
   (i)   Funding
   (ii)   Solvency
   (iii)   Termination/wind-up/conversion

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

(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.

**Sources:**

Reference – CIA Ed note guidance on selection and disclosure of plausible adverse scenarios, CSOP – 1000-1700, CIA Consolidated Standards of practice – 3100-3500

**Commentary on Question:**

*This question was testing a candidate's knowledge of required content in funding valuation reports including detailed knowledge of the Plausible Adverse Scenarios and their related disclosure requirements.  Candidates generally did well on part a, however a common theme was not including enough list points to receive full credit.  Part b was done poorly as many candidates did not provide the disclosure requirements or how the scenarios would impacts the required elements.*

**Solution:**

(a)   List the disclosure requirements for the actuarial valuation report according to the Standards of Practice.

The actuarial valuation report for an Ontario registered pension plan must include the following items that should be disclosed:
- Statement of Opinion regarding the following four valuation items:
  - membership data is sufficient and reliable
  - methods are appropriate
  - assumptions are appropriate
  - prepared in accordance with accepted actuarial standards in Canada

## 5.    Continued

- The calculation date, report date and next calculation date
- Disclose whether or not there any subsequent events and describe their treatment if applicable.
- The significant terms of engagement should be described
- The client name and users of the report and the purpose of the work
- Summary of:
  - plan provisions – reference amendments, if any;
  - Source of membership data, reconciliation since last valuation, membership statistics, tests applied and description on any limitation to the data;
  - Source of asset information, reconciliation since last valuation, summary of assets by major category;
  - Assumptions for all valuation bases, which assumptions are required on what bases and rationale as required, whether any provision for adverse deviation or margin for adverse deviations is used, describe any changes since the previous valuation, limitation on any assumptions
  - Actuarial Methodology for each basis
- Explanation of the difference between Solvency and hypothetical WU valuations and the assumptions used for each. Noting the differences if any. Ontario allows smoothing of assets and liabilities. This must also be disclosed.
- Description of the valuation types included i.e. Going Concern, Solvency, Wind-up
- All required disclosures for each type of valuation:
  - Going Concern: Normal cost, liabilities, funded status, PfAD on liabilities and normal cost, sensitivity analysis including Plausible Adverse scenarios, gain & loss reconciliation, actuarial surplus if any, any special payment requirements
  - Solvency: Liabilities, funded status, solvency ratio, termination expense, excluded liabilities from wind-up if any
  - Wind-up: Liabilities, funded status, transfer ratio, termination expense
- Prior Year Credit Balance, if any
- Contribution requirements for Employee and Employers:
  - until next valuation
  - Minimum amounts as required by the Ontario Pension Benefits Act
  - Maximum allowable as permitted by the Income Tax Act

(b)    Describe three plausible adverse scenarios that you would include in the valuation report, including the elements required for reporting on each scenario.

**5.** **Continued**

- Plausible Adverse Scenarios are those that represent a non-trivial probability of occurring within the short term. To meet this threshold, the adverse scenario would generally be consistent with the likelihood of between 1 in 10 and 1 in 20, based on the opinion of the actuary. In all cases, they may be based on deterministic or stochastic approaches.
- For each scenario the following disclosures should be included:
  - Qualitative description of the selected plausible adverse scenario
  - Sufficient description of any assumptions used for purposes of reporting the results under the plausible adverse scenario
  - description of any cross effects, reflection of risks in combination
  - One may also consider compensating adjustments, such as a reduction in implicit margin in the discount rate that may have an impact on the results.
- Scenario #1 – Testing Interest Rate Risk
  - A decrease in the interest rate will have an increase on the liabilities and an opposite impact on the fixed income portion of the fund assets.
  - Must disclosure the effect on the funded status
  - The impact on the liabilities and the service cost/rule for calculating service cost must be disclosed
  - The assumptions should be disclosed including the description of assumed # pts decrease in interest rates on fixed income, the impact on return expectations for Plan's assets classes, and the ultimate impact on discount rate
- Scenario #2 – Deterioration of Asset Value
  - Apply a shock at the valuation date to the market value of assets
  - Must disclosure the effect on the funded status
  - Will have no impact on the liabilities or service cost.
  - The assumptions should be disclosed including the description of the assumed percentage drop in asset value and what portion of the portfolio is impacted (i.e. non-fixed income only or all)
- Scenario #3 – Longevity Risk
  - An increase in longevity is an adverse scenario that will impact the liabilities and normal cost.
  - The impact on the liabilities and the service cost/rule for calculating service cost must be disclosed
  - There is no impact on the market value of assets
  - A description of assumed increase in life expectancy should be included

**6.**  **Learning Objectives:**
   5.   The candidate will understand how to evaluate and apply regulatory policies and restrictions for registered retirement plans.

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

**Sources:**
Morneau Shepell, Handbook of Canadian Pension and Benefit Plans, 16th Edition, 2016 – Chapter 8: Registration of Pension Plans Under the Income Tax Act and Taxation of Retirement Savings

Canada Revenue Agency PA Guide

Canada Revenue Agency PSPA Guide

Canada Revenue Agency PAR Guide

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

**Solution:**
(a)   Calculate the 2020 Pension Adjustment for Members X and Y.

   **Commentary on Question:**
   *Many candidates did not recognize the use of a reasonable estimate of earnings for member X (i.e., use 3.0% salary scale and no bonus payable). Most candidates correctly applied the ITA Max for Member Y.*

   2020 PA formula = (9 x 2020 DB accrual) – 600
   2020 DB accrual = min(Pension Plan Accrual, ITA Maximum Accrual) = min (1.8% x 2020 Salary Rate x 2020 credited service, ITA limit x 2020 credited service)

   Member X
   Pension Plan Accrual = 1.8% x $90,000 x 1.03 x 1.0 = $1,668.60
   ITA Maximum Accrual = $3,092.22 x 1.0 = $3,092.22
   2020 PA formula = 9 x min ($3,092.22, $1,668.60) – 600 = $14,417.40

   Member Y
   Pension Plan Accrual = 1.8% x $180,000 x 1.01 x 1.20 x 1.0 = $3,926.88
   ITA Maximum Accrual = $3,092.22 x 1.0 = $3,092.22
   2020 PA formula = 9 x min ($3,092.22, $3,926.88) – 600 = $27,229.98

**6.** **Continued**

    (b)    Describe the benefit improvements than can be made to maximize the pension benefit payable from the plan without generating a Past Service Pension Adjustment.

**Commentary on Question:**
*Candidates did not perform as well in this section of the question. In particular, many candidates could only identify some points related to improvement in ancillary benefits and excluded benefits.*

- Improvement in ancillary benefits (e.g. survivor benefits, bridging benefits (even if paid), a change in an early retirement reduction, even if it applies to a member who retired during the year, pension deferral past age 65)

- adjustments required as a result of increases in earnings under an earnings-related plan (e.g., any indexation of earnings to reflect the increase in average wages and salaries between the year the earnings were paid and the year in which benefits are determined)

- an increase in a pension credit resulting from the indexation automatically factored into the maximum permissible lifetime retirement benefit.

- after 2003 the plan is amended on a yearly basis to increase the DB limit from the prior year's DB limit to the DB limit for the current year.

- a nil PSPA results if the increase in benefits qualifies as an "excluded benefit." (e.g., cost-of-living increases to pensions in payment, cost-of-living increases before pension starts (in a deferral period))

- a nil PSPA results if the member is not entitled to the increase in plan benefits retroactively because the member's past service benefits were capped by a legislative limit.

- adjustments to a member's pension income that depend on whether the member is totally and permanently disabled when pension payments start.

- additional benefits provided under a plan because a member has contributed more than 50% of the value of his or her pension (as required by most provincial pension legislation). This applies to all members if the plan covers members in a jurisdiction requiring such additional benefits.

**7.** **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:**
(2b) Evaluate and recommend appropriate assumptions for funding purposes.

(2c) Evaluate actual experience, including comparisons to assumptions.

**Sources:**
ASOP 23: Data Quality

ASOP 25: Credibility Procedures

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

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

**Solution:**
(a) Assess the appropriateness of the termination assumption used in the January 1, 2020 AVR.

**Commentary on Question**:
*Most candidates performed well on this question, recognizing that the termination assumption was not appropriate and the downsizing event was not expected to occur again.*

- An assumption is reasonable if it is appropriate for the purpose of the measurement and if it reflects the actuary's estimate of future experience.
- Since no further downsizing is planned or expected, the termination assumption was not appropriate as it was based on data that does not represent a reasonable expectation of future experience.
- In setting the new termination assumption, the prior Actuary should have carved out the variance in experience due to a one-time downsizing event that was not expected to occur again.
- The assumed termination rates should be much lower once the one-time downsizing impact is removed.

(b) Describe how the termination assumption should have been developed based on the Standards of Practice.

**7.** **Continued**

> **Commentary on Question**:
> *Most candidates were able to identify that the experience resulting from the downsizing event should be excluded from the termination assumption, but few candidates listed employer-specific/job-related factors or were able to identify the significant difference in assumption compared to the previous valuation report.*

- The actuary should consider employer-specific or job-related factors such as occupation, employment, work environment, and hazardous conditions.
- In this case, the prior Actuary should have had a discussion with the client as to why termination rates had increased so much as compared to the previous valuation.
- The Actuary would have realized that a one-time downsizing event had happened and to request more information regarding the individual members who were true terminations and who were terminated as part of the downsizing.
- Once receiving this information, the Actuary could have performed an experience study using only the members who were true terminations as experience to produce a long-term expectation for termination.

(c) Describe the steps that should be taken and considerations for developing the credibility procedure for using the experience data.

> **Commentary on Question**:
> *Many candidates had difficulty answering this question. Candidates were unable to describe the steps for developing a credibility procedure and many candidates did not provide enough considerations to receive full points.*

- Credibility Procedure is a process that involves the following:
  - the evaluation of subject experience (estimated rate of turnover based on experience from the plan's population) for potential use in setting the assumptions without reference to other data; or
  - the identification of relevant experience (estimated rate of turnover from a standard table) and the selection and implementation of a method for blending the relevant experience with the subject experience.
- The amount of weight given to each depends on (1) the "accuracy" of the relevant experience and (2) the volatility of subject experience.
- Large variability in subject experience implies less reliable estimates and therefore less credibility. Generally, more subject experience data result in more accurate estimates, less variability and thus higher credibility.

# 7.    Continued

- In selecting or developing a credibility procedure, the actuary should consider the following criteria:
  - Whether the data is expected to produce reasonable results
  - Whether the data is appropriate for the intended use and purpose
  - Whether the procedure is practical to implement when taking into consideration both the cost and benefit of employing a procedure.
- The actuary should consider the predictive value of more recent experience as compared to experience from earlier time periods
- Selection of Relevant Experience:
  - The actuary should exercise professional judgment and use care in selecting and using relevant experience.
  - Such relevant experience should have characteristics similar to the subject experience. If subject experience is a material part of relevant experience, the actuary should use professional judgment in deciding whether and how to use that relevant experience.
- In carrying out credibility procedures, the actuary should consider the homogeneity of both the subject experience and the relevant experience
- Professional judgement: In some situations, an acceptable procedure for blending the subject experience with the relevant experience may be based on the actuary assigning full, partial, or zero credibility to the subject experience without using a rigorous mathematical model.

**8.** **Learning Objectives:**

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

**Learning Outcomes:**

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

**Sources:**

Section 3500 of the Canadian Institute of Actuaries' Standards of Practice

**Commentary on Question:**

*Commentary listed underneath question component.*

**Solution:**

(a)    Calculate the commuted value interest rates under Section 3500 of the Canadian Institute of Actuaries' Standards of Practice as at the member's date of termination.

    **Commentary on Question**:

    *Overall, candidates struggled with the details of the calculation and most candidates failed to receive full marks due to one or more of the following:*

- *Failing to annualize the semi-annual published rates*
- *Failing to recognize the one-month lag required by the standard*
- *Incorrectly calculating the spread on provincial and federal bonds – in many cases a spread was not calculated, and the candidate used one of the provincial or federal bond rates in place of the spread*
- *Final rates were not rounded*

- Annualize published figures: $(1+i/2)^2-1$

| Month | i7 | iL | rL | Mid-Term Provincial Bond Index | Mid-Term Corporate Bond Index | Long-Term Provincial Bond Index | Long-Term Corporate Bond Index | Mid-Term Federal Non-Agency Bond Index | Long-Term Federal Non-Agency Bond Index |
|---|---|---|---|---|---|---|---|---|---|
| Dec-20 | 1.64% | 1.68% | 0.32% | 2.25% | 3.01% | 2.56% | 3.42% | 1.72% | 1.77% |

- Calculate midterm real rate: 0.31%

- Calculate Spread components:

**8.** **Continued**

PS1-10 = (Canada Mid-term provincial bond index yield, annualized) – (Canada Mid-term
federal non-agency bond index yield, annualized) = 2.25%-1.72% = 0.54%

CS1-10 = (Canada Mid-term corporate bond index yield, annualized) – (Canada Mid-term
federal non-agency bond index yield, annualized) = 3.01% - 1.72% = 1.31%

PS10+ = (Canada Long-term provincial bond index yield, annualized) – (Canada Longterm federal non-agency bond index yield, annualized) = 2.56% - 1.77% = 0.79%

CS10+ = (Canada Long-term corporate bond index yield, annualized) – (Canada Longterm federal non-agency bond index yield, annualized) = 3.42% - 1.77% = 1.65%

- Calculate the spreads:

$s_{1-10}$ = (0.667 * PS1-10) + (0.333 * CS1-10) = 0.667*0.54%+1.31%*0.333) = 0.79%
$s_{10+}$ = (0.667 * PS10+) + (0.333 * CS10+) = 0.667*0.79%+1.65%*0.333) = 1.08%

- Calculate the non-indexed rates:

$i_{1-10}$ = i7 + s1-10 = 1.64% + 0.79% = 2.43% (rounded to 2.40%)
$i_{10+}$ = iL + 0.5 * (iL – i7 ) + s10+ = 1.68% + 0.5*(1.68%- 1.64%) + 1.08% = 2.78% (2.80% rounded)

- Calculate the implied inflation:

$c_{1-10}$ = (1+i7) / (1+r7) – 1 = 1.32%
$c_{10+}$ = (1+iL + 0.5 * (iL – i7)) /(1+rL + 0.5 * (rL – r7)) – 1 = 1.37%

- Calculate the indexed rates:

$i50\%(1-10)$ = (1+ i1-10)/(1+ 0.5*c1-10)-1 = 1.80% (rounded)
$i50\%(10+)$ = (1+ i10+)/(1+ 0.5*c10+)-1 = 2.10% (rounded)

# 8. Continued

(b) Calculate the commuted value at the member's date of termination assuming the member terminated:

(i) Voluntarily; and

(ii) Involuntarily.

**Commentary on Question**:
*Candidates either did well on Part B or they scored poorly as they failed to calculate the CV under the CV standard effective December 1, 2020 or did not understand how grow-in impacted the CV calculation under the involuntary termination situation*

| | Annuity Factor | Grow-In (Involuntary Term) | | | No Grow-In | | |
|---|---|---|---|---|---|---|---|
| | | Points | Reduction | Reduced Factor | Points | Reduction | Reduced Factor |
| Immediate | 23.9 | 66 | 0.8 | 19.1 | 66 | 0.8 | 19.1 |
| Deferred to 56 | 22.9 | 68 | 0.82 | 18.8 | 67 | 0.82 | 18.8 |
| Deferred to 62 | 17.4 | 80 | 1 | 17.4 | 73 | 0.94 | 16.4 |
| Deferred to 65 | 14.9 | 86 | 1 | 14.9 | 76 | 1 | 14.9 |

| | Grow In (Involuntary Term) | No-Grow-In |
|---|---|---|
| Best Age | 55 | 55 |
| EURA | 62 | 65 |
| CV | (0.5*19.12+0.5*17.40)*25000 = 456,500 | (0.5*19.12+0.5*14.90)*25000 = 425,250 |

**9.**

**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:**

(3e) Perform valuations for special purposes, including:
- (i) Plan termination/wind-up/conversion valuations
- (ii) Hypothetical wind-up and solvency valuations
- (iii) Open group valuations
- (iv) Share risk pension plan valuations

(5d) The candidate will be able to describe and apply regulation pertaining to plan termination/wind-up.

**Sources:**

Calculation of Incremental Cost on a Hypothetical Wind-Up or Solvency basis, CIA Educational Note, Dec 2010

FR-114-19: Ontario Pension Benefits Act R.R.O. 1990, Reg 909 (excluding sections 5.5.1 and 5.5.2 - Funding and Funding Relief for Specified Pension Plans and 5.5.3, 5.6, 5.6.1, 5.6.2, 5.6.3, 5.7, 5.8, 5.9, 5.10 - Solvency Funding Relief) – update with current version of Regs (https://www.ontario.ca/laws/regulation/900909)

FR-115-19: Ontario Pension Benefits Act, R.S.O. 1990, Ch. P.8 – update with current version of Act (https://www.ontario.ca/laws/statute/90p08)

**Commentary on Question:**
*Most candidates were able to obtain some partial points on this question, with several capturing most components of the solution. The most common errors were not recognizing which plan members were eligible for grow-in, incorrect application of the termination decrement (or no application at all) and benefit payments for the following year liability calculation/solvency incremental cost.*

**Solution:**
You are performing a funding valuation as at December 31, 2020 for a defined benefit pension plan registered in Ontario.

Calculate the one (1)-year Solvency Incremental Cost for the defined pension plan described below.

# 9.    Continued

**Member 12001**

Does not have 55 points and is therefore not grow-in eligible.

Liability at December 31, 2020:
Benefit at age 65 (normal retirement date) = 1.5% x FAE3 x credited service
= 1.5% x (65,000 + 63,000 + 62,500)/3 x 10 = 9,525

Liability = benefit x annuity factor (age 33, deferred 32 years)
= 9,525 x 8.04 = 76,550

Liability at December 31, 2021:

Assumed to remain active.

Benefit at age 65 (normal retirement date) = 1.5% x FAE3 x credited service
= 1.5% x (65,000*1.03 + 65,000 + 63,000)/3 x 11 = 10,722

Liability = benefit x annuity factor (age 34, deferred 31 years)
= 10,722 x 8.24 = 88,326

**Member 12004**

Has 55 points and is therefore grow-in eligible.

Liability at December 31, 2020:
FAE3 = (72,000 + 71,500 + 70,400)/3 = 71,300

**9.** **Continued**

Grow-in calculation

| Decrement Age | ERF | FAE3 | Credited Service | Benefit | Annuity Factor (age 55, deferred to decrement age) | Liability |
|---|---|---|---|---|---|---|
| 55 | 0.6 | 71,300 | 16.0 | 10,267.20 | 15.07 | 154,721.89 |
| 56 | 0.64 | 71,300 | 16.0 | 10,951.68 | 14.43 | 158,062.36 |
| 57 | 0.68 | 71,300 | 16.0 | 11,636.16 | 13.81 | 160,750.58 |
| 58 | 0.72 | 71,300 | 16.0 | 12,320.64 | 13.22 | 162,817.44 |
| 59 | 0.76 | 71,300 | 16.0 | 13,005.12 | 12.63 | 164,289.87 |
| 60 | 0.8 | 71,300 | 16.0 | 13,689.60 | 12.07 | 165,190.41 |
| 61 | 0.84 | 71,300 | 16.0 | 14,374.08 | 11.52 | 165,537.80 |
| 62 | 0.88 | 71,300 | 16.0 | 15,058.56 | 10.98 | 165,350.43 |
| 63 | 0.92 | 71,300 | 16.0 | 15,743.04 | 10.46 | 164,646.43 |
| 64 | 0.96 | 71,300 | 16.0 | 16,427.52 | 9.95 | 163,451.09 |
| 65 | 1 | 71,300 | 16.0 | 17,112.00 | 9.45 | 161,789.57 |

Liability = 50% of maximum liability + 50% of liability at age 65
= 50% x 165,538 + 50% x 161,790 = 163,664

Liability at December 31, 2021:

There is a 2% probability of termination.
Expected termination benefit = age 65 liability x 2% = 161,799 x 2% = 3,236
(if assumed involuntary and solvency liability of 163,664 used, this would also be acceptable)

FAE3 = (72,000*1.03 + 72,000 + 71,500)/3 = 72,553

**9.** **Continued**

Grow-in calculation

| Decrement Age | ERF | FAE3 | Credited Service | Benefit | Annuity Factor (age 55, deferred to decrement age) | Liability |
|---|---|---|---|---|---|---|
| 55 | 0.6 | 72,553 | 17.0 | 11,100.66 | 15.45 | 171,463.79 |
| 56 | 0.64 | 72,553 | 17.0 | 11,840.70 | 14.79 | 175,165.71 |
| 57 | 0.68 | 72,553 | 17.0 | 12,580.75 | 14.16 | 178,144.82 |
| 58 | 0.72 | 72,553 | 17.0 | 13,320.79 | 13.55 | 180,435.32 |
| 59 | 0.76 | 72,553 | 17.0 | 14,060.84 | 12.95 | 182,067.08 |
| 60 | 0.8 | 72,553 | 17.0 | 14,800.88 | 12.37 | 183,065.07 |
| 61 | 0.84 | 72,553 | 17.0 | 15,540.92 | 11.80 | 183,450.05 |
| 62 | 0.88 | 72,553 | 17.0 | 16,280.97 | 11.26 | 183,242.41 |
| 63 | 0.92 | 72,553 | 17.0 | 17,021.01 | 10.72 | 182,462.22 |
| 64 | 0.96 | 72,553 | 17.0 | 17,761.06 | 10.20 | 181,137.54 |
| 65 | 1 | 72,553 | 17.0 | 18,501.10 | 9.68 | 179,090.65 |

Liability = (50% of maximum liability + 50% of liability at age 65) x probability of remaining active
= (50% x 183,450 + 50% x 179,091) x (1-2%) = 177,645

**Member 14052**

Has 55 points and is therefore grow-in eligible.

Liability at December 31, 2020:
FAE3 = (82,500 + 81,000 + 80,000)/3 = 81,167

**9.** **Continued**

Grow-in calculation

| Decrement Age | ERF | FAE3 | Credited Service | Benefit | Annuity Factor (age 59, deferred to decrement age) | Liability |
|---|---|---|---|---|---|---|
| 59 | 0.76 | 81,167 | 20.0 | 18,506.00 | 19.67 | 364,070.89 |
| 60 | 0.8 | 81,167 | 20.0 | 19,480.00 | 18.78 | 365,894.62 |
| 61 | 0.84 | 81,167 | 20.0 | 20,454.00 | 17.92 | 366,477.71 |
| 62 | 0.88 | 81,167 | 20.0 | 21,428.00 | 17.07 | 365,857.68 |
| 63 | 0.92 | 81,167 | 20.0 | 22,402.00 | 16.25 | 364,072.75 |
| 64 | 0.96 | 81,167 | 20.0 | 23,376.00 | 15.45 | 361,180.32 |
| 65 | 1 | 81,167 | 20.0 | 24,350.00 | 14.67 | 357,238.19 |

Liability = 50% of maximum liability + 50% of liability at age 65
= 50% x 366,478 + 50% x 357,238 = 361,858

Liability at December 31, 2021:
Assumed to remain active.

FAE3 = (82,500*1.03 + 82,500 + 81,000)/3 = 82,825

Grow-in calculation

| Decrement Age | ERF | FAE3 | Credited Service | Benefit | Annuity Factor (age 59, deferred to decrement age) | Liability |
|---|---|---|---|---|---|---|
| 60 | 0.8 | 82,825 | 21.0 | 20,871.90 | 19.25 | 401,839.78 |
| 61 | 0.84 | 82,825 | 21.0 | 21,915.50 | 18.37 | 402,480.15 |
| 62 | 0.88 | 82,825 | 21.0 | 22,959.09 | 17.50 | 401,799.20 |
| 63 | 0.92 | 82,825 | 21.0 | 24,002.69 | 16.66 | 399,838.93 |
| 64 | 0.96 | 82,825 | 21.0 | 25,046.28 | 15.84 | 396,662.35 |
| 65 | 1 | 82,825 | 21.0 | 26,089.88 | 15.04 | 392,332.95 |

Liability = (50% of maximum liability + 50% of liability at age 65)
= (50% x 402,480 + 50% x 392,333) = 397,407

**9.** **Continued**

### Member 30001

Liability at December 31, 2020:

Liability = annual pension x annuity factor (age 70, immediate)
= 2,000 x 12 x 14.22 = 341,367

Liability at December 31, 2021:

Assumed to remain retired, payment of 24,000 made during 2021.

Liability = annual pension x annuity factor (age 71, immediate)
= 2,000 x 12 x 13.72 = 329,279

### Solvency Incremental Cost

Liability at December 31, 2020
= 341,367 + 361,858 + 163,664 + 76,550
**= 943,439**

Liability at December 31, 2021
= 329,279 + 397,407 + 177,645 + 88,326
**= 992,657**

Solvency Incremental Cost
= Present value of 2021 Liability + present value of benefit payments – 2020 liability
= 992,657/(1 + 0.025) + (24,000 + 3,236)/(1 + 0.025/2) – 943,439
**= 51,906**

(also correct if assumption is all benefit payments are paid at beginning of year)

**10.**

**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.

**Sources:**

FR-121-19: Assumptions for Hypothetical Wind-Up and Solvency Valuations with Effective Dates between December 31, 2018, and December 30, 2019;

FR-143-19: Educational Note Supplement: Guidance for Assumptions for Hypothetical Wind-Up and Solvency Valuations Update – Effective March 31, 2019, and Applicable to Valuations with Effective Dates Between March 31, 2019, and December 30, 2019

CIA Standards of Practice – Pension – Section 3200 Advice on the Funded Status or Funding of a Pension Plan and Section 3500 Pension

**Commentary on Question:**

*The question was testing the candidate's ability to describe the process and considerations relevant to setting assumptions for a Solvency valuation as well as considerations for the assumptions required to calculate Solvency Incremental Costs.*

*Overall this question was done poorly by candidates as they either did not include enough descriptions to award full points or did not focus on considerations related to Solvency assumptions.*

**Solution:**

(a)   Describe the considerations in setting the following assumptions for a solvency valuation:

(i)   mortality rates assumption;

(ii)   portion electing a commuted value;

(iii)   wind-up expenses;

(iv)   increase in average wage index

# 10. Continued

**Commentary on Question:**
*Full credit was given to candidates who appropriately described how the requested assumptions were impacted by use in a solvency valuation and describing the considerations for each assumption as it relates to a solvency valuation. Candidates who described assumption considerations with regards to the going concern basis or not correctly relating to the solvency basis received no credit.*

(i) **Mortality Assumption**
   − Commuted Value Basis
      o The mortality table is promulgated for the computation of pension commuted values.
      o The table is the 2014 Combined Canadian Pensioners' Mortality Table (CPM2014) with the CPM Improvement Scale B (CPM-B)
      o There is to be no adjustments considered to reflect sub- or super-standard mortality for determination of the commuted values for solvency valuation purposes
      o If required by legislation or the terms of the plan, commuted values would be calculated on a unisex basis. The methodology to determine the relative proportions of males versus females can be determined in multiple ways. It is important that the unisex basis should be appropriate for the particular plan.
   − Annuity Purchase Basis
      o The mortality table is not promulgated and in the case of an actual annuity purchase would be set based on the selected annuity purchase provider's mortality assumptions.
      o The CIA produces guidance on the mortality table to use for annuity purchase.
      o The actuary should consider making an adjustment to the regular annuity purchase assumptions where there is demonstrated substandard or super-standard mortality or where an insurer might be expected to assume so. In such cases, the actuary would be expected to make an adjustment to the mortality assumption in a manner consistent with the underlying annuity purchase basis
      o Given the uncertainty, surrounding the actual mortality basis that would be typical of a group annuity purchase, it is reasonable to assume that there is a range of bases that can be expected not to be materially different from the actual mortality basis. Therefore, an adjustment to the regular annuity purchase assumptions would be warranted when the plan's assumed basis falls outside that range.

# 10. Continued

## (ii) Portion electing a commuted value

- Upon plan wind-up, members are given options for the method of settling their benefit entitlements. The options vary by eligibility and by province of employment, but in general, involve either a lump sum transfer or an immediate or deferred pension, the actuary must consider the specifics of the plan, member demographics and legislative requirements when making an assumption regard the portion of members electing a commuted value.
- The actuary should ensure alignment with settlement assumptions used for Going Concern valuations, unless specific reason not to.
- Plan experience should be considered while taking into account the credibility of the data when determining any adjustments.
- The actuary must consider the relevant plan terms and provisions around commuted values and their various circumstances.

## (iii) Wind-up expenses

- When considering the level of wind-up expenses to hold in the solvency balance sheet the actuary would assume that the pension plan has neither a surplus nor a deficit.
- The expected length of the wind-up process (typical range of 18 to 24 months) should be considered.
- Wind-up expenses related to the resolution of surplus or deficit issues, including if the terms of a wind-up are contested, need not be considered.
- The actuary should consider and make an assumption as to the solvency of the Plan Sponsor and ensure the assumption with respect to the payment of expenses and the assumption with respect to the solvency of the employer would be consistent.
- An actuary would consider expenses payable from the Plan's assets in respect of actuarial and administration expenses that may reasonably be expected to be incurred in terminating the Plan and to be charged to the Plan when setting the wind-up expenses
- Additional consideration should be given on whether to include provisions for:
  - o transaction fees related to the liquidation of the Plan's assets;
  - o Expenses that may reasonably be expected to be paid by the pension fund under the postulated scenario between the wind-up date and the settlement date.

# 10. Continued

(iv) **Increase in average wage index**
   - The actuary should consider whether an assumption regarding the average wage index is required for the valuation. It is often used to project YMPE or ITA maximum pension limits beyond the valuation date.
   - If the plan terms require YMPE projections or the ITA maximum pension limits to be determined at the date of commencement, then using an average wage index assumption for the solvency assumption should be included.
   - The increase in the average wage index is prescribed to increase at rates that are one percentage point higher than the rates of increase in the Consumer Price Index, which is also a prescribed rate on a solvency basis.

(b) Describe the considerations for setting the assumptions required when determining the solvency incremental cost.

**Commentary on Question**:
*Full credit was given to candidates who appropriately described the considerations for assumptions used for the solvency incremental cost and included at least six considerations. Many candidates simply did not include enough considerations to receive full points.*

The main considerations are as follows:
- The financial assumptions would be consistent with the solvency valuation at time 0.
- The demographic assumptions are typically set consistent to Going Concern Assumptions at time 0. Alternatively, if the actuary considers such experience to be different from the longer term expected experience assumed for a going concern valuation, one may reflect expected experience between time 0 and time t.
- Consider the demographic assumptions to be used for each of the following experience items:
  o *Expected Benefits Payments during the following year* – Lump sum and pension payments
  o *Decrements* – expected withdrawals, deaths, disabilities and retirements during the year
  o *Service Accruals* – expectation of service accrual for the year for each active member
  o *Projected changes in benefits and/or pensionable earnings* - depends on plan type
- If the plan is open, consideration must be given to new entrants during the year and how much additional liability to include in the incremental cost for them. Assumptions must be made to the number and demographics of the new entrants over the period. If the plan is closed, no assumption for future entrants are required.
Additional things to consider in setting the solvency incremental cost assumptions
- If there are any pending amendments to the pension plan, the impact should be included in the incremental cost, as per Standards of Practice.

# 10. Continued

- The incremental cost would allow for the expected changes in benefits due to factors such as members becoming eligible for early retirement "grow-in" benefits, or members becoming eligible for unreduced or subsidized early retirement benefits, where such factors would result in a significant increase in the hypothetical wind-up or solvency liability between time 0 and time t.
- Where the interest rate(s) that would be used to value the projected or solvency liability for a particular member at time t would be different from the interest rate(s) used at time 0 (e.g., because the probability of method of settlement is expected to be different at time t than it was at time 0, or because smoothed interest rates are being used), the actuary would account for the change in interest rates.
- If Smoothing is used, it would be appropriate to assume that the unsmoothed interest rates at time t remain at the same levels applicable at time 0.

**11.** **Learning Objectives:**

4.　　The candidate will understand the principles and rationale behind regulation.

**Learning Outcomes:**

(4a)　Describe the principles and motivations behind pension legislation and regulation.

**Sources:**

FR – 139-18 - OECD Core Principles of Private Pension Regulation (Parts I and II, pp. 11-75)

**Commentary on Question:**

*Many candidates struggled with this question due to lack of familiarity with the OECD Core Principles. Partial points we awarded for those candidates who identified the relevant parts of the Pension Benefits Act (Ontario) that related to Core Principle 5.*

**Solution:**

Describe ways in which the regulatory framework provided by the Pension Benefits Act (Ontario) adheres to "Core Principle 5. Plan design, pension benefits, disclosure and redress" from the OECD Core Principles of Private Pension Regulation.

Examples of relevant portions of the Pension Benefits Act (Ontario) that adhere to Core Principle 5 are shown below. There may also be additional items that could have been stated and awarded points if relevant to Core Principle 5.

Plan design/pension benefits

- No reduction of accrued benefits, except in exception circumstances
- Timely notice regarding any reduction in future benefit accruals
- Contributions must be made expeditiously
- The right to sufficient and diverse investment choices for member directed investments
- Appropriate default options
- Different payout options

Disclosure

- Disclosure requirement regarding investment choices for member directed investments
- Ready access to basic information on pension plan
- Ready access to disclosures (annual reports, valuation reports, etc.)
- Members notified if required contributions are not made
- Individual benefits statements required
- Require adequate information on portability
- Adequate notice for significant amendments

Redress

- Mechanisms for complaints and appeal process

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

**Learning Outcomes:**
(3a)     Differentiate between the various purposes for valuing pension plans:
    (i)     Funding
    (ii)     Solvency
    (iii)     Termination/wind-up/conversion

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

(3c)     Analyze and communicate the pattern of cost recognition that arises under a variety of funding methods

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

**Sources:**
1.Guidance on Asset Valuation Methods, CIA Educational Note, Sep 2014
2.Asset Valuation Methods under ERISA, Pension Forum 9/2002, Ch. 1, 3, 4 and 5
3.Survey of Asset Valuation Methods for Defined Benefit Plans (Section 2 only)

**Commentary on Question:**
*Candidates should be prepared to discuss the considerations outlined in the CIA guidance note, and reference how each consideration relates to the asset strategies outlined in part a)*

*Most candidate were able to point out the desirable characteristics of an asset valuation method. However, candidates did not consider the Company's existing investment strategy in relation to the proposed asset valuation methods. Some candidates also did not point out that the 4% expected return assumption under option 2 needs to be justified against the going concern interest rate assumption.*

**Solution:**
Assess the appropriateness of each of the above asset valuation methods to achieve Company ABC's objective, taking into consideration the Canadian Institute of Actuaries' guidance on asset valuation methods.

**12.** **Continued**

In selecting an asset valuation method, the actuary would focus on the objectives, the requirements of the Standards of Practice, and any regulatory constraints. Some desirable characteristics of an asset valuation method are noted below along with their applicability for each asset valuation method

|  | Unit method (10-year average) | 20% Corridor based on expected income | Deferred recognition of equity returns only |
|---|---|---|---|
| Achieves objectives | Method is expected to smooth the fluctuations in assets from year to year. However, applying smoothing techniques to the entire portfolio may undermine the effectiveness of the investment strategy that Company ABC already has in place to minimize the impact of solvency funded status to changes in interest rates | Method is expected to smooth the fluctuations in assets from year to year. However, applying smoothing techniques to the entire portfolio may undermine the effectiveness of the investment strategy that Company ABC already has in place to minimize the impact of solvency funded status to changes in interest rates | Method is expected to smooth the fluctuations in assets from year to year. As the objective of the asset valuation method is to moderate the volatility of contribution rates, the combination of the current interest rates strategy with this option (smoothing of equity portfolio only) may be best |
| Tracks to market value | Includes current market value as a component and ensures that the asset value is expected to track to market value over time. | Includes current market value as a component and ensures that the asset value is expected to track to market value over time. | Includes current market value as a component and ensures that the asset value is expected to track to market value over time. |
| Does not unduly deviate from market value | Isn't expected to deviate significantly from market value. | Isn't expected to deviate significantly from market value. Further restricts the potential for undue deviation through the use of a "corridor". In determining the corridor of 20% the actuary should take into consideration the purposes of the valuation and the characteristics of the plan | Isn't expected to deviate significantly from market value. |
| Has a logical and reasonable relationship to market value | Appears to be rational and consistent with the Standards of Practice. | Appears to be rational and consistent with the Standards of Practice. | Appears to be rational and consistent with the Standards of Practice. |
| Generally free of bias | Method is generally free from any bias | Method is generally free from any bias. It uses a | Method is generally free from any bias |

| | | symmetrical corridor. It also uses an expected return of 4% and the principles underlying the determination of an appropriate assumption for the expected return are similar to the principles underlying the determination of an appropriate going concern interest rate assumption. Accordingly, when using such an asset valuation method, the actuary would be prepared to justify any differences in these two assumed rates. | |
|---|---|---|---|
| Has no undue influence on investment decisions and vice versa | Does not have influence on investment decisions | Does not have influence on investment decisions | This method may be expected to provide any incentive to influence or affect individual investment transactions or activity |
| Is consistent with the length of typical economic cycles | Not appropriate as it delays recognition of investment-related gains or losses over 10 years, which is beyond the typical length of an economic cycle of 5 years | Appropriate. The smoothing period is less than a typical economic cycle of 5 years | Appropriate. The smoothing period is less than a typical economic cycle of 5 years |