RET FRC Model Solutions
Fall 2023

1. Learning Objectives:

1. The candidate will understand how to analyze data for quality and appropriateness.

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.

Commentary on Question:

Successful candidates were able to correctly identify the specific data issues mentioned below. Points were not awarded without specifically identifying the member IDs and providing an appropriate explanation of the data issue

Solution:

(a) Identify potentially incorrect, missing, or incomplete data required for each valuation

January 1, 2022:

- ID: 8346: Using date of birth and years of service, the implied age at the date of hire is 19-20. In addition, the pensionable earnings is relatively low compared to other active employees given the number of years of service.

- ID: 9276: Member is still actively employed at age 67 as of January 1, 2022.

- ID: 2652: Deferred vested member's age is 67 as of January 1, 2022

- ID: 3388: Date of retirement is in the future

- ID: 4501: Date of retirement implies age at retirement of 53, which does not agree with the earliest retirement age in the plan provisions.

1. **Continued**

January 1, 2023:

- ID: 8829: Date of birth changed compared to the prior year

- ID: 9001: New entrant to the plan, but valuation data shows 3 years of service – a potential re-hire?

- ID: 8911: A new retiree, DOB changed

- ID: 8911: A new retiree, but the amount of monthly pension is high given 5 years of service as of January 1, 2022

- ID: 3988: Form of payment changed from January 1, 2022 data without any changes to other data for participant

- ID: 8346: Earnings decreased 5.7% compared to the prior year. In addition, years of service increased by 2 years instead of 1.

- ID: 4501: Date of retirement changed compared to the prior year

- None of the pension amounts changed, even though there is 2% indexation

(b) Describe actions that you may take to rectify the data concerns, taking into consideration Standards of Practice.

Commentary on Question:
Successful candidates were able to articulate specific steps to rectify the data issues described above. No marks were given for references to the Standards of Practice that didn't relate to the data issues presented in the question.

- Have administrator consider contacting members directly to confirm their personal information relevant for valuation data purposes

- For deferred pensioners, request client or plan administrator to provide termination statements to confirm monthly pension amount at NRD, NRD and EURD

- For retirees, request client or plan administrator to provide retirement option forms to confirm monthly pension amounts and forms of pension.

- If some data issues cannot be resolved, consider making assumptions but disclose these assumptions.

- Determine if the errors in data were material to the valuation results (i.e. funding requirements) at January 1, 2022. If the errors are not material, no further action is necessary and the errors can be corrected in the next valuation

- If the errors are deemed material, engage the prior actuary to discuss the situation. If after this discussion there is rationale for the data (supporting documentation etc.), no further action is necessary and the errors can be corrected in the next valuation

1. Continued

- If there is agreement that the errors are material, the colleague should revise their report and/or communicate the impact to users of the reports

- If there is no resolution, the apparent non-compliance should be reported to the Professional Conduct Board (Rule 13)

2. 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.

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

(3f) Calculate actuarially equivalent benefits.

Sources:

Canadian Pensions and Retirement Income Planning, Willis Towers Watson, 6th Edition, 2017 Ch. 15 (excluding Section 1525)

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

Morneau Shepell, Handbook of Canadian Pension and Benefit Plans, 17th Edition, 2020 Ch. 3 and 6 (excluding pp., 176-183)

FR-133-17: Actuarial Equivalence Calculations

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

2. Continued

Guidance on Asset Valuation Methods, CIA Revised Educational Note, Sep 2014

FR-154-23: Regulation 193/18 Purchase of Pension Benefits from an Insurance Company under Ontario Pension Benefits Act

Section 3500 of the Practice-Specific Standards for the Pension Plans – Pension Commuted Values, CIA Educational Note, Aug 2020

Commentary on Question:
This question was to test candidates' understanding of the following:

- *Calculation of funded status and contribution requirements of an Ontario registered pension plan on going concern and solvency bases;*
- *Use of asset smoothing method to determine the going concern asset value;*
- *Valuation of buy-in liabilities; and*
- *Evaluating actual experience compared to the assumptions.*

Solution:

(a) Calculate the funded status of the plan on going concern and solvency bases at January 1, 2022.

Commentary on Question:
Many candidates did not get the AVA calculation correct (e.g. not calculating the investment gain/loss correctly, missing the 1/3 and 2/3 gain/loss deferral for years 2022 and 2021 respectively and some candidates just took the average of the market values).
There were also a few errors in the treatment of the buy-in piece (e.g. candidates incorrectly included the buy-in piece in the PfAD calculation, or excluded the buy-in piece in the total asset/liability calculation).
Most candidates also forgot to add back the wind-up expense piece in the solvency ratio calculation.

Calculate the funded status of the plan on a going concern basis at January 1, 2022

Actuarial Value of Assets (AVA) Calculation

Discount rate (DR)	5.7%	5.7%	5.7%
	2019	2020	2021
January 1 market value of assets:*	1,250,000	1,346,700	1,048,000
Employer normal cost contribution:	16,500	17,000	18,000
Employer special payments:	60,000	70,000	95,000
Benefit payments:	(94,000)	(96,000)	(98,000)
Transfer in from insurer:	54,200	55,300	55,700
Administration expenses:	(40,000)	(45,000)	(42,000)
Investment return:*	100,000	(300,000)	30,000
December 31 market value of assets:*	1,346,700	1,048,000	1,106,700

2. Continued

Cash Flow (CF) = Contributions + Tramsfer in - Benefit payments - Admin expenses	(3,300)	1,300	28,700
Expected investment return = [Asset (beg) + CF/2] x DR	71,156	76,799	60,554
Asset gain and (loss) = Expected investment return - Actual investment return	28,844	(376,799)	(30,554)

	Gain and (loss)	Percent deferred	Percent Recognized	Deferred Amount
2021 gain and (loss)	(30,554)	66.7%	33.3%	(20,369.30)
2020 gain and (loss)	(376,799)	33.3%	66.7%	(125,599.65)

AVA at 1/1/2022 = MV at Dec 31, 2021 – total deferred amount
= $1,106,700 – [-$145,969]
= **$1,252,669**

Total GC Value of Asset = AVA at 1/1/2022 + Buy-in contract value
= $1,252,669 + $850,000
= **$2,102,669**

Going concern liabilities:	*indexed*	*non-indexed*
Active members	1,198,000	963,000
Retired members	663,000	549,400
Subtotal	**1,861,000**	**1,512,400**
PfAD = non-indexed liabilities x PfAD %	136,116	
Insured liabilities	850,000	
Total Going Concern Liability	**2,847,116**	

Going concern Value of Assets	2,102,669
Going concern liabilities:	2,711,000
PfAD	136,116
Total	**2,847,116**
Going concern excess/(shortfall) at 1/1/2022	**(744,447)**
Going Concern Funded Ratio at 1/1/2022	74%

Calculate the funded status of the plan on a solvency basis at January 1, 2022

Market value of asset	1,106,700
Plan termination expenses:	(100,000)
Buy-in contract (solvency excludes indexation)	870,000
Solvency assets	**1,876,700**

Total solvency liability = sum of all liabilities (including insured pensioners)
= $1,242,100 + $678,000 + $870,000
= **$2,790,100**

Solvency assets	1,876,700
Total solvency liability	2,790,100
Solvency excess (shortfall)	**(913,400)**
Solvency ratio*	71%
*adding back windup expense in solvency ratio calculation	

2. Continued

(b) Calculate the minimum required employer contributions for 2022 and the new amortization payment schedule.

Commentary on Question:
Some candidates missed the one-year deferral period in calculating the present value of the existing (2022) going concern special payments.
The blended solvency ratio should be calculated excluding the insured liability.
Solvency special payment should be calculated on a reduced solvency ratio of 85%.

Total Employer Current Service Cost Contribution
Total normal cost (incl. indexation) = 13,000 + 38, 200 = $51,200
PfAD = total normal cost (excl. indexation) x PfAD % = [10,000 + 30,700] x 9% = $3,663
Total employer service cost contributions = $51,200 + $3,663 = **$54,863**

Total 2022 special payment = sum of going concern and solvency payments
= (1,000 + 1,500) x 12 = **$30,000**

2022 minimum required employer contributions	
Employer current service cost contributions	54,863
Special payments	30,000
Total	**84,863**

Blended solvency rate* = [Transfer value discount rate x Active members solvency liability + Annuity purchase discount rate x retired members solvency liability]/ [total liabilities]
= [2.1% x 1,242,100 + 3.0% x $678,000]/[$1,242,100 + $678,000]
=2.42%
* calculated excluding the insured annuities
* weighted using active vs. inactive liabilities given breakdown of liabilities using transfer rate vs. annuity purchase rate was not provided

Going concern excess/(shortfall) = **($744,447)**
Solvency excess/ (shortfall) = ($913,400)
Reduced Solvency excess/ (shortfall) = Solvency asset – 85% x Solvency liability
= $1,876,700 – 0.85 x $2,790,100
= (**$494,885)**

Existing Special Payments Schedule (from previous valuation schedule)

Type	Start	End	Monthly amount	GC Period	Solvency Period	GC PV per annum (using 5.7%)	Solvency PV per annum (using 2.42%)
GC One	1/1/2021	12/31/2021	1,800	-		-	
GC Two	1/1/2022	12/31/2031	1,000	120	60	91,907	56,496
Solvency One	1/1/2022	12/31/2026	1,500		60		84,744
					120	91,907	141,239

New Special Payment Schedule

Type	Start	End	Monthly amount	GC Period	Solvency Period	GC PV per annum	Solvency PV per annum
Existing GC	1/1/2022	12/31/2022	1,000	12	12	11,647	11,846
New GC	1/1/2023	12/31/2032	8,427.74	120	60	732,800	464,881
Solvency One	1/1/2022	1/30/2023	1,500		12.3		18,158
						744,447	494,885

2. Continued

New Going Concern Special payment of $8,428 was calculated using discount rate of 5.7% per annum (i.e., 0.46% per month) and amortization period of 10 years (i.e., 120 months), taking into account 1-year of existing going concern special payment.

Note that the end period for the existing solvency special payment schedule has been reduced based on the reduced solvency shortfall and the existing/new going concern special payments.

New amortization Schedule

Type	Monthly amortization payment	Date established	Start date	Date of last payment
Going concern One	1,000	12/31/2020	1/1/2022	12/31/2022
Going concern Two	8,428	12/31/2021	1/1/2023	12/31/2032
Going concern Three	-	-	-	-
Solvency One	1,500	12/31/2021	1/1/2022	1/30/2023
Solvency Two	-	-	-	-
Solvency Three	-	-	-	-

(c) Calculate the funded status of the plan on going concern and solvency bases at January 1, 2023.

Commentary on Question:
Same comment as above for the AVA calculation. As for the liabilities, most candidates did well in the calculations of liabilities for inactive members, but some did not score well for the active liabilities due to incorrect projection of benefits/service, missing decrements.. Some candidates excluded the insured liabilities in the funded status calculation.

Calculate the liabilities for inactive members at January 1, 2023

ID	Status	Age	Actual Monthly Pension (indexed at 6.3%)	Factor GC (indexed)	Factor GC (non-indexed)	Factor Solv (non-indexed)	Going Concern Liability (indexed)	Going Concern Liability (non-indexed)	Solvency Liability (non-indexed)
3	Pensioner	61	1,276	15.68	12.62	15.05	240,017	193,177	230,373
4	Pensioner	70	2,658	12.69	10.68	12.45	404,684	340,585	397,031
5	Annuitant	66	1,913	14.11	11.63	13.70	323,977	267,034	314,563
6	Deceased	69	0				0	0	0

Calculate the liabilities for active members at January 1, 2023

For ID 1 - Calculation of going concern liability and normal cost:

Calculation of Final average earning (FAE) and projected pension benefit at each decrement

	Actual earnings/projected earnings at 2.5%					
Age	Year-2	Year - 1	Year - 0	Final Average Earning (FAE)	Service	Projected pension (1.8%xFAExSvc)
45	83,000	85,000	85,000	84,333	5	7,590
50	91,536	93,824	96,170	93,843	5	8,446
62	123,105	126,183	129,338	126,209	5	11,359
65	132,571	135,885	139,282	135,913	5	12,232

Age	Years to decrement	tPxV calculation = [Product of all (1-qxT)(1-qxR)]/[(1+DR)^years to decrement]	tPxV
45	0	1/(1+DR)^0 =1/(1+6.5%)^0	1
50	5	[(1-5%)(1-0%)]/[(1+6.5%)^5]	0.6934
62	17	[(1-5%)(1-0%)(1-1.8%)(1-0%)]/[(1+6.5%)^17]	0.3198
65	20	[(1-5%)(1-0%)(1-1.8%)(1-0%)(1-0%)(1-50%)]/[(1+6.5%)^20]	0.1324

2. Continued

AL(x) = tPXv * Qx * B(x) * annuity(r)

Where B(x) is the projected pension calculated above times ERF. ERF = 100% at termination since plan provides deferred pension starting at age 65 at termination or early commencement from age 55 on an actuarially equivalent basis.
ID1 will be entitled to unreduced pension at age 62 based on plan provision [i.e., retire with 10 or more years of service]

At age 45, indexed factor for deferred pension = 14.44/ [1.065^(65-45)] = 4.0980
At age 50, indexed factor for deferred pension = 14.44/ [1.065^(65-50)] = 5.6147
At age 62/65, ID1 will be entitled to immediate pension.

NC(x) = AL(x) / Svc(x)
NC (indexed) = 53,482/5 = 10,696
NC (non-indexed) = 43,545/5 = 8,709

	Age	Years to Decrement	Projected FAE	Projected pension	ERF	QxT	QxR	tPxV	Factor (indexed)	Factor (non-indexed)	AL (indexed)	AL (non-indexed)	Projected pension (NC)	NC (indexed)	NC (non-indexed)
Termination	45	0	84,333	7,590	100%	5%	0%	1.0000	4.10	3.36	1,555	1,276	9,108	311	255
Termination	50	5	93,843	8,446	100%	1.80%	0%	0.6934	5.61	4.61	592	486	10,135	118	97
EURA	62	17	126,209	11,359	100%	0%	50.00%	0.3198	15.39	12.44	27,953	22,595	13,631	5,591	4,519
NRD	65	20	135,913	12,232	100%	0%	100%	0.1324	14.44	11.85	23,382	19,188	14,679	4,676	3,838
											53,482	**43,545**		**10,696**	**8,709**

ID1 - Calculation of solvency liability:
ID1 is under the age of 55 and member's benefit is assumed to be settled by commuted value. ID1 is not entitled to early retirement subsidy at termination and therefore, liability is calculated on an actuarial equivalent basis.

Age	FAE3	Accrued pension	Non-Indexed LS Factor	AL (non-indexed)
55	84,333	7,590	11.10	45,844
56	84,333	7,590	10.47	45,844
57	84,333	7,590	9.88	45,844
58	84,333	7,590	9.31	45,844
59	84,333	7,590	8.77	45,844
60	84,333	7,590	8.26	45,844
61	84,333	7,590	7.77	45,844
62	84,333	7,590	7.31	45,844
63	84,333	7,590	6.86	45,844
64	84,333	7,590	6.44	45,844
65	**84,333**	**7,590**	**6.04**	**45,844**

For ID2 - Calculation of going concern liability and normal cost:
Similar methodology as above

Member ID	ID2		2020	120,000											
Current age	63		2021	140,000											
Service	30		2022	143,500											
	Age	Years to Decrement	Projected earnings	Projected pension	ERF	QxT	QxR	tPxV	Factor (indexed)	Factor (non-indexed)	AL (indexed)	AL (non-indexed)	Projected pension (NC)	NC (indexed)	NC (non-indexed)
EURA	63	0	134,500	72,630	100%	0%	0%	1.0000	15.08	12.25	0	0	75,051	0	0
NRD	65	2	147,117	79,443	100%	0%	100%	0.8817	14.44	11.85	1,011,407	829,998	82,092	33,714	27,667
											1,011,407	**829,998**		**33,714**	**27,667**

For ID2 - Calculation of solvency liability:
ID2 is entitled to earliest unreduced pension at current age (63), liability is therefore optimal at age 63.

2. Continued

	Age	FAE3	Reduction	Accrued pension	Non-Indexed AP Factor	AL (non-indexed)
EURA (also Optimal age)	63	134,500	0	72,630	14.53	**1,055,314**

Going concern funding target		
Going concern liabilities:	*indexed*	*non-indexed*
Subtotal (AL of ID1, ID2, ID3, ID4)	**1,709,590**	**1,407,305**
PfAD (9%* 1,407,305)	126,657	
Insured liabilities (ID5)	323,977	
Total	**2,160,224**	

Actuarial Value of Assets (AVA) Calculation [same methodology as in part (a)]

Expected return on asset	5.7%	5.7%	5.7%
	2020	2021	2022
January 1 market value of assets:*	1,346,700	1,048,000	1,106,700
Employer normal cost contribution:	17,000	18,000	54,863
Employer special payments:	70,000	95,000	30,000
Benefit payments:	(96,000)	(98,000)	(84,000)
Transfer in from insurer:	55,300	55,700	39,600
Administration expenses:	(45,000)	(42,000)	(45,000)
Investment return:*	(300,000)	30,000	190,000
December 31 market value of assets:*	1,048,000	1,106,700	1,292,163
Cash Flow	1,300	28,700	(4,537)
Expected investment return	76,799	60,554	62,953
Asset gain and (loss)	(376,799)	(30,554)	127,047

	Gain and (loss)	Percent deferred	Percent Recognized	Deferred Amount
2022 gain and (loss)	127,047	66.7%	33.3%	84,698
2021 gain and (loss)	(30,554)	33.3%	66.7%	(10,185)

AVA at 1/1/2023 = MV at Dec 31, 2022 – total deferred amount
= $1,292,163 –$74,514
= **$1,217,649**

Total GC Value of Asset = AVA at 1/1/2023 + Buy-in contract value
= $1,217,649 + $323,977*
= **$1,541,626**

*Going concern liability (indexed) for buy-in annuitant (ID5), see calculation above.

Market value of asset	1,292,163
Windup expense	(100,000)
Buy-in contract	314,563
Solvency assets	**1,506,726**

Present value of accrued benefits for:	
Active members	1,101,158
Retired members	627,404
Insured annuities	314,563
Total solvency liability	**2,043,124**

2. Continued

Going concern value of assets	1,541,626
Going concern liabilities	2,033,567
PfAD	126,657
Total	**2,160,224**
Going concern excess/(shortfall) at 1/1/2023	**(618,598)**
Solvency assets	1,506,726
Total solvency liability	2,043,124
Solvency excess (shortfall)	**(536,398)**

(d) Calculate the minimum required employer contributions for 2023 and the special payment schedule resulting from the valuation.

Commentary on Question:
Similar comment as in part (b).

2023 employer minimum contribution requirements	
Employer current service cost contributions	47,684
Special payments	101,133
Total	**148,817**

2023 special payment = 8,427.74 x 12

Amortization schedule:

Type	Monthly amortization payment	Date established	Start date	Date of last payment
Going concern One	8,428	12/31/2020	1/1/2023	12/31/2023
Going concern Two	6,241	12/31/2021	1/1/2024	12/31/2033
Going concern Three	-	-	-	-
Solvency One		-	-	-
Solvency Two	-	-	-	-
Solvency Three	-	-	-	-

Intermediate steps:

Blended solvency rate*
= [4.3% x 1,101,158 + 4.9% x $627,404]/[$ 1,101,158 + $627,404]
=**4.52%**
* calculated excluding the insured annuities
* weighted using active vs. inactive liabilities
* Full points will be given for candidates calculating the blended solvency rate weighted on liabilities (as calculated from part c) using transfer rate vs. annuity purchase rate.

From part (c)

GC liabilities indexed without buy in	1,709,590
GC liabilities non-indexed without buy in	1,407,305
GC Buy-In	323,977
Solvency liabilities non-indexed without buy in	1,728,561
Solvency buy-in	314,563
Normal Cost indexed	44,410
Normal Cost non-indexed	36,376

2. Continued

Calculate minimum required contributions	2023
Total Normal Cost	44,410
PfAD on Non-Indexed CSC (9% x 36,376)	3,274
Total Employer Current Service Cost Contributions	**47,684**

Going Concern excess/(shortfall)	(618,598)
Solvency excess/(shortfall)	(536,398)
Reduced Solvency excess/(shortfall) = 1,506,726 - 0.85* 2,043,124	(229,930)

Existing GC special payment schedule

Type	Start	End	Monthly amount	GC Period	Solvency Period	GC PV per annum (using 6.5% p.a.)	Solvency PV (using 4.52% per annum)
GC One	1/1/2023	12/31/2032	8,428	120	60	1,404,926	564,834
					60	1,404,926	564,834

New special payment schedule

Type	Start	End	Monthly amount	GC Period	Solvency Period	GC PV per annum	Solvency PV per annum
Existing GC	1/1/2023	12/31/2023	8,428	12	12	97,757	98,749
New GC	1/1/2024	12/31/2033	6,241	120	60	520,434	320,876
						618,191	419,625

New Going Concern Special payment of $6,241 was calculated using discount rate of 6.5% per annum (i.e., 0.53% per month) and amortization period of 10 years (i.e., 120 months), taking into account 1-year of existing going concern special payment.

No solvency special payment is required based on the reduced solvency shortfall and the existing/new going concern special payments.

(e) Assess the reasonableness of the gain/(loss) analysis completed by your analyst below:

Source	Gain/(loss) amount
Investment return	127,000
Mortality	500,000
Inflation	70,000
Retirement	(130,000)
Salary	(10,000)

Commentary on Question:
Candidates would have received full marks on this part if they commented on 1) whether the gain/loss sign is correct/incorrect; 2) reasonableness of the magnitude of the gain/loss; 3) provided supporting rationale (could be descriptions) to assess the reasonableness of the gain/loss analyses.
Many candidates did not do well in this part.

2. Continued

Source	Gain/ (Loss)	Actuary's comment
Investment return	127,000	**Correct/ Gain/ magnitude is reasonable** Investment gain adequately reflect a gain of 17% vs 5.7%; 2/3 of Gain in 2023 will be deferred and 1/3 of past loss will be recognized in 2023. We would expect the investment experience after smoothing on GC to reflect a smaller gain for the period
Mortality gain	500,000	**Incorrect/ should be a small loss.** Buy-in annuitant's death is not reflected as plan's mortality experience. All other members remain in the plan, there should be no mortality gain but a small mortality loss given members' age are still relatively young.
Inflation	70,000	**Incorrect/ should be a small loss** Both sign and amount are incorrect. Inflation experience should be a loss on two retirees' liability. The buy in member's experience should be not be included, the actual loss is smaller than 70K.
Retirement	(130,000)	**Incorrect/ should be a gain** The sign is incorrect. Retirement experience is expected to be a gain as active defer retirement by one year roughly equal to 1 year of benefit payment minus the additional pension amount accrued
Salary	(10,000)	**Incorrect/ should be a small gain.** 2022 salary experience is incline with assumption for ID 2 (salary increased by 2.5%) and salary for ID 1 is unchanged The salary experience dollar amount is expected to be small.

Investment return

MVA 2021.12.31	1,106,700
Expected return rate	5.70%
Pension payment	(84,000)
Expected contribution	84,863
Transfer In	39,600
Administration expenses	(45,000)
Expected return	62,953
Actual Investment gain	190,000
Investment Gain	127,047

Expected return = MVA 2021.12.31 * 5.7% + sum of cash flow * 5.7% /2
= 1,106,700 * 5.7% + [(84,000)+84,863+39,600-45,000]*5.7%/2
= $62,953

Investment gain = actual gain – expected return = 190,000 – 62,953 = $127,047

Mortality experience

Estimated Expected liability at 1/1/2023	492,152	rollforward liability with six month benefit payment with interest rate. This buy-in retiree died mid year, no further liability.
Actual liability at 1/1/2023	0	
Mortality Gain/(loss)	492,152	However, this gain is from a buy-in retiree's death, no gain/loss on insured liabilities

Estimated expected liability (ID6) = pben x 12 x annuity x (1+DR) – 6 x pben x (1+DR) ^0.5
= 3,000 x 12 x 13.42 x (1.057) – 6 x 3,000 x (1.057) ^0.5
= 492,152

Inflation

loss on the non-insured annuities only

Expected inflation: 2.0%
Actual inflation: 6.3%

ID	monthly pension	Expected monthly pension	Actual monthly pension	Gain/(loss) = [expected pension - actual pension] x annuity
3	1,200	1,224	1,276	(9,709)
4	2,500	2,550	2,658	(16,370)
			Inflation loss	**(26,079)**

2. Continued

Retirement
ID2 could have retired at age 62 but did not.
Gain on deferred retirement by 1 year (not paying for pension plus member's aging by one year, offset by one more year of accrual)

NC = 38,200
Estimated pension amount = projected pension at age 63 x 29 year of service/ 30 year of service
= $72,630 x 29/30 = 70,209
Rough estimate gain/(loss) = 70,209 – 38, 200 = $32, 009

Salary

	Expected liability (*use solution b) to estimate by changing 2022 salary to expected salary*)	Actual GC liability	Gain/(loss)	
ID1	54,794	53,482	1,311	
ID2	1,011,407	1,011,407	0	none since actual salary increase is 2.5% which is inline with assumptions
		Salary gain	**1,311**	

3. 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 35 – 3.3 and 3.5

Commentary on Question:

This question was meant to test the candidates' ability to assess demographic assumptions based on standards of practice and recommend changes to those assumptions following significant plan provision changes. Most candidates were able to successfully assess the assumption in part a) as expected. The key to the assessment was the credibility of the plan experience and how that influences the assessment. Many Candidates struggled with part b) and fully articulating how the changes to the settlement and retirement assumption would be necessary following the provision changes. Full marks were given for part b where the candidate was able to recommend an assumption change and the rationale for the change.

Solution:

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

Commentary on Question:

Commentary on part (a), if appropriate. Click here to enter text.

In general for all 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 also assess the reasonableness of an assumption by ensuring it is appropriate for the purpose of the measurement.

With regards to the **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 and do extend to age 71.
  - the retirement rates are higher for age 61 – 64.
- The assumption should take into consideration plan design. Given the early retirement subsidies, the assumption may need to be revised to better reflect plan experience.

3. Continued

- The plan does not provide an unreduced pension and does allow members to retire as late as age 71.
- The actuary should consider extending the retirement assumption to cover the full period of retirement (i.e. age 55 to 71) to better reflect actual plan experience.
- 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.

With regards to the **Termination Assumption:**

- Given that the plan experience is <u>not credible</u> for termination scale, the actuary should consider all the relevant assumption universe, including:
  - 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 and settlement election assumption. Justify your recommendation.

Commentary on Question:
Commentary on part (b), if appropriate. Click here to enter text.

Retirement Assumption:

This is a significant change to the early retirement provision and it is expected that members above and below 85 points will react differently. The provision change should result in a different retirement assumption. It is recommended to update the retirement assumption to either a points-based or an age and continuous service-based table. The assumption should consider both a member's age and their service as it is anticipated to impact experience.

3. Continued

Retirement rates should increase for those members who have 85 points or more. In the absence of plan specific experience for the new early retirement provisions, rates from published tables based on experience under uninsured plan and annuity contracts or based on any other populations considered representative of the group at hand should be used.

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

Settlement election Assumption:

This is a significant provision change for retirement eligible members. It is recommended to update the settlement election assumption to include an assumption for ages above 55 (retirement eligible).

As this is a new provision, there is no credible experience. Instead look to other sources of information representative of the group at hand, including but not limited to, experience studies or published tables, studies, reports or general trends. Also can consider the current settlement elections assumed on a hypothetical wind-up basis.

This change in plan provision would allow for members to elect a lump sum transfer after age 55 and there is expected to be an increase in members electing a lump sum based on actuarial judgement. It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data

Based on industry experience, I would recommend including a settlement assumption of 45%-50% for those members over 55.

4. Learning Objectives:

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

Learning Outcomes:

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

Sources:

Pension Mathematics for Actuaries, Anderson, Arthur W., 3rd Edition, 2006

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) Calculate the smoothed value of assets as at January 1, 2023 using the two asset smoothing methods under consideration.

Commentary on Question:

Most candidates were familiar with Method 1 and performed well. Candidates struggled with Method 2 and many candidates did not attempt this part of the question.

Method 1:

Net Investment gain/(loss) 2022:	16,225 = 17,243-1,018
Smoothed value of assets (pre-corridor):	122,264.5 = 30,377-1/2*16,225
Corridor:	
Low – 95%	123,858.2 = 130,377*0.95
High – 105%	136,895.9 = 130,377*1.05
Smoothed value of assets (post-corridor):	123,858.15 =MIN(MAX(122,264.5,123,858.15),136,895.85)

4. Continued

Method 2: *This solution uses simple interest, but compound interest could be used.*

	2019	2020	2021	2022	2023
1/1/2019	**87,153**				
CF	(316)				
Interest Rate	5.75%				
Interest	5,002				
12/31/2019	**91,839**				
1/1/2020	**91,839**	**102,193**			
CF	(6,394)	(6,394)			
Interest Rate	5.25%	5.25%			
Interest	4,654	5,197			
12/31/2020	**90,099**	**100,996**			
1/1/2021	**90,099**	**100,996**	**106,990**		
CF	(3,691)	(3,691)	(3,691)		
Interest Rate	5.25%	5.25%	5.25%		
Interest	4,633	5,205	5,520		
12/31/2021	**91,041**	**102,511**	**108,819**		
1/1/2022	**91,041**	**102,511**	**108,819**	**118,869**	
CF	(3,771)	(3,771)	(3,771)	(3,771)	
Interest Rate	5.25%	5.25%	5.25%	5.25%	
Interest	4,681	5,283	5,614	6,142	
12/31/2022	**91,951**	**104,023**	**110,662**	**121,240**	
1/1/2023	**91,951**	**104,023**	**110,662**	**121,240**	**130,377**

Smoothed value of assets = AVERAGE(91,951, 104,023, 110,662, 121,240, 130,377) = 111,650

(b) Compare and contrast the two asset smoothing methods taking into consideration the Canadian Institute of Actuaries' guidance on asset valuation methods.

Commentary on Question:
Generally, candidates did not perform well on this part of the question. Most candidates did not provide enough answers to obtain full credit.

	Method 1	Method 2
Achieves Objectives	Method is expected to smooth the fluctuations in assets from year to year. However the smoothed asset value will be very close to the market value and the method may not adequately mitigate the impact of market volatility on the Company's contribution requirements to	Method is expected to smooth the fluctuations in assets from year to year.

	the plan because: 1) the period over which realized gains/losses are recognized is short, 2) the corridor is small/tight and 3) unrealized gains/losses are not being smoothed	
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.
Does not unduly deviate from market value	Isn't expected to deviate significantly from market value. Restricts the potential for undue deviation through the use of a "corridor".	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.
Generally free of bias	Method is generally free from any bias. It uses a symmetrical corridor.	Method is generally free from any bias. Uses an expected return assumption equal to the going concern discount rate (principles underlying the determination of an appropriate expected return assumption should be similar and/or consistent to the principles underlying the determination of an appropriate going concern interest rate assumption).
Has no undue influence on investment decisions and vice versa	Smooths unrealized gains and losses only; May influence the decision to liquidate certain asset positions based on the impact it would have on the smoothed asset value.	Does not have influence on investment decisions
Is consistent with the length of typical economic cycles	Inappropriate. The smoothing period is only 2 years	Appropriate. The smoothing period is within a typical economic cycle of 5 years

6. 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:

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

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

Sources:

Guidance for Assumptions for Hypothetical Wind-Up and Solvency Valuations with Effective Dates on or after December 31, 2022, and no later than June 29, 2024, CIA Educational Note Supplement, Mar 2023

Calculation of Incremental Cost on a Hypothetical Wind-Up or Solvency Basis, CIA Educational Note, Apr 2023

Commentary on Question:

This question tests the candidate's ability to calculate Solvency Incremental Cost (SIC) and to describe the considerations in setting the SIC projection assumptions.

Candidates in general performed better in part (a) than in part (b). For part (a), some candidates did not perform the Age/Service test and Optimal Retirement Age test to receive full points. Most candidates were not able to discount liabilities at different discount rates for the two members from Time 1 to Time 0. For part (b), most candidates did not come up with enough aspects and details to receive full points.

Solution:

(a) Calculate the 2023 solvency incremental cost (SIC).

Member A (Age 49, Service 5)

Time 0 (January 1, 2023) Calculations

Points = Age + Service

Age	49
Service	5
Points	54

No grow-in as less than 55 points

Actuarially reduced from age 65 (assume Member A retires at age 65)

FAE3 (2020-2022) = ($70,000 + $73,000 + $75,000) / 3 = $72,667

Accrued Pension = 2% x $72,667 x 5 = $7,267

Solvency Liability at Time 0 (January 1, 2023)
= Accrued Pension x Annuity Factor (age 49 deferred for 16 years, at 5%)
= $7,267 x 5.78 = $42,001

Time 1 (January 1, 2024) Calculations

Points = Age + Service
Age 50
Service 6
Points 56
Grow-in to Early Retirement Subsidies because > 55 points

FAE3 (2021-2023) = ($73,000 + $75,000 + ($75,000 x 1.03)) / 3 = $75,083

Accrued Pension = 2% x $75,083 x 6 = $9,010

Optimal retirement age test required (ages 55-65)
Maximum Value = Age 55 = $87,001
Unreduced Age = Age 60 = $78,117
$87,001*.5 + $78,117 *.5 = $82,559

Age	Deferral	Ret Age	A. Reduction (4%/yr from 60)	B. Factor (5%)	C. Accrued Pension	Solvency Liability [(1-A) x C x B]
50	5	55	20%	12.07	9,010	87,001
50	6	56	16%	11.32	9,010	85,674
50	7	57	12%	10.60	9,010	84,045
50	8	58	8%	9.92	9,010	82,229
50	9	59	4%	9.23	9,010	79,836
50	10	60	0%	8.67	9,010	78,117
50	11	61	0%	8.09	9,010	72,891
50	12	62	0%	7.54	9,010	67,935
50	13	63	0%	7.02	9,010	63,250
50	14	64	0%	6.53	9,010	58,835
50	15	65	0%	6.06	9,010	54,601

Discount Liability at Time 1 (January 1, 2024) back by 5%
= $82,559 / 1.05 = $78,627

Solvency Incremental Cost at Time 0 (January 1, 2023)
= $78,627 – $42,001 = $36,626

Member B (Age 60, Service 30)

Time 0 (January 1, 2023) Calculations

Points = Age + Service
Age 60
Service 30
Points 90
Grow-in to Early Retirement Subsidies because > 55 points

Accrued Pension = 2% x FAE3 x Credited Service
= 2% x (($90,000 + $95,000 + $98,000) / 3) x 30 = $56,600

Optimal retirement age test required (ages 60-65)
Maximum Value = Unreduced Age = Age 60 = $912,392

Age	Deferral	Ret Age	A. Reduction (4%/yr from 60)	B. Factor (4%)	C. Accrued Pension	Solvency Liability [(1-A) x C x B]
60	0	60	0%	16.12	56,600	912,392
60	1	61	0%	15.14	56,600	856,924
60	2	62	0%	14.20	56,600	803,720
60	3	63	0%	13.30	56,600	752,780
60	4	64	0%	12.45	56,600	704,670
60	5	65	0%	11.63	56,600	658,258

Time 1 (January 1, 2024) Calculations

Optimal retirement age test required (ages 61-65)
Maximum Value = Unreduced Age = Age 61 = $959,812

Age	Deferral	Ret Age	A. Reduction (4%/yr from 60)	B. Factor (4%)	C. Accrued Pension	Solvency Liability [(1-A) x C x B]
61	0	61	0%	15.80	60,748	959,812
61	1	62	0%	14.82	60,748	900,279
61	2	63	0%	13.89	60,748	843,784
61	3	64	0%	12.99	60,748	789,111
61	4	65	0%	12.14	60,748	737,476

Solvency Incremental Cost at Time 0 (January 1, 2023)
= $959,812 / 1.04 – $912,392 = $10,504

Total SIC

Total Solvency Incremental Cost at Time 0 (January 1, 2023) for Members A & B
= $36,626 + $10,504 = $47,130

(b) Describe the considerations in setting the SIC projection assumptions.

Benefit payments: The assumptions for the expected benefit payments in the first element and decrement probabilities, service accruals, and projected changes in benefits and/or pensionable earnings in the second element would be consistent with the assumptions used in the pension plan's going concern valuation between time 0 and time t, if such a valuation were to be conducted as of time 0. Alternatively, if the actuary considers such experience to be different from the longer term expected experience assumed for a going concern valuation, he/she may reflect expected experience between time 0 and time t.

Discount rate: The interest rate to be used to discount from time t to time 0 for both the first and second elements would be the interest rate used to determine the hypothetical wind-up or solvency liability at time 0. However, if this rate is a real interest rate (net of inflation), use of a corresponding nominal interest rate would be appropriate. Where there is more than one interest rate used for the hypothetical wind-up or solvency liability of a member at time 0 (e.g., because there are probabilities assigned to the method of settlement), the projected liability would be split into these same components and discounted to time 0 using the interest rate inherent in each component.

Decrementing: Active and inactive plan members as of time 0 and assumed new entrants over the period between time 0 and time t would generally be considered in calculating the incremental cost. For active members, projected hypothetical wind-up or solvency benefits at time t would reflect the value of a deferred or immediate pension to which a member is expected to be entitled based on the assumed probabilities of termination or retirement between time 0 and time t.

Assumptions used at time 0 and t: The assumptions used to calculate the projected liability at time t in the second element would generally be consistent with the assumptions for the hypothetical wind-up or solvency liability at time 0, assuming that interest rates remain at the levels applicable at time 0, that the select period is reset at time t for interest rate assumptions that are select and ultimate (e.g., at time t the select period would be reset to 10 years for interest rates established in accordance with the Standards of Practice for the calculation of commuted values), and that the Standards of Practice for the calculation of commuted values and the guidance for estimated annuity purchase costs in effect at time 0 remain in effect at time t.

6. Continued

Benefit improvements (scheduled increases): In certain circumstances, a non-zero incremental cost could be generated for inactive plan members. For example, an expected change between time 0 and time t in the benefits provided to inactive members that is not reflected in the liability at time 0 (e.g., a scheduled increase in the monthly pensions of retired members) would generally result in a non-zero incremental cost for the inactive plan members.
Benefit improvements (pending amendment): The incremental cost would include the effect of a pending amendment to the pension plan, consistent with paragraph 3210.19 of the Standards of Practice.

Approximations: Considering materiality and subsection 1510 of the Standards of Practice, approximations may be used, among others, in respect of

- if the method of settlement is expected to be different at time t than it was at time 0, the projected hypothetical wind-up or solvency liability for a member could be valued based on the settlement method at time 0, with discounting of the liability using the corresponding interest rate(s),

- if the solvency basis includes smoothing of interest rates, the projected solvency liability could be valued using the same smoothed interest rates applicable at time 0,

- decrements and/or assumed new entrants between time 0 and time t could be ignored, and

- the projected hypothetical wind-up or solvency liability at time t, discounted to time 0, could be calculated at time 0, but using the data expected at time t.

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:

(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 GC valuations, ASOP 27, CSOP 3100 - 3500

Commentary on Question:

This question was testing knowledge of components of different valuation assumptions and their interaction in a high inflation rate environment. Part a) was answered well by candidates with most candidates correctly identifying different approaches to calculate going concern discount rates. Some candidates lost points on expenses by not identifying expense assumptions can be explicit or implicit. Candidates struggled in part b). Most did not recognize the impact of high inflation on the going concern/wind-up discount rates. Most candidates also did not identify the higher expense assumption projection due to inflation, or the change in retirement behavior leading to delayed retirement.

Solution:

(a) Describe the considerations for setting the following going concern valuation assumptions for a pension plan:

(i) Discount rate

(ii) Inflation rate

(iii) Average Industrial Wage growth

(iv) Salary scale

(v) Plan expenses

7. Continued

All assumptions developed should be internally consistent within a plan and also throughout the various plans of ABC Company (e.g. there should be a singular view of the future levels of inflation).

Discount Rate

- A long-term compounded annualized expected rate of return on the plan's invested assets, typically a single effective discount rate. An acceptable approach is the building block approach which should reflect the plan's specific asset allocation on the valuation date as well as any future anticipated changes in asset allocation. The rate development should use the expected rate of return on the various asset categories, weighted by the plan's target asset allocation, plus an additional return related to rebalancing and diversification.
- An alternative approach to the building block approach is to use the yields on high quality fixed income investments, considering expected future benefit payments from the pension plan. The resulting discount rate in this case would be independent of the plan's invested assets.
- Consideration:
    - Building block should consider inflation consistent with long-term inflation assumption. Care should be taken in setting asset return assumptions for inflation linked assets that may be more volatile in a high inflation environment.

Inflation Rate

- Should reflect long-term expectations, typically through a singular rate. A select and ultimate rate should be considered in the current high inflation environments.
- The inflation assumption could be used as a building block component in the development of the wage growth, salary scale, and discount rate assumptions.
- Considerations:
    - Inflation assumption to be used as basis of pension indexation linked to CPI escalations.
    - Should consider a select / ultimate rate to avoid large experience losses in short-term during high inflation environment.

Average Industrial Wage Growth

- Applicable to determine Income Tax Act (ITA) maximums, Years' Maximum Pensionable Earnings (YMPE). Reflect long-term expectations of economic growth for the broad economy.
- Consideration: Assumption to be consistent with development of inflation assumption.

7. Continued

Salary Scale

- Salary scale assumption should reflect the long-term annualized rate of salary increase expected for the plan population. Should be developed using a building block approach, based on underlying expectation for inflation, average wage growth assumption and merit/promotion, as a single effective rate or table of rates varying by age and/or service.
- Should be developed taking into account historical plan experience and management's expectations for the future for the plan population.
- Consideration:
    - Include assumption for bonus payout level where a company has historically paid below / above 100%.

Plan Expenses

- Should reflect expectation of ongoing future expenses payable from the plan, taking into account what expenses are paid from the plan vs. directly by the employer. Can be reflected as explicit provision for expenses (in normal cost), or implicitly (net out in discount rate).
- During periods of high inflation, expense assumptions should be updated to reflect the likely increase in expenses, in particular explicit assumptions.

(b) Explain how the high inflation environment could impact the plans' going concern and hypothetical wind-up liabilities.

Impact on going concern liabilities:

- High inflation environment can impact the going-concern discount rate (bond yields, equities return assumption, return on inflation linked assets) – it may result in a higher going-concern discount rate which decreased going concern liabilities
- High inflation environment may results in higher inflation assumption or use of select / ultimate inflation rates, where select rate being higher reflecting current higher inflation. For indexed benefits linked to CPI increase, the impact is an increase in going concern liabilities
- High inflation environment can increase the AIW increase, ITA limit increase and salary scale assumptions (building blocks to inflation assumption) which in turn increases going concern liabilities
- High inflation environment can increase the YMPE increase assumption (building blocks to inflation assumption). For benefit formulas linked to YMPE with lower accrual rate below YMPE, it would decrease going concern liabilities
- High inflation environment may increase implicit plan expenses assumption which may in turn decrease going-concern discount rate and increase going concern liabilities

7. Continued

- High inflation environment may delay retirement decision. Delayed retirement may result in higher service accrual offset by lost in early retirement subsidies. If the retirement assumption is no changed, the impact can be an experience gain or loss in going concern liabilities at the next valuation

Impact on hypothetical wind-up liabilities:

- High inflation can impact the hypothetical wind-up/ solvency discount rates (CV discount rates and annuity proxy rates which are based on nominal and real return bond yields) – it may result in a higher discount rates which decreases hypothetical wind-up/ solvency liabilities
- High inflation environment may results in higher implied inflation in real return bond yields. For indexed benefits, the impact is an increase in hypothetical wind-up liabilities (given future indexation can only be excluded from solvency liabilities)
- High inflation can increase the AIW / ITA limit / YMPE / salary increase experience, however will only increase or decrease hypothetical wind-up liabilities when experience is reflected at next valuation
- High inflation may increase explicit plan termination expenses assumption used in determining hypothetical wind-up funded position, but no impact of hypothetical wind-up liabilities
- High inflation may delay retirement decision. Delayed retirement may result in higher service accrual offset by lost in early retirement subsidies. The impact can be an increase or decrease in hypothetical wind-up liabilities when experience is reflected at next valuation