DP-RC Model Solutions
Spring 2013

1. Learning Objectives:

2. The candidate will understand how the regulatory environment affects plan design and understand how to apply relevant restrictions.

9. The candidate will be able to understand principles and rationale behind regulation.

Learning Outcomes:

(9a) Describe the principles and motivations behind tax policy.

Sources:

Turner, *Pension Policy: The Search for Better Solutions*, 2009, Ch. 5

Watson Wyatt Canadian Pensions and Retirement Income Planning, 4th edition

Commentary on Question:

In this question, candidates were asked to demonstrate their understanding of how the tax policy influences employer and employee behavior.

A well-prepared candidate should to be able to explain how the tax policy can affect plan design, employee and employer contributions, investments, payouts and government revenue.

Solution:

(a) Describe tax policies that could be used to encourage employers to provide defined benefit pension plans.

Commentary on Question:

Part (a) was a straightforward list-type question. Candidates generally did well on this section, as long as they were aware of the sort of tax benefits the government provides for pension plans.

- Allow tax deduction for employer contributions to retirement plans
- Allow tax exemption of investment earnings on retirement vehicles
- Allow employee contributions to be tax deductible
- Reduce taxes on the withdrawal of surplus assets when the plan is funded over a certain level and not terminating
- Increase maximum amount of benefit/pay that can be provided in registered plan to cover more benefits on tax preferred basis

1. Continued

(b) Describe tax policies that could be used to encourage employees to save for retirement.

Commentary on Question:
Candidates generally managed to list the common incentives, which was similar to part (a). Only a few candidates were able to identify additional tax policies beyond the ones described in (a).

- Make provision for individual saving plans that allow for the following:
  - Tax deductible contributions
  - Tax free investment earnings
  - Tax free payouts

- Increase the amount of contributions or payout that is tax preferred

- Allow any contribution limits to carry over to future years to avoid loss of contribution room in years where employees have difficulty making the full contributions.

(c) Describe ways the government of Canada has mitigated the loss of tax revenue associated with (a) and (b).

Commentary on Question:
This question requires a full understanding of the methods by which the Income Tax Act limits the tax loss to the government of the pension system. However, only a few candidates were able to apply the Income Tax Act limits on benefits provided under registered pension plans to answer this question.

Government of Canada has mitigated the loss of tax revenue by:

- Setting maximum employer contributions limits to DB plans
  - Contributions must be recommended by an actuary
  - Limit service cost if large surplus
- Maximum deductible employee contributions to DB plan
- Maximum contributions to DPSPs
- Maximum contributions to MPPPs/DC Plans
- Employee and employer contributions must not exceed PA limit for the year
- Limit on benefits that can be provided in DB plans by
  - 2% limit on accrual of lifetime benefits
  - Limit on bridging benefits
  - Limit on early retirement benefits
  - Limit on death benefits

2. Learning Objectives:

10. The candidate will be able to analyze the relationship of plan investments with plan design and valuations.

Learning Outcomes:

(10b) Solve for a measure of investment performance relevant to a given benchmark.

Sources:

RD129-09, How the Liability Benchmark is Developed and Used in Practice

R-D123-07: Maginn and Tuttle, Managing Investment Portfolios, Third Edition, Chapter 12 through Section 7

Commentary on Question:

In this question, candidates were asked to demonstrate their understanding of asset-only and liability benchmarks. A well prepared candidate would be able to define, compare and contrast two benchmarks.

Solution:

(a) In an asset-only framework, macro attribution analysis is used to evaluate an asset manager's investment performance.

Describe the following components of macro attribution analysis:

(i) Risk-free asset.

(ii) Asset categories.

(iii) Net contributions.

Commentary on Question:

Most candidates were able to answer (i) and (ii) well. (iii) seemed to be more challenging. The key to Net Contributions macro attribution analysis is that it assumes the net cash flows are invested at 0%. Some candidates wrote that Net Contributions analysis shows how the fund is affected by the timing of contributions, which is incorrect.

(i) Risk-Free Assets macro attribution analysis assumes the fund's beginning value and its net external cash inflows are invested at the risk-free rates. The investment strategy is highly conservative and risk-averse and invests all assets in risk-free assets, such as 90-day Treasury bills. The fund's value increases by an additional amount over the value achieved under the Net Contributions investment strategy.

2. Continued

(ii) Asset Categories macro attribution analysis assumes the fund's beginning value and external cash flows are invested passively in a combination of the designated asset category benchmarks – a pure index or all-passive approach. The specific allocations to each benchmark are based on the plan sponsor's investment policy allocation.

Fund sponsors typically choose to allocate funds within an asset category among a number of active managers with different investment styles and therefore expose their assets to 2 additional sources of investment returns/risks – investment style and active management skills.

(iii) Net Contributions macro attribution analysis assumes the net flows are invested at a zero rate of return. Fund value changes simply by the net inflows (i.e. ending market value = beginning market value + net inflows). Net Contribution macro attribution analysis provides a useful baseline for performance analysis.

(b) In an asset-liability framework, a liability benchmark can be used to measure plan performance.

(i) Define a liability benchmark.

(ii) Describe how to create a liability benchmark.

Commentary on Question:
Most candidates were able to define a liability benchmark correctly.

For part (ii), most candidates were able to describe the steps of obtaining and discounting benefit cash flows. The alternative solution to this particular question is to create a liability index and replicate the benchmark using swap securities that comprise a specific curve used to discount liability cash flows.

(i) A liability benchmark represents the fair market value of a pension plan's obligations. It is similar to a standard market index that represents a collection of securities that can be used to analyze performance.
Each plan's benchmark is unique due to plan demographics, plan type, participant age, number of participants, etc. There are 6 characteristics of a market-based benchmark useful for comparison in formulation of a liability benchmark:

- Unambiguous
- Investable
- Measurable
- Appropriate

2. Continued

- Reflective of current investment options
- Specified in advance

(ii) Steps of creating a liability benchmark:

1) Obtain projected benefit cash flows – benefit payment profile might be based on ABOs or PBOs
2) Consider plan-specific factors such as economic and demographic assumptions, plan design and country-specific accounting rules and regulations
3) Discount cash flows to calculate present value using market based rates (e.g. full yield curve approach based on corporate or government yield curves).

(c) Compare and contrast a liability benchmark with an asset-only benchmark.

Commentary on Question:
The key concept here is that an asset-only benchmark only focuses on asset performance, while a liability benchmark focuses on plan liability and funded status. Most candidates were able to describe an asset-only benchmark correctly, but were not able to explain in detail how a liability benchmark is different from asset-only benchmark.

An asset-only benchmark is a blend of market indices, typically a policy benchmark (e.g. x% in equity, y% fixed income). It is intended to mirror the asset allocation established by the plan sponsor or trustee to compare asset-only results with the blended index performance. It only focuses on asset performance compared to the policy benchmark, not the plan's funded status.

A liability benchmark focuses on plan liability, and the asset performance is measured relative to movements in liabilities. It aligns the plan assets to make certain of benefit payments for the liabilities they are expected to support. It provides pension stakeholders with an accurate measure of the plan's funded status and ensures its survival/ongoing viability.

3. Learning Objectives:

5. The candidate will be able to apply/synthesize the various methods used to value a pension plan or retiree health plan for various purposes.

8. The candidate will be able to evaluate the actuarial considerations in plan options and administration.

Learning Outcomes:

(5b) Perform periodic valuations of ongoing plans, calculating normal cost and actuarial liability, using the variety of cost methods for budgeting, funding accounting and measuring economic value.

(5d) Perform valuations for special purposes, including:
- (i) Plan termination/windup
- (ii) Solvency valuations
- (iii) Open group valuations

(8b) Assess the impact of applicable regulation, including:
- Commuted value standard

Sources:

RD619-11 (Educational Note: Calculation of Incremental Cost on a Hypothetical Wind-Up or Solvency Basis)

RD612-12 (PBA Ontario)

RD600-12 (PBA Ontario - Regulation)

Pension Mathematics for Actuaries, Anderson, Third Edition, 2006, Ch. 1-4, 6, 7

Commentary on Question:

In this question, candidates were asked to calculate going-concern accrued liability and normal cost and solvency accrued liability and incremental cost, and to explain the differences between the normal cost and the incremental cost.

A well prepared candidate would have a good understanding of accrued liability and normal cost/solvency incremental cost calculations under the different valuation bases, using the different assumptions provided and using different possible cost methods.

A well prepared candidate would also have a good understanding of the actuarial standards behind calculating a solvency incremental cost, including the methodology to be used and the approximations allowed.

The areas many candidates did not do well were in not properly reflecting the termination assumption and in not accurately determining whether the active member is entitled to grow-in under the calculation of the solvency accrued liability.

3. Continued

Solution:

(a) Calculate the going-concern accrued liability and normal cost and solvency accrued liability at January 1, 2013.

Commentary on Question:

The cost method indicated for the going-concern liability was Unit Credit. The exact application of the method would require the use of the benefit rate at January 1, 2013 of $50. However, in practice, many actuaries will use the ultimate benefit rate to value the going-concern liability. For this reason the use of both the ultimate benefit rate ($52) and the current benefit rate ($50) were accepted.

Going-Concern Accrued Liability at 1.1.2013:

Active member

$= {}_{(60-43)}p_{43} * v^{(60-43)} *$ Monthly benefit at 1.1.2013 *12 * credited service * Early retirement reduction * $\ddot{a}_{60}$

$+ \sum$ prob(term)* $v^{(65-43)}$* Monthly benefit at 1.1.2013 *12 * credited service * Early retirement reduction * $\ddot{a}_{65}$

= 0.99* 0.99 * 1.055^(-17) * $50*12* 2 *0.85 *12.8

+ 0.01 * 1.055^(-22) * $50*12* 2 *1*11.4

+ (1- (0.99 * 0.99)-0.01) * 1.055^(-22) * $50*12* 2 *1*11.4

= $5,234

Alternate answer for the active member GC accrued liability:

The candidate could use a benefit rate of $52 per month for decrement after 1.1.2014 in the above answer.

$= {}_{(60-43)}p_{43} * v^{(60-43)} *$ Monthly benefit at 1.1.2014 *12 * credited service * Early retirement reduction * $\ddot{a}_{60}$

$+ \sum$ prob(term)* $v^{(65-43)}$* Monthly benefit at 1.1.2013 or 1.1.2014 *12 * credited service *

Early retirement reduction * $\ddot{a}_{65}$

= 0.99* 0.99 * 1.055^(-17) * $52*12* 2 *0.85 *12.8

+ 0.01 * 1.055^(-22) * $50*12* 2 *1*11.4

+ (1- (0.99 * 0.99)-0.01) * 1.055^(-22) * $52*12* 2 *1*11.4

= $5,441

Retired member

= Monthly benefit *12 * $\ddot{a}_{70}$

= $1,020 * 12 *9.9

= $121,176

Total GC accrued liability = $126,410

Under the alternate answer: Total GC accrued liability = $126,617

3. Continued

Going-Concern Normal Cost at 1.1.2013:

Going-concern Normal Cost at 1.1.2013
$= {}_{(60-43)}p_{43} * v^{(60-43)} *$ (Change in accrued benefit) * Early retirement reduction * $\ddot{a}_{60}$
$+ \sum$ prob(term)* $v^{(65-43)}$* (Change in accrued benefit) * Early retirement reduction * $\ddot{a}_{65}$
= 0.99* 0.99 * 1.055^(-17) *($52 *12 *3 - $50 *12 *2)*0.85 *12.8 + 0.01 * 1.055^(-22) * $50*12*1*11.4
+ (1- (0.99 * 0.99)-0.01) * 1.055^(-22) * ($52 *12 *3 - $50 *12 *2) * 1*11.4
= $2,928

Under the alternate answer:

$= {}_{(60-43)}p_{43} * v^{(60-43)} *$ Monthly benefit *12 * Early retirement reduction * $\ddot{a}_{60}$
$+ \sum$ prob(term)* $v^{(65-43)}$* Monthly benefit *12 * Early retirement reduction * $\ddot{a}_{65}$
= 0.99* 0.99 * 1.055^(-17) * $52*12*0.85 *12.8 + 0.01 * 1.055^(-22) * $50*12*1*11.4
+ (1- (0.99 * 0.99)-0.01) * 1.055^(-22) * $52*12* 1*11.4
= GC AL/ service = $5,441 /2 = $2,721

Solvency Accrued Liability at 1.1.2013:

Active member has 45 points, therefore not entitled to grow-in. The retirement age that produces the highest value is age 65 as values at all other retirement ages are calculated based on actuarial reduction.
Active member (valued at 3.5% for 10 years, 3.5% thereafter)
= v(65-43)* Monthly benefit *12 * credited service * Early retirement reduction * $\ddot{a}_{65}$
= 1.035^(-22) * $50 *12 * 2 *(1-0.03*0) *13.6
= $7,657

Retired member (valued at 3.3%)
= Monthly benefit *12 * $\ddot{a}_{70}$
= $1,020 * 12 *11.7
= $143,208

Total solvency accrued liability = $150,865

(b) Effective January 1, 2014, an ad hoc increase to pensions-in-pay of 1% per year will be granted. Calculate the Solvency Incremental Cost (SIC) for 2013.

SIC at 1.1.2013 =
1) the PV at 1.1.2013 of expected benefit payments between 1.1.2013 and 1.1.2014
= Monthly benefit *12 * v
= $1,020 * 12 /1.033
= $11,849

3. Continued

PLUS
2) A projected solvency liability at 1.1.2014, discounted to 1.1.2013
Active member (valued at 3.5% for 10 years, 3.5% thereafter)
= v(65-43)* Monthly benefit *12 * credited service * Early retirement reduction * $\ddot{a}_{65}$
= 1.035^(-22) * $52 *12 * 3 *(1-0.03*0) *13.6
= $11,944

Retired member (valued at 3.30%)
= $v^{(71-70)}$Monthly benefit *12 * $\ddot{a}_{71}$
= 1.033^(-1) * $1,020 *1.01 * 12 *11.3
= $135,232
Total projected solvency liability at 1.1.2014 = $147,176

Alternate answer:
For the active member, projected solvency liability at 1.1.2014 could reflect the assumed probability under going-concern assumptions of termination between 1.1.2013 and 1.1.2014.
The above uses an approximation that ignores this termination decrement. However, reflecting the termination probability, the alternate solution would be:
Active member projected solvency liability at 1.1.2014, discounted to 1.1.2013
= $11,944 * 0.99 = $11,825
Total projected solvency liability at 1.1.2014 = $11,825 + $135,232 = $147,057
MINUS
3) The solvency liability at 1.1.2013 = $150,865
Therefore SIC at 1.1.2013
= $11,849 + $147,176 - $150,865 = 8,160

Alternate answer: Therefore SIC at 1.1.2013 = $11,849 + $147,057 - $150,865 = 8,041

(c) Explain the factors that contribute to the difference between the going-concern normal cost and the SIC.

- The GC service cost generally represents the expected change in liability between 1.1.2013 and the next valuation due to service rendered during the period.
- The Incremental Cost represents the **expected change in liability due to all factors**, other than expected benefit payments.
- The GC service cost reflects plan provisions at 1.1.2013 which do not include the **ad-hoc indexing** at the next valuation date, while the SIC includes it.
- The SIC in a given year could include the full impact of **grow-in benefits** for a member who reaches 55 points and becomes entitled to subsidized early retirement.

3. Continued

- The GC service cost already reflects subsidized early retirement from one year to the other.
- The **interest rates** used to calculate GC service cost may reflect the expected return on the pension plan's assets (5.5%) while the incremental cost calculation is independent of the expected return on plan assets (3.5% for 10 years, 3.5% thereafter).
- Other **assumption differences**, such as termination and retirement age, would also explain the differences between GC service cost and SIC.
- The GC service cost assumes a 1% probability of termination before age 45 and a retirement age of 60.
- The SIC assumes no pre-retirement decrement other than all members are terminated at the valuation date due to wind-up of the plan and a retirement age that produces the optional pension value.

4. Learning Objectives:

6. The candidate will be able to analyze/synthesize factors that go into selection of actuarial assumptions.

Learning Outcomes:

(6e) Describe and apply the building of economic assumptions.

Sources:

Yamamoto Chapter 9 pp. 262-267

Society of Actuaries Long Term Healthcare Trends Resource Model Practical Issues for Actuaries

Modeling Long Term Healthcare Cost Trends, Getzen

Commentary on Question:

In this question, candidates were asked to demonstrate not only their understanding of the input parameters used in the long term healthcare trends resource model but also how to use the model for changing environments. A well-prepared candidate would have been able to identify the model input parameters and demonstrate an understanding of which inputs would need to be modified under certain scenarios.

For part (a), a well-prepared candidate would have been able to describe the five input parameters required by the model to project annual growth in medical costs along with the two optional parameters that can be used to place limitations/restrictions on the growth of medical cost and change the shape of future trends.

For part (b), a well-prepared candidate would have been able to describe the modifications required to the input parameters under each of the two scenarios.

Most candidates performed well on part (a) of the question. For part (b), some candidates did not describe the specific input parameters that would be modified and whether the trend would increase or decrease as a result of these modifications.

Solution:

(a) Describe the input parameters required by the Society of Actuaries' Long Term Healthcare Trend Resource Model

Five input parameters are required by the model to project annual growth in medical costs:

1. Rate of Inflation
    - Ordinary increase in prices
    - Measured by the GDP deflator (obtained by dividing nominal GDP by real GDP) and set for year 2000 base
    - Baseline 3.2% (range 1.5% - 5.5%)

4. Continued

2. Rate of Growth in Real Income/GDP Per Capita
    - Growth in real per capita income is the major driver of increasing health care costs
    - Baseline 1.9% (range 0.8% - 3%)
3. Income Elasticity Multiplier
    - Income effect on medical demand and labor cost
    - Use of an income elasticity multiplier less than 1.0 would imply a shrinking share of spending on health as nation became wealthier and clearly counter-factual.
    - U.S. has had significantly higher elasticity and analysts would argue that rapid growth in US due more to stronger desire to use latest technology than to income effects.
    - Baseline 1.4 (range 1.0 - 1.6)
4. Technology Trend (excess)
    - Extra increase due to technology and other factors
    - Combined (income + technology) effects ought to be consistent with actual rates of "excess" growth above incomes/wages in prior years
    - Baseline 1.2% (range 0.0% - 2.5%)
5. 2011 Baseline Health Share of GDP
    - Baseline estimate for the share of GDP spent on health is almost identical to the 17.49% provided in the most recent CMS projection
    - Baseline 17.5%

There are two optional parameters that can be used to place limitations/restrictions on the growth of medical cost and change the shape of future trends.

1. Resistance Point
    - Rate of increase in medical costs cannot continue indefinitely to exceed the rate of growth in per capita income without facing logical contradiction of spending more than 100% GDP
    - Baseline set at 25%
2. Limit Year
    - Year for limiting medical cost growth to growth in per capita income

Other Parameters

1. Change Parameter Values in 2020-2030 and 2030+
2. Change Short-Run Annual %'s
3. Baseline $ Per Person Medical Costs

4. Continued

(b) Describe modifications to the input parameters under the following scenarios:

(i) Increase in future co-pays and deductibles paid by the retiree.

(ii) Medical advancements which significantly increase drug costs.

Increase in future co-pays and deductibles paid by the retiree.

- Projecting trend will be below the baseline if the fraction of total costs paid for through co-pays and deductibles is rising
- Reduction in annual growth could be applied to the model by changing the "excess growth rate" (technology) input
- With a lower rate of growth rate assumption, the percentage of GDP resistance point would be reached later than under the baseline

Medical break-through which significantly increases drug costs

- May increase income elasticity to show increase in medical spending
- May assume a higher technology trend (excess) input assumption
- Projecting trend will be higher than the baseline
- Will result in overall healthcare trend rate assumption reaching resistance point earlier

5. Learning Objectives:

1. The candidate will be able to analyze different types of registered/qualified defined benefit and defined contribution plans, as well as retiree health plans.

Learning Outcomes:

(1d) Given a plan type, explain the relevance and range of plan features including the following:
- (i) Plan eligibility requirements
- (ii) Benefit eligibility requirements, accrual, vest and phased retirement
- (iii) Benefit/contribution formula
- (iv) Payment options and associated adjustments to the amount of benefit
- (v) Ancillary benefits
- (vi) Benefit subsidies and their value, vested or non-vested
- (vii) Participant investment options
- (viii) Required and optional employee contributions
- (ix) Phased retirement and DROP plans

Sources:

OECD paper: Evaluating the Design of Private Pension Plans: Costs and Benefits of Risk Sharing, D-140-11

Commentary on Question:

The question was testing candidates understanding of the risk sharing characteristics of various pension plans and the trade-off between the uncertainty of benefits and the uncertainty of contributions in the design of sustainable pension plans.

Candidates appeared to have difficulty identifying the source of the material relating to this question and as such did not provide an answer based on replacement rates and replacement ratios.

Solution:

(a) Describe the two main approaches to managing intergenerational risks in pension plans.

The two main approaches to managing intergenerational risks:
1. Pension plans collectively organize risk sharing by redistributing the risks between various stakeholders; and
2. Pension plans use hedging solutions via financial markets, e.g. buy hedges or reinsure risks.

(b) Compare and contrast the intergenerational risk sharing characteristics of the following three plans from the employees' and employer's perspective.

(i) Career average defined benefit plan with conditional indexation.

5. Continued

(ii) Defined benefit plan where employee and employer contribution rates are fixed but benefits and indexation are linked to funded status ("Collective Defined Contribution Plan").

(iii) Hybrid plan.

Evaluation of the intergenerational risk sharing characteristics is based on two performance criterion:

1. Funding ratios – the ratio of plan assets to liabilities; and
2. Replacement rates – the ratio of pensioner's benefit at retirement relative to final wage.

(i) Narrowest range of replacement rates of the three plans and largest range of funding ratios of the three plans.

(ii) Largest range of replacement rates of the three plans and narrowest range of funding ratios of the three plans.

(iii) Moderate range of outcomes for replacement rates and funding ratios.

(c) Recommend the pension plan design in (b) that will provide the greatest potential for sustainable risk sharing among plan members. Justify your answer.

The hybrid plan provides the greatest potential for sustainable risk sharing among plan members. Simulations indicate that hybrid plans offer positive outcomes for level and predictability of replacement rates with less negative outcomes for higher contribution rates.

6. Learning Objectives:

1. The candidate will be able to analyze different types of registered/qualified defined benefit and defined contribution plans, as well as retiree health plans.

6. The candidate will be able to analyze/synthesize factors that go into selection of actuarial assumptions.

8. The candidate will be able to evaluate the actuarial considerations in plan options and administration.

Learning Outcomes:

(6c) Evaluate appropriateness of current assumptions given the purpose.

Sources:

CIA Ed Note Financial Risks Inherent in Multi-employer Pension Plans and Target Benefit pension Plans, CIA Task Force on MEPP/TBPP Funding

R-D112-10: 2009 Selection of Actuarial Assumptions, Consultant Resource Manual, SOA Version, Mercer – omit pages 13-31, 34-37 and 63-64

Commentary on Question:

In this question, candidates were asked to identify the main differences between a target benefit plan and a DB plan. Candidates were given three main components to compare and contrast. For part (b), candidates were asked to analyze the characteristics of NOCs benefits and how those would translate to a target benefit plan.

A well prepared candidate would be able to describe the main features and characteristics of a target benefit plan, as well as general governance and funding considerations when setting assumptions. For part (b), a well prepared candidate would be able to identify the issues and reasons that NOCs current benefits were unsuited for a target benefit plan.

Describing DB plans or ideal benefit formulas for the target benefit plan does not constitute a good answer for part a). A successful candidate addressed overall plan design. An answer for part (b), where the candidate did not describe how NOCs current benefits related to a target benefit plan, but instead described what an ideal target benefit plan formula should be does not constitute a good answer.

Solution:

(a) Compare and contrast the following features of target benefit pension plans versus traditional defined benefit pension plans:

(i) Plan characteristics and design.

(ii) Governance.

(iii) Funding.

6. Continued

Plan Characteristics and design unique to target benefit plans and contrast with traditional DB plans:

- Target benefit plans base the level of benefits on the level and structure of contributions, with the contributions based on a fixed amount per hour worked or a fixed percent of salary.
- Once the level of benefits is established, it is communicated to members, but can be changed depending on plan experience or assumption changes.
- The cost to the employer is known, as it is in a fixed plan document or a collective agreement and can't be changed unless one of these changes.
- As a result, the Employer does not have to fund any additional shortfalls and the employee bears all the risk.
- Risks are borne by plan members spread across plan membership, unlike traditional DB where risks are borne by the employer

Governance: The plan is typically administered by a board of trustees, made up of members on the employer and employee side.

Funding: The target benefit should be funded using appropriate margins in the assumptions (pfads). The margins reduce the likelihood of future benefit reductions.

(b) Evaluate the implications of including the following current Full-Time Salaried Pension Plan provisions in a target benefit pension plan:

(i) Normal retirement benefit.

(ii) Early retirement benefit.

(iii) Disability benefit.

(i) The normal retirement benefit is salary related and subject to regulatory maximums. As a result there is exposure to inflation risk as well as regulatory risk (inflation risk if not reflected properly in the target benefit liabilities, regulatory risk should policy makers change the limits or rules). There will be gains and losses if salary inflation is different from expected inflation.

The normal benefit is also exposed to mortality and longevity risk if mortality improvements are not appropriately reflected in liabilities. Also, the Normal form provides for a J&S, which exposes the plan to the spouses' longevity risk.

6. Continued

(ii) The plan also provides an early retirement subsidy, so there is the risk that members will elect to retire earlier causing strain on the plan. It can also be problematic if retirees return to work at the same or similar trade after receipt of pension has commenced.

(iii) The plan provides for continued accruals with no reduction upon disability which can be very costly to the plan. There should be some consideration of removing this benefit and focus on more of the core benefits.

7. Learning Objectives:

5. The candidate will be able to apply/synthesize the various methods used to value a pension plan or retiree health plan for various purposes.

Learning Outcomes:

(5a) Differentiate between the various purposes for valuing pension plans:
- (i) Budgeting
- (ii) Funding
- (iii) Accounting
- (iv) Solvency
- (v) Termination/wind up
- (vi) Economic value

Sources:

Pension Mathematics for Actuaries, Anderson, Third Edition, 2006

Commentary on Question:

Candidates were asked to demonstrate their understanding of cost method and assumptions gains and losses. A well prepared candidate would be able to determine the pension payable at normal retirement, the normal cost under the aggregate method and factor in the other actuarial assumptions in the calculation of the normal cost.

Candidates generally did well when determining the actuarial liabilities for Employee B. However, some candidates fail to recognize the application of the "50% Rule" appropriately. A few candidates actually applied the Project Unit Credit cost method versus the Aggregate method. The Anderson book was not clear whether the present value of employee contributions should be deducted when determining the normal cost, nor does the question specify whether we are interested in "Total Normal Cost" so both solutions were accepted. Most candidates have trouble with determining the present value of future salary as they fail to recognize the probability of termination in the calculation. Points were given for showing all work.

Solution:

Calculate the 2013 normal cost.

Determining the Present Value of Future Benefits for Employee A

x = current age = 25

y = normal retirement date = 65

$PVFBretben = 0.02 \times Salary \times (1+ss)^{y-x-1} \times (y-x+1) \times (1-q_t)^2 \times (1+i)^{-(y-x)} \times \ddot{a}65(12)$

$= 0.02 \times \$55{,}000 \times 1.0375^{39} \times 41 \times 0.95^2 \times 1.0525^{-40} \times 12$

$= \$265{,}129$

$PVaccben(x) = 0.02 \times SALx\text{-}1 \times svc \times \ddot{a}65(12) \times (1+i)^{-(y-x)}$

Contribution with interest:

$AccCon(x) = (1+Ic) * CWI_{x-1} + 0.05 * SAL_{x-1} * (1+Ic)$

7. Continued

Calc Total benefit at age 26:

$PVaccben_{26} = 0.02 \times \$55{,}000 \times 2 \times 12 \times 1.0525^{-39}$
$= \$3{,}589$
$AccCon_{26} = 0.05 * \$55{,}000 * 1.04 + 2800*1.04$
$= \$5{,}772$

$ExcessCon_{26} = \$5{,}772 - \$3{,}589/2$
$= \$3{,}978$
$TotalBen_{26} = \$3{,}589 + \$3{,}978$
$= \$7{,}566$

Calc Total benefit at age 27:

$PVaccben_{27} = 0.02 \times \$55{,}000 \times 1.0375 \times 3 \times 12 \times 1.0525^{-38}$
$= \$5{,}878$
$AccCon_{27} = 0.05 \times (\$55{,}000 \times 1.04^2 + \$55{,}000 \times 1.0375 \times 1.04) + 2800 * 1.04^2$
$= \$8{,}970$
$ExcessCon_{27} = \$8{,}970 - \$5{,}878/2$
$= \$6{,}031$
$TotalBen_{27} = \$5{,}878 + \$6{,}031$
$= \$11{,}909$

z = termination scale = 0.05

Calc PVFB termination benefit:

$PVFBtermben = z*Totben_{x+1}/(1+i)+(1-z)*z*Totben_{x+2}/(1+i)^2$
$+(1-z)^2*z*Totben_{x+3}/(1+i)^3$
$= 0.05x\$7{,}566/1.0525+0.95x0.05x\$11{,}909/1.0525^{-2}$
$= \$870$

So, the present value of future benefits for employee A is:
$PVFB^A = PVFBretben + PVFBtermben$
$= 265{,}129 + 870$
$= 265{,}999$

Calculate the Present Value of Future Benefits for Employee B
x = current age = 50
y = normal retirement date = 65

$PVFB^B = 0.02 \times Salary \times (1+ss)^{y-x-1} \times (y-x+10) \times (1+q_t)^0 \times (1+i)^{-(y-x)} \times \ddot{a}_{65}(12)$
$PVFB^B = 0.02 \times \$80{,}000 \times 1.0375^{14} \times 25 \times 0.95^0 \times 1.0525^{-15} \times 12$
$= \$373{,}029$

7. Continued

Total Present value of future benefits for the plan:

$PVFB = PVFB^A + PVFB^B$
$= \$269,999 + \$373,029$
$= \$639,028$

Calculate the Present Value of Future Salary:

Let $j = 1.0525/1.0375-1$

$PVFS^A = \$55,000\ [1 + (.95 \times 1.0375/1.0525) + 0.95^2 ä_{38j} * 1.0375^2/1.0525^2]$
$= 1,529,379$

$PVFS^B = \$80,000\ ä_{15j}$
$= 1,087,372$

$PVFS = \$1,529,370 + \$1,087,372 = \$2,616,742$

Normal Cost
Total $NC_t = \underline{(PVFB_t - F_t)}\ /PVFS_t \times S_t$
$= \$\ (639,028 - 120,000)/\$2,616,742 \times (\$55,000 + \$80,000)$
$= \$26,777$ OR

Alternatively, you can determine the Employer normal cost by first determine the total present value of employee contribution:

$PVEEC = 5\% * PVFS = 5\% * \$2,616,742$
$= 130,837$

Employer $NC_t = (PVFB_t - F_t - PVEEC)\ /PVFS_t \times S_t$
$= \$\ (639,028 - 120,000 - 130,837)/\$2,616,742 \times (\$55,000 + \$80,000)$
$= \$20,027$

8. Learning Objectives:

5. The candidate will be able to apply/synthesize the various methods used to value a pension plan or retiree health plan for various purposes.

6. The candidate will be able to analyze/synthesize factors that go into selection of actuarial assumptions.

11. The candidate will be able to apply standards of practice and the guides to professional conduct.

Learning Outcomes:

(5b) Perform periodic valuations of ongoing plans, calculating normal cost and actuarial liability, using the variety of cost methods for budgeting, funding accounting and measuring economic value.

(6a) Evaluating actual experience, including comparisons to assumptions.

(6c) Evaluate appropriateness of current assumptions given the purpose.

(6e) Describe and apply the building of economic assumptions.

Sources:

R-D618-11: CIA Educational Note: Determination of Best Estimate Discount Rates for Going Concern Funding Valuations

R-D112-10: 2009 Selection of Actuarial Assumptions, Consultant Resource Manual – omit pages 13-31, 34-37 and 63-64

CIA accounting discount rate educational note: Accounting Discount Rate Assumption for Pension and Post-employment Benefit Plans

R-D613-11 CIA General Standards
R-D614-11 CIA Consolidated Standards of Practice

Commentary on Question:

Candidates were asked to demonstrate their understanding on the methodologies used in determining assumptions under various valuations. A well prepared candidate would have had a good understanding about the issues actuaries face when preparing a recommended discount rate for going concern and accounting valuations. The candidate would also be able to synthesize the factors and considerations that go into the selection of actuarial assumptions, and compare and contrast the differences

The question has 2 parts. Part (a) of the question asks the candidate to demonstrate their understanding of the factors and considerations used in selecting discount rates for accounting and going concern valuations. A well prepared candidate will be able to address the differences between the methodologies.

8. Continued

Part (b) of the question is a Canadian specific question. It tests the candidate's understanding of the main issues when selecting an accounting discount rate due to the Canadian corporate bond market and the proposed methodologies to derive the accounting discount rate. A well prepared candidate needs to be very familiar with the CIA educational note. He or she should be able to not only list the issues, but also provide some explanation of the issues.

Most candidates did very well on the going concern discount rate. Less candidates did well on the accounting discount rate.

Solution:

(a) Compare and contrast the methodologies used to determine a going-concern discount rate and an accounting discount rate.

Commentary on Question:
Most candidates correctly point out that the going concern discount rate should be developed based on the building block approach, and the accounting discount rate should be based on the "cash-flow matching" approach, but some of them failed to provide some additional justification of these two approaches.

Most candidates correctly addressed the additional considerations in respect of active management impact, expense and margin for adverse deviation when selecting the discount rate. However, very few candidates addressed the difference from multiple perspectives by addressing item # and 4 below.

1. The methods used to select discount rate are different:
   Accounting discount rate:
   - Accounting standards require that, for an ongoing pension plan, the accounting discount rate be selected by reference to market yields of high-quality corporate debt instruments at the accounting measurement date with cash flows that match the timing and amount of expected benefit payments
   - Discount rate selection can be based on
     - a plan's specific cash flows
     - hypothetical cash flows .

   Going Concern Discount Rate:
   Method 1: Based on the expected investment return on the assets of the pension plan at the calculation date.
   - Reflect a long-term horizon but a shorter-term perspective may be needed for very mature plans
   - One accepted method is the building block approach

8. Continued

- A more sophisticated methodology is to use a stochastic asset model and calculate a probability distribution of long-term investment returns by asset class

Method 2: Based on the yields of fixed income investments

- Need to consider the expected future benefit payments of the plan
- It reflects the yields on Government of Canada or other high-quality bonds
- It should match projected benefit cash flow or have a comparable duration

2. Some additional considerations

   Impact of active management

   - Going-concern discount rate: the actuary will assume there will be no additional returns achieved, net of investment expenses, from an active investment management strategy
   - Not applicable to accounting discount rate as selection of discount rate does not depend on how the pension fund is invested

   Expenses

   - Going-concern discount rate: the actuary may reduce the going concern discount rate by an appropriate allowance for future plan expenses that are expected to be paid from the pension fund.
   - Not applicable to accounting discount rate

   Margin for adverse deviation

   - The discount rate for going concern valuation can include a margin for adverse deviation
   - Margin for adverse deviation is not reflected in setting discount rate for accounting valuation.

3. The parties/persons responsible for setting discount rate assumptions are different

   - In accounting valuation, actuaries are engaged to provide guidance on the selection of assumptions but the final decision should be made by the plan sponsor.
   - Accounting standards require that assumptions should be management's best estimate. The assumptions that the actuary would propose for accounting valuations should be best estimate assumptions,
   - In going concern valuations, the assumptions are selected by the actuary. May include margins for adverse deviations.

4. The guidance/standards used to set discount rates are different

   Accounting discount rate:

   - Set in accordance with the relevant accounting standard

8. Continued

- The actuary should use methods and assumptions that are appropriate to the basis of accounting in the employer's or pension plan's financial statements or
- Consistent with the terms of an appropriate engagement
- CSOP also provides some additional guidance on the setting the discount rate

Going concern discount rate

- The rate should be set in accordance with CSOP and the relevant pension legislation

(b) Based on the Canadian Institute of Actuaries' (CIA) Accounting Discount Rate Assumption for Pension and Post-Employment Benefit Plans Educational Note:

(i) Describe the main issues identified in setting the accounting discount rate in Canada.

(ii) Describe the three alternatives reviewed by the CIA including the rationale for the recommended approach.

Commentary on Question:
In part (i)of the question, most candidates correctly state that the main issue is the insufficient number of high-quality corporate bonds with long maturities in Canada; however only few explain that this is an issue because of the nature of the pension plan obligations: pension obligations are long-term in nature, so the long end of the yield curve matters most.

In part (ii) of the question, the candidates either answer the question very well by correctly listing and explaining the three approaches; or cannot refer to any of the three approaches outlined in CIA's educational note.

(i) The main issue that CIA identified is that there are insufficient of high-quality corporate bonds with <u>long maturities</u> issued in Canada (there is no deep market in Aa Canadian bonds with long maturities

- Pension plan obligations are long-term in nature
- The yields that matter most are the yields for debt instruments with long maturities
- There are few Aa-rated Canadian corporate bonds with maturity beyond 15 years (there is no deep market in Aa Canadian bonds with long maturities)

8. Continued

- To derive the accounting discount rates an extrapolation of the long end of the yield curve is required based on a small pool of bonds
  - Significant amount of subjectivity
  - Lead to a lack of credibility due to large differences among actuarial firms

Some other issues CIA identified (optional):

- What "high quality" means
  - In Canada, it means corporate bonds rated Aa or higher
  - There were no Aaa-rated corporate bonds in Canada with long maturity
- Which debt instruments should be included
- How to address the lack of suitable debt instruments at certain maturities

(ii) Three alternative approaches were proposed for extrapolating the long end of the yield curve (maturities greater than 10 years):

1. Supplement the Aa-rated corporate bonds with A-rated corporate bonds with or without a spread adjustment
   - It adds a significant number of data points at longer maturities.
   - Wider credit spreads for A-rated versus Aa-rated bonds
   - A spread adjustment may be subtracted from the yields on A-rated corporate bonds
   - A-rated bonds are considered upper-medium grade (compared to high grade for Aa-rated bonds)

2. Supplement the Aa-rated corporate bonds denominated in Canadian dollars with Aa-rated corporate bonds denominated in U.S. dollars that are further transformed in Canadian dollars
   - It may be attractive because of the deepness of the U.S. bond market
   - But it may not be considered permissible under current Accounting Standards because the requirement to use debt securities denominated in Canadian dollars

3. Use Canadian provincial bonds rated Aa to which a spread adjustment is added to reflect the additional credit risk of Aa-rated corporate bonds.
   - The high-quality Canadian provincial bonds is deep, including long maturities
   - A spread adjustment is added to reflect the difference in credit risk between Aa-rated corporate bonds and Aa-rated provincial bonds

8. Continued

Approach #3 is the preferred approach

- The methodology for extrapolating the Aa-rated corporate yield curve beyond 10 years is reasonable
- It's most consistent with Canadian accounting standard
- It's not based on bonds rated below Aa, which is a characteristic of approach #1.

9. **Learning Objectives:**

1. The candidate will be able to analyze different types of registered/qualified defined benefit and defined contribution plans, as well as retiree health plans.

10. The candidate will be able to analyze the relationship of plan investments with plan design and valuations.

Learning Outcomes:

(1a) Describe the structure of the following plans:

- Fixed dollar and pay-related defined benefit plans
- Hybrid plan designs such as, cash balance, pension equity, and floor offset plans, flexible pension plans
- Defined contribution plans including 401(k) plans and capital accumulation plans
- Retiree Health Plans

(1d) Given a plan type, explain the relevance and range of plan features including the following:

(i) Plan eligibility requirements
(ii) Benefit eligibility requirements, accrual, vest and phased retirement
(iii) Benefit/contribution formula
(iv) Payment options and associated adjustments to the amount of benefit
(v) Ancillary benefits
(vi) Benefit subsidies and their value, vested or non-vested
(vii) Participant investment options
(viii) Required and optional employee contributions
(ix) Phased retirement and DROP plans

(10a) Evaluate the interaction of plan investments and:

- Plan design,
- Plan funding,
- Valuation assumptions, and
- Valuation methods.

(10c) Given a context, describe and compare the structure of appropriate investment vehicles.

Sources:

R-D149-12: Green DB, Eliminate Wasteful Practices and Make You DB Plan Sustainable

Commentary on Question:

In this question, candidates will be able to determine what plan provisions and investment strategies assist with the sustainability of DB plans in the long term.

9. Continued

A well-prepared candidate will not only able to demonstrate an understanding of what supports sustainability, but will also be able to show that a move towards more basic levels of retirement income without ancillaries along with reduced equity exposure are consistent with this objective.

Candidates did well on part (a). However, in part (b) most candidates did not discuss what changes need to be made to the equity mix to meet sustainability nor did they justify why their recommendations will align with the President's objectives.

Solution:

(a) Assess NewCo and OldCo's current pension arrangements in light of NewCo's objectives.

OldCo

Objective - enhance sustainability

- Low accrual rate
- Career average benefit
- Features NOT enhancing sustainability
  - Post-retirement indexation
  - Generous early retirement provisions
  - Portability available on retirement

Objective - minimize funding volatility

- Too high equity content

Objective - basic level of retirement income

- Attained with 1% career average

NewCo

Objective - enhance sustainability

- No post-retirement indexation
- No subsidized early retirement
- No portability available on early retirement
- Features NOT enhancing sustainability
  - 1.5% accrual rate
  - Final average benefit
  - Portability available on retirement

Objective - minimize funding volatility

- Only 20% equity weight is good

Objective - basic level of retirement income

- Too high - has 1.5% final average benefit

(b) Based on your analysis in (a), propose a plan design for the merged company that aligns with the President's objectives. Justify your recommendation.

9. Continued

Provide modest amount of guaranteed income

- Any accrual rate less than 1.5%
- Value is wasted at higher benefit levels
- Investment and longevity risk are expensive
- Use DC for higher benefits providing higher standard of living

Do not provide final average pay plan

- Career pay or career units
- Cost and risk of final pay benefits outweigh their value

Do not provide early retirement subsidies

- Early retirement benefits can be provided by DC savings
- Early retirement provisions for one generation may not make sense for later

Do not provide indexation

- Cost and risk outweigh value

Do not provide lump sum benefits

- Longevity pooling provides high value

Reduce equity weight and move into

- Longer duration bonds and
- Other interest sensitive instruments
- Investors are interested in company performance
  - Not pension fund performance
- Any target mix with 25% or less equity is acceptable

10. Learning Objectives:

6. The candidate will be able to analyze/synthesize factors that go into selection of actuarial assumptions

Learning Outcomes:

(6c) Evaluate appropriateness of current assumptions given the purpose.

Sources:

Selecting and Documenting Mortality Assumptions for Pensions (Academy paper)

R-D125-11: ASOP No. 35 Selection of Demographic and other Noneconomic Assumptions for Measuring pension Obligations

R-D112-10: 2009 Selection of Actuarial Assumptions, Consultant Resource Manual, SOA Version, Mercer

Commentary on Question:

In this question, candidates were asked to demonstrate the following:

- ability to analyze a mortality table assumption for a defined benefit pension plan and provide comments on its reasonableness
- describe the process for selecting an appropriate mortality table and mortality improvement assumptions
- list factors that are considered when selecting a mortality table and mortality improvement assumptions; and
- provide considerations in selecting mortality improvement assumptions.

For part (a), a well-prepared candidate would have commented on each aspect of the current assumption with respect to all the details provided regarding the assumption. The candidate should have explained why the assumption was or was not appropriate.

For part (b), the candidate should have described in general how an assumption is selected and then provide details regarding specific considerations for selecting mortality and mortality improvement assumptions.

Solution:

(a) You are given the following for a defined benefit pension plan:

- Plan membership consists of 12,000 actives and 60,000 inactives (terminated vested participants, disabled participants, retired participants, and beneficiaries);
- There is no assumption for pre-retirement mortality; and
- The post-retirement mortality assumption is a static 2005 unisex group life insurance mortality table.

Critique the current mortality assumptions.

Commentary on Question:

Overall candidates responded sufficiently for part (a).

10. Continued

Pre-Retirement Mortality
Pre-retirement mortality generally does not have a significant impact on results, so assuming no pre-retirement mortality could be considered appropriate. However, it is usually only excluded for small plans and this plan has a large active population.

Post-Retirement Mortality
The assumption does not include mortality improvements which should be considered.

A separate assumption for disabled participants may be appropriate depending on actual plan experience and the plan definition of disability.

Gender is typically reflected in mortality assumptions as male and female mortality can be significantly different. The unisex weighting of the current table may not appropriately represent the plan's population.

The mortality table for pension valuations should be a group annuity table and not a group life insurance table. The group life insurance table is not considered reasonable for pension purposes as group life insurance tables have higher rates of mortality and are generally loaded for adverse experience.

(b) Describe the process and considerations for selecting appropriate mortality assumptions.

Commentary on Question:
For part (b), many candidates did not include a discussion of the assumption setting process or mention mortality improvements prior to the measurement date.

The process for setting a mortality assumption is as follows:

- Identify the type of assumption that is appropriate considering the purpose of the measurement, characteristics of the group, and materiality
- Consider the relevant assumption universe – standard tables and modifications
- Consider plan demographic factors – collar, income, gender, occupation, status, type of retirement form of payment, presence of medical coverage, and any other relevant factors
- Select the assumption
- Evaluate the assumption for reasonableness; the expectation should be that the assumption does not produce significant gains or losses

The assumption selection should consider that mortality rates will have improved since the base year of the table. The selected table should reflect mortality improvements to both the measurement date and anticipated future improvements in mortality.

11. Learning Objectives:

10. The candidate will be able to analyze the relationship of plan investments with plan design and valuations.

Learning Outcomes:

(10a) Evaluate the interaction of plan investments and:

- Plan design,
- Plan funding,
- Valuation assumptions, and
- Valuation methods.

Sources:

R-D131-09: Plan Sponsor Guide to Liability-Driven Investing

R-D132-09: Top 10 Myths About Liability Driven Investment

Commentary on Question:

In this question, candidates were asked to demonstrate their knowledge of LDI strategies and describe how this can be used to minimize interest rate risk. A well prepared candidate was expected to understand how LDI minimizes interest rate risk by extending the duration of the plan, and the limitations of LDI Strategies.

Solution:

(a) Critique the following assertions regarding LDI strategies:

(i) The interest rate risk in most pension liabilities is an uncompensated risk, so it is always a good idea to reduce it as much as possible.

(ii) An LDI strategy can completely eliminate interest rate risk.

(iii) Interest rate risk can be hedged by analyzing the timing of future benefit payment cash flows and matching the fixed income exposure to that timing.

Commentary on Question:

Part (a) was based on Myths 2, 3 and 8 from study note R-D132-09: Top 10 Myths About Liability Driven Investment.

(i) This assertion assumes that if a plan sponsor cannot predict future interest rates, this risk is unintentional and uncompensated.

LDI assumes that pension liabilities have interest rate sensitivity similar to long-term corporate bonds. If plan assets do not have this same sensitivity, then the funded status changes with interest rates. This interest rate mismatch can be removed by using longer duration bonds and/or interest rate derivatives.

11. Continued

Implementing a full interest rate hedge may not be optimal: If interest rates are expected to increase, some interest rate exposure may be preferred. For some plan sponsors, the interest rate risk in the pension liabilities may be a natural hedge for other interest rate risks in their income statement and balance sheets. Full interest rate hedging may require derivatives that some plan sponsors cannot use effectively. Finally, there is a point of diminishing impact, beyond which the extra precision does not justify the added costs.

(ii) Although an LDI strategy can reduce most interest rate risk, it is difficult to match the discount rates used in GAAP accounting, or the discount rates under the Pension Protection Act (PPA). Many LDI programs that emphasize interest rate risk reduction use LIBOR swaps, but these have lower yields than the high-quality corporate bond rates used to measure liabilities. Treasury Strips are even lower yielding.

Even the most carefully crafted LDI strategies cannot eliminate all interest rate risk due to defaults and ratings migrations. While a great deal can be done to hedge interest rate risk, plan sponsors need to be realistic about what is possible. The task is to optimize the interest rate hedge within "real world" practical constraints.

(iii) This assertion is common among asset managers unfamiliar with pension liabilities. Many plans have interest sensitive cash flows, while others have durations longer than the apparent durations of their cash flows. Cash balance plans and traditional plans paying lump sums are common examples. While most pension actuaries are trained to adjust for interest sensitive cash flows and forms of payment, a LDI program designed by someone unfamiliar with these issues can result in the plan sponsor taking on unintended risks.

(b) Given the CFO's concern, describe an appropriate LDI strategy for the Salaried Pension Plan for each of the following funding strategies:

(i) Immediate full funding.

(ii) Fully funding the plan over a five year period.

Commentary on Question:
Part (b) was based on LDI strategies to minimize interest rate risk described in study note R-D131-09: Plan Sponsor Guide to Liability-Driven Investing. Responses should have been based on this study note and made reference to the Salaried Pension Plan from the case study.

11. Continued

(i) If NOC makes large contributions to fully fund the plan, then it should apply LDI to minimize interest rate risk and protect the downside risk of funded status ratio.

Current plan assets have 55% equities. The duration of assets is smaller than the duration of liabilities. The Salaried plan is 85% funded at 1/1/12, so the plan sponsor contribution will need to be large to fill funded status gap.

Sensitivity to changes in interest rates is the main cause of variability in pension liabilities. To hedge this interest-rate sensitivity, we change the duration of assets to be similar to the duration of liabilities. We can increase the duration of assets, substituting long bonds for intermediate bonds or increasing the proportion of long bonds. We recommend changing asset allocation towards a higher concentration of fixed income to match liability duration.

This strategy does not use derivatives, avoiding their disadvantages: sufficient liquidity to fund margin requirements, other risks including counterparty, liquidity, valuation and tracking. This strategy does not use equities, forgoing the upside potential (not needed for fully funded plan), but protects from funded status deterioration.

(ii) The answer will be different if NOC wants to fully fund the plan within five years. Before the plan is 100% funded, need equities for upside potential.

To match duration, we can combine bonds and derivatives to control interest rate risk, using fixed income derivatives (futures and forward contracts, swaps and options) to increase duration. The more aggressive the portfolio, the more derivatives are used to bridge the duration gap. The advantage of using derivatives is that they overlay assets; they do not have to sell equity or bonds to achieve the desired duration.

Once Plan is fully funded, change assets to 100% fixed income to match liability duration.

12. Learning Objectives:

4. The candidate will understand alternative plan types that occur internationally.

Learning Outcomes:

(4b) Give examples of the structure of different plan types.

Sources:

R-D140-11: Private Pensions: Alternative Approaches Could Address Retirement Risks Faced by Workers but Pose Payoffs, pp.1-38

Morneau Sobeco, *Handbook of Canadian Pension and Benefit Plans,*14th edition, 2008, Chapter 12

Commentary on Question:

This question expected candidates to be able to describe four risks faced in retirement and explain how those risks could be mitigated by changes in plan design. In part (a), since the four risks were provided in the question, a fully correct solution provided extra details beyond just defining the risk. In part (b), each plan design feature could be changed in at least one way to mitigate one or more of the risks from part (a).

Solution:

(a) Describe the following risks in accumulating and preserving defined contribution retirement savings faced by employees:

(i) Contributions.

(ii) Leakage.

(iii) Fees.

(iv) Drawdown of benefits.

Commentary on Question:

Many candidates did a good job defining each of the four risks, but in general, the descriptions were lacking in supporting information.

The first risk is that contributions may not be adequate to accumulate a sufficient benefit. This is especially seen in workers who are young or have low income levels. This risk is magnified when the failure to make an employee contribution also results in the failure to receive any matching employer contributions.

The second risk, leakage, has to do with employees failing to accumulate a sufficient retirement benefit because of their early access to funds. For example, they may take loans and fail to repay them, or they may take hardship withdrawals, or they may cash out their benefit when they change jobs.

12. Continued

The third risk is that high fees will eat into the earnings from the account balance. Employees typically bear investment fees, and in many cases, also pay administrative fees. These lower the annual return, resulting in smaller balances at retirement.

Finally, since DC benefits are usually paid as a lump sum, there are risks associated with the asset drawdown. First, there is longevity risk, which means the retiree might outlive his or her account balance. Next, there is investment risk, meaning the retiree is exposed to a decline in assets if investment return is poor. Lastly, there is inflation risk, which means inflation could diminish the purchasing power of a retiree's benefit.

(b) You are given the following plan design:

- Employee contributions: voluntary up to 10% of base pay
- Employer contributions: 3% of base pay plus 100% matching on employee contributions up to 3% of base pay
- Investment options: range of 25 different funds in various asset classes
- Employee loans: permitted without restriction
- Form of distribution: lump sum

Propose changes to the plan design to help mitigate the risks described in (a).

Commentary on Question:
Candidates, in general, provided changes that would mitigate the risks in part (a). However, few suggested changes to all of the listed plan design features. Also, many failed to directly link the proposed change to a specific risk from part (a).

Proposed change to EE contributions: First, automatically enroll employees at a certain level (e.g., 3%) and automatically escalate the contribution percentage (e.g., 1% per year for the first three years). This is a good idea because auto enrollment and auto escalation have been shown to increase participation rates. Another possibility is to include bonus and/or overtime pay in the definition of eligible earnings. These changes combat the Contribution risk.

Proposed change to ER contributions: Could increase the ER match or the EE contribution necessary to get the full ER match. This would encourage higher contribution levels, combating the Contribution risk.

Proposed change to investment options: Reduce the number of options, as this has been shown to lower fees, which would reduce the Fee risk.

12. Continued

Proposed change to employee loans: Prohibit employee loans. This would reduce the use of retirement income for current consumption, which would combat the Leakage risk.

Proposed change to the form of distribution: Provide annuities rather than lump sums (or at least offer annuities as an option under the plan). This could help eliminate longevity risk, which is related to the Drawdown of Benefits risk in part (a).

13. Learning Objectives:

3. The candidate will be able to analyze plans designed for executives or the highly paid.

Learning Outcomes:

(3b) Given a specific context, apply principles and features of supplemental retirement plans.

Sources:

R-D604-07:"Creative Compensation Arrangements for private Corp", Marcel Theroux, Canadian Tax Foundation, 1998 Ontario Conf., Tab 10 Canada Only

Watson Wyatt Canadian Pensions and Retirement Income Planning, 3rd Edition, Ch 14 p.266 , Ch. 15 p.320-322 Ch-16 P. 332-334 (4th edition Ch. 16 p. 313, Ch. 17)

Morneau Sobeco, *Handbook of Canadian Pension and Benefit Plans,*14th edition, 2008, Chapter 11 and 12

Commentary on Question:

In this question candidates were asked to demonstrate their knowledge of the use of supplemental retirement plans to defer compensation for highly paid executives.

For part (a), a well prepared candidate demonstrated an understanding of each plan design and compared the advantages and disadvantages of the three plan designs for both the employee and the employer.

For part (b), a well prepared candidate showed an understanding of what an IPP is and discussed both the general and more specific challenges in using this plan design as a salary deferral vehicle for a highly paid executive.

Solution:

(a) Compare and contrast the following deferred compensation arrangements:

- Employee Profit Sharing Plan (EPSP);
- Supplemental Executive Retirement Plan (SERP) funded through a Split-dollar Retirement Compensation Arrangement (RCA); and
- Notional Defined Contribution SERP.

13. Continued

Commentary on Question:
Most candidates provided a good explanation of an EPSP and Notional Defined Contribution SERP. However, some candidates did not discuss the life insurance aspect of the Split-Dollar RCA and many candidates listed information on each plan without providing any comparison analysis. The key areas of comparison were tax effectiveness and benefit security.

Employee Profit Sharing Plans

- Employer contributions must reference company profits in some way
- Contributions are taxed immediately when they are made and are treated as salary to the employee (i.e. attract payroll taxes for employer)
- Investment income is also taxed immediately
- Taxes can be deferred for 16 months
- Vesting rules are flexible such that employees may not be vested until termination or retirement
- This is the most secure of the three plans because it is pre-funded

SERP funded through a Split-Dollar RCA

- 50% of contributions are withheld by the CRA (to be refunded on termination or retirement), so only 50% of contributions earn tax-free income
- The non-refundable contributions are used to buy split-dollar life insurance
- The RCA only owns the investment portion of the life insurance policy, the employer would own the death portion
- Benefits to the employee are taxed upon receipt
- This has the best tax advantages of the three plans
- However, there are significant administrative and set-up costs
- There is some security because the SERP is fully or partially funded
- The insurance policy must be held until the death of the member

Notional Defined Contribution SERP

- There is no restriction on employer contributions
- This is the easiest plan to set up and administer
- Employee is taxed when benefits are received, not when contributions are made
- This is the least secure arrangement because it is completely unfunded

(b) Your client is considering an Individual Pension Plan (IPP) for the senior executive. Describe the challenges of sponsoring an IPP in Canada.

13. Continued

Commentary on Question:
Candidates generally did not perform well on this part of the question. Most candidates did not point out that the IPP would be a registered pension plan (with Income Tax Act limits on benefits) and, more specifically, a Designated Plan because the single member of the plan would be very highly paid.

Generally, the situation with IPPs today, based on their treatment by regulators, is confusing and chaotic. The written rules continue to be supplemented by a large number that follow the oral tradition. The guardian of these plans, the registered plans division, displays a marked distrust, if not hostility, towards the IPP.

The IPP should be the ideal vehicle for the portability of pension funds because there are no tax limits when transferring between RPPs, as opposed to a transfer from an RPP to RRSP. However, the regulatory authorities won't let it be used that way because they put additional restrictions on transfers from IPPs.

Specifically, since this is a registered plan, the ITA maximum pension benefit is applicable, which isn't appropriate for providing benefits to our highly paid executive. Further, this would be considered a Designated Plan because over 50% of the members earn more than 2.5 times the YMPE. For a Designated Plan the actuary must prepare a maximum funding valuation using specified assumptions. This valuation usually results in maximum contributions that are lower than the minimum contributions using standard rules, so the plan will likely be in a deficit due to low contributions. However, terminal funding can be used for Designated Plans (a one-time contribution at decrement to fully fund the liabilities). When setting up a new Designated Plan, no pre-1991 service can be granted. In this case the IPP only works if a high enough benefit can be provided with post-90 service and the cost of setting up the plan and funding mostly on termination (i.e. low investment earnings) is worth it.

14. Learning Objectives:

5. The candidate will be able to apply/synthesize the various methods used to value a pension plan or retiree health plan for various purposes.

Learning Outcomes:

(5b) Perform periodic valuations of ongoing plans, calculating normal cost and actuarial liability, using the variety of cost methods for budgeting, funding accounting and measuring economic value.

Sources:

Pension Mathematics for Actuaries, Anderson, Third Edition, 2006, Chapters 2 and 7

Commentary on Question:

A well prepared candidate will be able to calculate unfunded accrued liability and normal cost using the Projected Unit Credit cost method. They will also calculate and reconcile the gain/loss resulting from various experience items and be able to identify the sources of change in the normal cost from one valuation to the next.

Solution:

(a) Calculate the total normal cost and the unfunded accrued liability of the plan at January 1, 2013.

Commentary on Question:

Overall, candidates performed quite well on this part of the question. Some candidates failed to recognize that the new entrant should have a normal cost even though their accrued liability is zero.

$PUC\ NC_x = B_{60} * 1/(60-w) * \ddot{a}_{60}^{(12)} * V^{(60-x)}$

$PUC\ AL_x = PUC\ NC_x * (x-w)$

Member A

$PUC\ NC_x = .02 * 50{,}000 * (1.04)^{29} * 12 * v^{30}$

$= 6{,}516$

$PUC\ AL_x = 6{,}516 * 0 = 0$

Member B

$PUC\ NC_x = .02 * 100{,}000 * (1.04)^{9} * 12 * v^{10}$

$= 19{,}074$

$PUC\ AL_x = 19{,}074 * 20 = 381{,}490$

$NC_{2013} = 6{,}516 + 19{,}074 = 25{,}590$

$AL_{2013} = 0 + 381{,}490 = 381{,}490$

14. Continued

UAL_{2013}= AL – F
= 381,490 – 350,000= 31,490

(b) Calculate the unfunded accrued liability of the plan at January 1, 2014.

Commentary on Question:
Overall, candidates performed quite well on this part of the question.

Member B
PUC AL_x= .02 * 100,000 * 1.1 * $(1.04)^8$ * 21 * 12 * v^9
= 449,094

Member A
PUC AL_x= 0

F_{2014}= 350,000 + 40,000= 390,000

UAL_{2014}= 449,094 – 390,000 = 59,094

(c) Calculate the gains and losses by source for 2013.

Commentary on Question:
Many candidates were able to identify and calculate 2 or 3 of the sources of gain and loss. Only a few candidates correctly calculated all of the sources of gain/loss and checked that these reconciled with the change in the unfunded accrued liability.

Gain on contribution:
Gain= 40,000 * 1.03 – 25,590 * 1.06
= 14,074

Loss on fund return:
Exp'd F_{2014}= 350,000 * 1.06 + 40,000 *1.03
= 412,200
Loss= 412,200 – 390,000= 22,200

Gain on termination:
Exp'd AL_{2014}= (0 + 6,516) * 1.06
= 6,907
Gain= 6,907 – 0= 6,907

Loss on salary increase:
Exp'd AL_{2014}= (381,490 + 19,074) * 1.06
= 424,598

14. Continued

Loss= 449,094 – 424,598= 24,496

Exp'd UAL= 31,490 *1.06= 33,379

Losses= Act'l UAL_{2014}- Exp'd UAL_{2014}
= 59,094 – 33,379= 25,715

Check losses= 22,200 + 24,496 – 14,074 - 6,907
= 25,715