COURSE 8

RETIREMENT BENEFITS

COMPREHENSIVE SEGMENT

SAMPLE EXAM

&

SOLUTIONS
QUESTION #1 – (14 points)

Your new client, Branch Banking Inc., sponsors a non-contributory defined benefit pension plan that covers all of its employees. They have no other retirement plans.

They are considering opening branches in 5 neighboring areas. They are somewhat concerned about the effect that the expansion will have on the plan sponsor’s pension expense.

Their plans are not well funded and the CFO feels that the biggest cause is a relatively low rate of return on their trust fund. The CFO would like the fund to be more heavily invested in local real estate projects. The CEO is concerned about how a change in asset class allocation will affect the long-range funding status of the retirement plans.

You have been asked to develop projections of the cash flows over the next 20 years.

Pension Plan Provisions

Benefit formula: 1.5% of final 3-year average salary times years of service up to 30 years.

Eligibility for participation: Immediate

Normal retirement age: Age 65.

Early retirement eligibility: Age 55 with 5 years of service.

Early retirement reduction: Unreduced with 20 years of service, otherwise, full actuarial reduction.

Vesting: Full vesting after 5 years of service.

Normal form of payment: Joint and 75% survivor.

Optional form of payment: Lump sum based on the greater of 6% interest, 83 GAM or the minimum prescribed by regulation. The lump sum option is available to all retiring or terminating employees at time of termination.
### Age and Service Distribution of Active Plan Participants as of the beginning of Year 1

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Under 1</th>
<th>1-4</th>
<th>5-9</th>
<th>10-14</th>
<th>15-19</th>
<th>20-29</th>
<th>30 &amp; over</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 25</td>
<td>#</td>
<td>90</td>
<td>240</td>
<td></td>
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<td></td>
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<td>330</td>
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<tr>
<td></td>
<td>Avg. Salary</td>
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<td>24,500</td>
<td></td>
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<td></td>
<td></td>
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<td>#</td>
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<td></td>
<td></td>
<td>540</td>
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<tr>
<td></td>
<td>Avg. Salary</td>
<td>29,750</td>
<td>35,120</td>
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<td>32,435</td>
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<td>240</td>
<td>60</td>
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<td>660</td>
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<tr>
<td></td>
<td>Avg. Salary</td>
<td>32,000</td>
<td>33,000</td>
<td>60,000</td>
<td>80,000</td>
<td>75,000</td>
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<td>63,636</td>
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<tr>
<td>45-54</td>
<td>#</td>
<td>30</td>
<td>90</td>
<td>90</td>
<td>120</td>
<td>150</td>
<td>120</td>
<td>600</td>
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<tr>
<td></td>
<td>Avg. Salary</td>
<td>65,000</td>
<td>77,000</td>
<td>98,000</td>
<td>120,000</td>
<td>135,000</td>
<td>140,000</td>
<td>115,250</td>
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<tr>
<td>55-64</td>
<td>#</td>
<td></td>
<td>30</td>
<td>120</td>
<td>150</td>
<td>180</td>
<td></td>
<td>480</td>
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<tr>
<td></td>
<td>Avg. Salary</td>
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<td>235,000</td>
<td>165,000</td>
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<td>65 &amp; Over</td>
<td>#</td>
<td></td>
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<td></td>
<td></td>
<td>60</td>
<td>120</td>
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<td>108,500</td>
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<tr>
<td>Total</td>
<td>#</td>
<td>120</td>
<td>570</td>
<td>420</td>
<td>360</td>
<td>480</td>
<td>420</td>
<td>360</td>
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<tr>
<td></td>
<td>Avg. Salary</td>
<td>34,250</td>
<td>27,776</td>
<td>43,791</td>
<td>83,667</td>
<td>113,750</td>
<td>156,714</td>
<td>149,167</td>
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### Age Distribution of Inactive Participants

<table>
<thead>
<tr>
<th>Age</th>
<th>Deferred Benefit Entitlement</th>
<th>Receiving Benefits</th>
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</thead>
<tbody>
<tr>
<td>45 - 49</td>
<td>Number 30</td>
<td>-</td>
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<tr>
<td></td>
<td>Avg. Benefit/Mo. 1,700</td>
<td></td>
</tr>
<tr>
<td>50 - 54</td>
<td>Number 30</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Avg. Benefit/Mo. 2,950</td>
<td></td>
</tr>
<tr>
<td>55 - 59</td>
<td>Number -</td>
<td>360</td>
</tr>
<tr>
<td></td>
<td>Avg. Benefit/Mo. 4,600</td>
<td></td>
</tr>
<tr>
<td>60 - 64</td>
<td>Number -</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Avg. Benefit/Mo. 6,200</td>
<td></td>
</tr>
<tr>
<td>65 - 69</td>
<td>Number -</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Avg. Benefit/Mo. 7,200</td>
<td></td>
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</table>
Trust Fund Information

<table>
<thead>
<tr>
<th>% of Assets:</th>
<th>Cash</th>
<th>Stocks</th>
<th>Long-Term Bonds</th>
<th>Real Estate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>10%</td>
<td>55%</td>
<td>35%</td>
<td>0%</td>
</tr>
<tr>
<td>CFO Proposal</td>
<td>10%</td>
<td>15%</td>
<td>50%</td>
<td>25%</td>
</tr>
</tbody>
</table>

a) Since this is the first project you are doing for Branch Banking, you will begin the project with a data request. List the additional information that you will need to request from the CFO to perform funding and expense valuations.

b) List the additional assumptions you will need to make to project the cash flows for this plan.

c) Describe any special considerations that arise in addressing the asset allocation alternatives in light of the demographics and plan provisions of Branch Banking Inc.

d) The CEO’s objective is that the plan be fully funded in 25 years. In addition, he has also requested level contributions over that 25-year period. Describe the issues related to the CEO’s goals and how you would select a cost method.
**SOLUTION – QUESTION #1**

a) Prior tax and government filings
   - Prior actuarial reports
   - Plan document for exact plan provisions
   - Any applicable collective bargaining agreements

For each individual employee:
   i. Birth date
   ii. Gender
   iii. Salary
   iv. Hire date
   v. Breaks in service
   vi. Hours worked if it is the basis for crediting service
   vii. Marital Status OR need a % married assumption
   viii. Information to identify key, highly paid (connected) employees

For assets:
   i. Current market value
   ii. Breakdown into asset classes
   iii. Investment policy
   iv. Past Trust Statements
   v. Book value to the extent required for determining an actuarial (smoothed) value of assets

For the aggregate employee group:
   i. Past termination rates for input into turnover assumption
   ii. Past retirement experience for input into retirement assumption
   iii. Past experience on lump sum elections
   iv. Past experience on selection of other optional forms of payment

For the employer:
   i. Hiring practices – i.e., employee replacement, key employee replacement, expected downsizing, early retirement windows, etc.
   ii. Timing and anticipated size of planned expansion to new branches
   iii. Policies effecting pay increases
   iv. Any other relevant policies affecting turnover or retirement
   v. Funding policy
   vi. Any anticipated plan amendments.
   vii. Policies on granting ad hoc COLA’s
b) For the new locations:
   i. Approximate number of new ee’s for new branches
   ii. Age distribution
   iii. Average salary by age group
   iv. Timing for opening new branches

For future hires:
   i. Anticipated growth in number of employees
   ii. Age distribution of annual hires
   iii. Average salary by age
       OR
   iv. Future hires will mimic current employees

For projecting the covered population
   i. Turnover probabilities
   ii. Mortality
   iii. Retirement rates – need to reflect incentives to retire at 20 years of service and at 30 years of service
   iv. Marital status at retirement
   v. Age of Spouse
   vi. Probability of electing a lump sum
   vii. Disability rates
   viii. Disabled life mortality (question does not state info on disability benefits)

For economic projections
   i. Expected inflation
   ii. Expected returns on each asset class – can be tied to inflation rate
   iii. Expected variance for inflation and asset returns (distribution of return rate)
   iv. Correlation between asset classes
   v. Correlation between asset classes and minimum interest rates for calculating lump sums
       OR
   vi. Trend for minimum interest rates for calculating lump sums
   vii. Expected salary increase trend – above inflation to reflect merit etc.
   viii. Salaries for new hires as related to salaries for current employees
   ix. Trend for maximum limitations on benefits or pensionable salary (relates to inflation)
   x. Reinvestment policy
   xi. Return rates for reinvestment
   xii. Policy on assets to liquidate in the even of a cash shortfall
   xiii. Funding policy (minimum contributions, maximum deductible contributions, etc.)
c) Liquidity is very important:

- The employee population is fairly old, therefore liquidity will be an important consideration. With the suggestion for heavy investment in real estate, this could be a considerable problem.

- Most of the liability is for actives and so it’s inflation linked. Investment of 60% of plan assets in fixed income does not reflect inflation well enough.

- Given the relatively large number of retirees, the amount of assets in cash is also an important consideration.

- Since the plan provides for lump sums, liquidity of assets is extremely important.

- There is too great a correlation between Real Estate returns and the Bank’s business in mortgages. Poor returns are likely to occur when the bank is least able to afford it.

In recommending an invest strategy, should consider the fact that the plan could be selected against when employees elect their form of payment. If the fund is invested in assets whose returns do not parallel shifts in the minimum required lump sum interest assumption, then employees may choose their form of payment in a way that could damage funding. Investment in bonds could be a good solution to parallel the rate for lump sums and for cash flow from coupons.


d) Entry age normal (EAN) cost method does give level costs, but they are for each individual employee. Since the workforce composition may be going through some dramatic changes with acquiring new branches, the method may not produce overall level contributions.

A better choice might be the frozen initial liability (FIL) method with a 25 year amortization of the initial EAN accrued liability. However, there may be a mismatch between the FIL target after 25 years and the EAN accrued liability, particularly with large groups of new employees entering in the future.

- Level contributions to fund the EAN accrued liability may exceed limits on tax deductibility.

- The EAN accrued liability could easily be significantly larger than the termination liability in 25 years. The CEO should consider the ramifications of what could be a sizeable surplus in the fund.
  - resources that may have been better used on the company,
  - possibly a better internal rate of return by keeping the dollars in the company
  - creating an incentive for takeover
  - pressure from employees to share the surplus
- taxes on the surplus if withdrawn

- The lump sum option may cause significant fluctuations in assets and liabilities, particularly with a cap of 6% on the lump sum interest rate. It may be difficult to keep contributions level under any method.

- If the CEO is set on level contributions, they may want to reconsider their investment strategy. Fluctuations in the return on assets can create sizeable gains and losses, particularly if asset amounts are large, as they would be with an EAN accrued liability target. Immunizing the fund may help keep contributions level but it may also lower the return on assets.
**QUESTION #2 – (10 points)**

You are the Actuary for SubCo. SubCo’s executives are concerned about the funding surplus in the hourly employee’s pension plan. The surplus has arisen from unusually high investment returns during the past two years and the actuarial gain realized from involuntary terminations in a recent downsizing. Union organizers have been talking to the hourly employees since the downsizing.

The following proposals were raised at a recent executive committee meeting:

1) Benefits should be increased in the hourly plan, particularly to protect against potential unionization.

2) Rather than increase benefits, the actuary should add more conservatism to the actuarial assumptions used for funding and expense valuations.

3) Direct the actuary to change the cost method and asset valuation method used.

4) Withdraw the surplus and use it for capital expansion.

5) Do not make any changes but use the surplus to limit our required contributions.

6) Use the surplus for early retirement incentives.

7) Use the surplus to purchase annuities for the inactives.

Evaluate the alternatives mentioned at the meeting.
(1) Increase benefit.

There is a conceptual debate on surplus ownership. Sponsors tend to think that the surplus belongs to them, since they are the bearer of financial risk. Since they are responsible for any funding shortfall, they should be allowed to enjoy any funding surplus. Consequently, increasing benefit is not a necessary conclusion of the surplus. On the other hand, employees tend to think that money in the pension plan is theirs, as the deposits made previously to the plan were made on their behalf. Since there is now more money, they should get a share of it. What is the philosophy of SubCo? If the benefit is increased, and employees have accrued benefits under this increased benefit structure, the plan sponsor cannot cutback these benefits later. Future benefits may be reduced, but not those that have been accrued. Even after the surplus has been used up, or after bad investment years, the plan sponsor still has the obligation to fund the plan based on these increased benefit. Such future obligations should be projected and analyzed before a decision is made. Furthermore, although future benefits may be reduced, such reduction may have an effect on employee morale, making unionization even more probable.

(2) Use more conservative assumptions.

A lower interest rate for funding will increase the liability and possibly ‘hide’ the surplus. The valuation assumption for funding purposes is currently at 8%. Is it justifiable given the high investment returns during the past two years? A more conservative termination assumption may have a similar effect. But will downsizing be continued? If so, is the change justifiable? Is the actuary willing to make the changes? The actuary has to follow a professional standard of practice, and so may decline to make such changes. The actuary must examine the experience under the plan, and use assumptions that are reasonable, and that reflect past experience and future expectation. If the assumptions cannot be justified, there may be challenges from tax authorities on the deductions claimed. For the expense valuation, similar analysis can be made. Currently, the discount rate is 8.5% and the expected long-term rate of return on assets is 9%. In determining the discount rate to be used, it is appropriate to consider the rates implicit in current prices of annuity contracts that could be used to settle plan obligations. SubCo may take into its consideration the rates of return on high-quality fixed-income investments currently and expected to be available. The expected long-term rate of return should depend on the investment mix of the assets, the rates currently being earned and the expected rates for reinvestment. Since investment experience has been favorable, is a lower rate justifiable? Besides the actuary, the accountant may also have an opinion on this matter. The decision on (7) below should also be a factor in the determination of these rates.
(3) Change cost and asset valuation method.

For the FAS87 valuation, the projected unit credit method must be used, and there is no choice here. For the funding valuation, the accrued benefit cost method is currently being used. A more conservative method, e.g., the entry age normal method, may be used to increase the liability, or to reduce the surplus.

Assets are currently valued at market value. For both FAS87 and funding valuations, smoothed average asset value instead of the market value of assets may be used. If so, there is no need to immediately take into account the increase in assets due to good investment results. Some changes in cost and asset valuation methods in funding may need to be approved by tax authorities before they can be used.

For both (2) and (3), a more fundamental consideration is the following: changing assumptions and methods can only ‘hide’ the surplus. But the money is still there. By using more conservative assumptions and methods, the plan sponsor is actually increasing the ‘true’ surplus, since eventual outgo from the plan is not dependent on the assumptions made in the valuations. More conservatism now may in fact cause worse surplus situations in the future.

(4) Withdraw surplus.

Money in the plan should be held for the exclusive benefit of its beneficiaries. It is not allowable to withdraw the surplus in an ongoing plan. Should the plan be terminated in order for the surplus to revert to the plan sponsor? Is this too extreme a solution? SubCo should consider the fees involved in the plan termination and the tax consequences (both income tax and excise tax) on its recovery of the surplus. Does SubCo want to establish another plan to replace this terminated plan? If so, will such termination/reversion/reestablishment endanger the benefit security of future participants? Will it be viewed as such by the employees of SubCo? Will such an action be compatible with the philosophy of SubCo? A possible way to remove excess assets from the pension plan is to make transfers to retiree health accounts.

(5) No change: use surplus to limit required contributions.

This goes back to the discussion in (1). If the philosophy of SubCo is that the surplus properly belongs to it, then this is the natural conclusion. The surplus should stay in the plan to reduce or eliminate future required contributions. This is also natural in the sense that, if valuation assumptions are reasonable and reflect plan experience, good and bad investment results will probably average out. Future bad experience may automatically wipe out the current surplus.
(6) Use surplus for early retirement incentives.

Is there still a need for downsizing? If so, offering early retirement incentives may be a way to encourage the ‘right’ people to retire. The early retirement incentives should be carefully structured to achieve such a goal. If not, these incentives may create the undesirable result that valuable employees are attracted to such offers and retire. SubCo should carefully evaluate anticipated utilization before introducing such incentives. If too many employees choose the early retirement incentives, the additional liability may exceed the surplus, and SubCo may be forced to make contributions that it has not planned for. Furthermore the funding cost of these benefits may need to be spread, so that either the surplus situation will remain for some years or there will be additional future obligations. Projections should be made and analyzed. If it is decided that such benefits are to be introduced, SubCo should study their effect on plan qualification. Are they available to employees on a nondiscriminatory basis? Is the timing of the amendment to establish these benefits nondiscriminatory? Will the additional benefits violate the maximum limitation based on the early retirement age? For accounting purposes, since future service of employees may be significantly reduced, there may be a one-time FAS88 cost effect.

(7) Use surplus to purchase annuities for the inactives.

This is an investment decision. Is it better for the plan to keep the surplus to achieve potentially higher earnings, or to partially insulate itself against future market fluctuations by purchasing annuities? The purchase of annuities serves to protect the gains made in the good years. The possible effects on the funding status of the plan should be considered.
QUESTION #3 – (9 points)

In response to strong competition, and a desire to control costs, SubCo has decided to amend the SubCo salaried employees’ pension plan effective January 1, 2000 to provide the following:

Normal Retirement Benefit: 1% of earnings during each year after January 1, 2000 plus 1% of 1999 earnings multiplied by service at December 31, 1999.

Early Retirement Benefit: Accrued benefit reduced by ¼ % per month that early retirement precedes age 60.

The CFO has also suggested a shift in the asset allocation as follows:

<table>
<thead>
<tr>
<th>Current</th>
<th>CFO Proposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Equities</td>
<td>40%</td>
</tr>
<tr>
<td>Global Equities</td>
<td>15%</td>
</tr>
<tr>
<td>Bonds</td>
<td>35%</td>
</tr>
<tr>
<td>Cash</td>
<td>10%</td>
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</tbody>
</table>

a) Evaluate the appropriateness of the current funding assumptions and methods for the amended plan and recommend any changes. Assume no change from the current asset allocation.

b) Evaluate the appropriateness of the current asset allocation and the CFO’s proposal as a strategy for this amended plan.
**SOLUTION—QUESTION #3**

Comments

1. If there is a desire to control costs, why are the benefits being improved? I would have expected a reduction in benefits. What does control costs mean?

2. Question a) should specify that the response should ignore the change in asset allocation.

3. The pension expense assumptions in the case study should be more prominent.

4. Consider merging questions a) and b) together or switching the sequence of b) and c) and incorporating the change in asset mix in the answer for the current question b).

5. I ignored the 20% investment restriction, as it is possible for plan sponsors to exceed the 20% limit.

**Question a)**

**Relevant Plan Provisions**

<table>
<thead>
<tr>
<th></th>
<th>Current Plan</th>
<th>Amended Plan</th>
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</thead>
<tbody>
<tr>
<td>Normal retirement benefit</td>
<td>1% CAE, updated to 1994 earnings</td>
<td>1% CAE, updated to 1999 earnings</td>
</tr>
<tr>
<td>Early retirement benefit</td>
<td>½ of 1% from age 62</td>
<td>¼ of 1% from age 60</td>
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**Relevant Actuarial Assumptions and Methods**

<table>
<thead>
<tr>
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<th>Current Plan</th>
<th>Amended Plan</th>
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</thead>
<tbody>
<tr>
<td>Interest</td>
<td>7.5% per annum</td>
<td>7.5% per annum</td>
</tr>
<tr>
<td>Salary scale</td>
<td>5.0% per annum</td>
<td>5.0% per annum</td>
</tr>
<tr>
<td>Turnover</td>
<td>Tabular</td>
<td>Tabular, unless justified by plan experience</td>
</tr>
<tr>
<td>Retirement age</td>
<td>64</td>
<td>50% at age 60, 50% at age 65</td>
</tr>
<tr>
<td>Actuarial cost method</td>
<td>Accrued Benefit Cost Method</td>
<td>Accrued Benefit Cost Method</td>
</tr>
</tbody>
</table>

1. The actuarial liabilities are based on salaries and service to the valuation date. There is no projection of salaries. Therefore, the salary scale is not used. Similarly, the inflation assumption is not used.

   If the actuarial cost method were changed to project and pro-rate the benefits, the salary scale would be used. However, this would result in larger actuarial liabilities. As cost control is an issue, this change is not recommended.

2. Turnover is more critical because of the loss of the early retirement subsidy for vested members. Assumptions should be reviewed due to early retirement improvements. Any change in the turnover assumption should be justified by plan experience.

3. The retirement age should be reviewed with the possibility of it changing. In the absence of any experience on which to base the assumption, the retirement age assumption should reflect both the lower age at which an unreduced pension is available and the higher subsidy for retirements before age 60.
A reasonable assumption would be 50% retire at age 60 and the balance at age 65. This is based on the assumption that plan members will wait to receive an unreduced pension and that some plan members enjoy their job and will want to work to age 65. It is recommended that this assumption be reviewed with each subsequent valuation as experience emerges.

4. Consideration should be given to reducing the interest assumption to be more conservative (e.g. 5.5% or 6%). This will provide an implicit margin for future earnings updates and ad hoc increases, as was done in the past. This would assist in achieving the goal of controlling costs, as it would be built into the annual contributions.

Question b)

Relevant Economic Assumptions

<table>
<thead>
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<th>Current Plan</th>
<th>Amended Plan</th>
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</thead>
<tbody>
<tr>
<td>Return on Assets</td>
<td>9.0% per annum</td>
<td>9.0% per annum</td>
</tr>
<tr>
<td>Discount rate</td>
<td>8.5% per annum</td>
<td>8.5% per annum</td>
</tr>
<tr>
<td>Salary scale</td>
<td>5.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Consumer price index</td>
<td>3.0%</td>
<td>3.0%</td>
</tr>
</tbody>
</table>

1. The change in the plan provisions will have no effect on the return on assets assumption.

2. The change in the plan provisions will have no effect on the discount rate assumption (determined by “settlement rate”).

3. If the salary scale was appropriate for the plan before the changes, there is no need to change it solely because of the change in the plan. A change in the salary scale is not recommended.

4. The change in the plan provisions will have no effect on the consumer price index assumption.

Question c)

1. There appears to be a pattern of updating the career average benefits periodically. Therefore, the assets should be invested to provide the necessary returns to support a liability that will be periodically updated.

2. The current asset allocation is typical for a pension fund – 55% in equities (including the exposure to foreign equities) and 45% in bonds and cash. Given that the updates to accrued benefits are not contractual, but rather provided on an ad hoc basis, this asset mix is appropriate.
The asset allocation is rather conservative in respect of the obligations that the assets are supporting (after factoring in the practice of ad hoc updates). The allocation to bonds and cash is at the high end of the spectrum.

The allocation between domestic and foreign equities again is typical for most pension funds and is neither aggressive nor conservative.

The overall asset allocation is conservative. It is likely that excess returns would be generated to assist in funding benefit improvements, however, it is unlikely that this asset allocation would assist with the goal of controlling costs. The cost though would be more stable (as compared against the CFO's proposal).

3. Changing the asset allocation to 60% equities / 40% bonds and cash should assist with the desire to control costs. However, this lower cost is expected over the long-term. Over short periods of time, the return on the pension fund assets may be lower (than under the current asset allocation). The CFO should be aware of this fluctuation and the company should only make this change if it can withstand this fluctuation.

4. Increasing the foreign component will assist by diversifying the risk for the component invested in equities.

However, the liabilities are domestic. The CFO’s recommended allocation of 30% to foreign equities is at the high end of the spectrum. Any allocation to foreign equities in excess of 30% is not recommended.

5. Reducing the cash component will assist with the cost control goal, as a larger proportion of the pension fund will be invested in assets that are expected to earn greater rates of return.
QUESTION #4 – (7 points)

Your company has been hired by the new management of MainCo to replace MainCo’s current actuary and pension consultant.

MainCo’s new management was recruited from high tech companies and has a mandate to remake MainCo. Their strategy is:
- to hire young aggressive workers
- to focus on new high tech products for MainCo
- to stay on the cutting edge in technology, encourage a steady flow of new hires
- to maintain a minimal number of employees, and therefore, they anticipate a fairly high level of employee burnout.

Your company was hired with the mandate to replace the current worldwide pension arrangements with an arrangement that meets the goals of MainCo’s new management, which can be summarized as follows:

- Retirement programs will be applied across North America.
- Retirement programs will be attractive to new recruits.
- A traditional defined benefit approach should be maintained as the core benefit program.
- Lump sum distributions of retirement benefits is inappropriate.
- Retirement program costs should be fixed and predictable.
- Retirement programs must be easy to administer.

a) Critique whether MainCo’s retirement benefit goals are consistent with the new business strategy.

b) Critique the MainCo Salaried Employees’ Pension Plan and Savings Plan against the list of retirement benefit goals.
**SOLUTION—QUESTION #4**

a) Critique whether MainCo’s retirement benefit goals are consistent with the new business strategy

MainCo’s retirement benefit goals appear to be at odds with the strategy to remake MainCo.

- The strategy will encourage high turnover after relatively short periods of service. The benefit goals appear to reward long service, consistent with the existing group of MainCo employees.
- New recruits are usually aware of the existence of a retirement program. The absence of a retirement program may be a disincentive to join an organization but the details of a traditional defined benefit program will not be an incentive for young, aggressive high-tech employees to join an organization.
- A traditional defined benefit approach can provide relatively stable, predictable costs for an average group of employees, in a low-inflation environment. Some designs, for example, career average rather than final pay formulas, also help with predictable costs. However, fluctuations in assets, unpredictable economic fluctuations, and rapid increases in compensation for some employees, costs for defined benefit plans often are unpredictable. Valuation methods and assumptions can also help with providing predictable stable costs but cannot always manage to smooth fluctuations.
- An HR strategy that encourages high turnover will not benefit from a benefit design that accrues benefit value slowly at young ages and faster at older ages. A highly mobile, aggressive young workforce will be looking for a total rewards package providing opportunities for rapid accumulation of wealth, whether through salary increases, stock options, or cash accumulation, and ease of portability as ties to the current employer are not expected to be long and should not be viewed as handcuffs.
- From MainCo’s point of view, both the ability to attract new hires and the ability to facilitate transition out of its workforce of employees with burnout are important. Portability of benefits, considerable build up of wealth in the benefit program at early ages, and visibility of those benefits when employees are reaching the stage of burnout should all be objectives of the new benefit programs.
- Benefit programs other than the traditional defined benefit approach will be easier to administer and easier to apply across North America.

b) Critique MainCo’s Salaried Employees’ Pension Plan and Savings Plan against the list of retirement benefit goals.

MainCo’s existing Pension Plan and Savings Plan are more consistent with the stated retirement benefit goals than with the new business and HR strategy.
The lack of a savings plan for SubCo is clearly inconsistent with a goal to have the same benefits across North America. MainCo’s pension plan is a final average plan vs. a career average for SubCo, again a major distinguishing characteristic for plans across North America. Essentially the features of retirement benefits offered to salaried, union, and Canadian vs. US employees are fundamentally different rather than the same across North America.

The vesting schedule in the existing MainCo pension and savings plans and the match in the savings plan could be attractive to new recruits. Very little else appears to be targeting new hires but rather rewarding long service employees, that is focused on retention.

For the savings plan, providing benefit statements only once a year also does not keep the value of the benefit in front of the employees. Thus, some of the effectiveness of the savings plan as a tool, either in retaining employees, or reminding them they have resources available should they decide to leave is lost.

The goal of having a traditional defined benefit approach as the core benefit program would be enhanced if the matching rate were reduced in the savings plan and the benefit accrual rate increased in the defined benefit plan, thus improving the attractiveness of the defined benefit plan. It is not usually necessary to have a 100% match in the savings plan to encourage active participation by employees.

The lack of lump sums in the defined benefit plan reinforces the idea that the plan is there to provide retirement income.

A final average pay defined benefit plan will be less likely to have fixed, predictable costs than a career average plan or a savings plan. On the other hand, some changes in the funding methods would help with predictability of costs. Additionally, the projected unit credit cost method is going to result in gradually increasing costs for existing employees by definition; using a smoothing technique for the actuarial value of assets would also help maintain stable, predictable costs for the pension plan.

The ad hoc cola in the pension plan is obviously going to complicate administration of the plan. MainCo would probably be better served to eliminate the ad hoc cola and provide a larger retirement benefit initially if the goal is administrative simplicity and ease. Providing statements only once a year from the savings plan obviously helps with administrative ease and simplicity but defeats other purposes of providing a savings plan.
**QUESTION #5 – (12 points)**

You have been hired by GiantCo, a very large multi-national company headquartered in the U.S.

GiantCo has recently purchased controlling interest in MainCo and JointCo. GiantCo has announced:

**MainCo**
1. MainCo will close all non-core facilities.
2. MainCo will be downsized by approximately 30% of salaried and 50% of hourly employees’ effective January 1, 2000.

**SubCo**
1. SubCo’s plant will be closed and all hourly employees terminated.
2. 30% of SubCo’s salaried employees will be terminated.
3. New production facilities will be established in India.

**JointCo**
1. The joint venture will be abandoned.

GiantCo sponsors a base pension plan that provides for 0.7% of final average earnings up to Social Security base and 1.3% of final average earnings in excess of the Social Security covered compensation with minimal ancillary benefits.

GiantCo also sponsors a 401(k) plan where the company provides a 25% match on the members first 3% of base pay contribution.

All MainCo and SubCo employees will be enrolled in the GiantCo plan. The MainCo and SubCo Salaried Employee plans will be frozen at the current level of accrued benefits. The MainCo and SubCo executive benefits programs will be terminated.

a) Recommend changes to the existing funding methods and assumptions for the “frozen” MainCo Salaried Employees pension plan.

b) Determine the effect on the fiscal year 2000 pension expense from the closing of the SubCo plant.

c) Project the accounting expense for the SubCo salaried employees pension plan, for two years, assuming no change in current assumptions.

d) Compare the current MainCo and SubCo programs to the GiantCo programs from the perspective of the remaining employees.
**SOLUTION - QUESTION #5**

(a) Current method is projected unit credit  
Current assumptions include interest of 7.5%, salary scale of 5.0%, GA71 mortality, and termination scale. *(need to clarify if any liability held in respect of ad hoc indexing – assume none)* Because benefits are now frozen, new assumptions should be chosen that reflect the fixed nature of the obligation. A “best estimate” approach to selecting assumptions, with some margin for adverse deviation, is most appropriate to the new situation.

With freeze of benefits, need to eliminate salary scale, and value frozen accrued benefits only. Would recommend reduction in interest rate, probably to 6.5% or 7.0%, depending on asset mix used. Actual rate would be expected long-term return on the pension fund, less a margin for adverse deviation. If GiantCo intends to continue ad hoc indexing, should include indexing assumption. If future indexing to be dependent on future experience gains, no additional reserve is necessary. Termination scale should be eliminated, as no gains should be realized from future terminations. For simplicity, assume no pre-retirement terminations or death (continue assumption of 100% married, for small degree of conservatism). Unless there is evidence of mortality experience supporting the current assumption, recommend moving to a more recent mortality table, such as GAM83. The older table may have mortality rates that are too high versus future expectations, and may understate current liabilities (note recent loss on mortality – need to check other years to see if this is a continuing trend). Assumed retirement age should be reduced to 62 to avoid potential losses on early retirement (no longer offset by effect of salary scale – again, note recent loss on early retirement). Assets may continue to be valued at market. Presumably, any fluctuation in funding levels for the MainCo plan will be small relative to GiantCo’s overall funding, and should not be cause for concern.

*(a number of solutions will be acceptable for this question. It is important that the student justify the choice of assumptions, appropriately recognizing the change in circumstances)*

(b) Closing of SubCo plant will trigger a curtailment of the Hourly Plan, and a 30% curtailment of the Salaried Plan (assume settlement will not occur until a future fiscal year).

Salaried Plan  
The curtailment is assumed to decrease the PBO (removal of salary scale, partially offset by increase in benefit values due to recognition of early retirement subsidy). Assume that the reduction in future years of service will be 30%.
Recognition of Prior Service Cost = 30% x 650,000 = $195,000
Change in PBO due to curtailment (assumed) = ($100,000)
Unrecognized net loss = 30% x 322,500 = $96,750
Unrecognized net (gain) at transition = 30% x (900,000) = ($300,000)
Combined unrecognized net (gain) = $96,750 + (300,000) = ($203,250)
Curtailment (gain) = ($100,000) (don’t increase gain with unrecognized net gain)
Amount recognized in earnings, as a loss = $195,000 + ($100,000) = $95,000
Other changes – reduction in interest cost of 8.5% x 100,000 = $8,500
- amortization of prior service cost reduced by 30% = $15,000
- no further Service Cost or interest on Service Cost (1.085 x $825,000 = $895,125)

Hourly Plan
Assume no change in PBO due to curtailment. Increase in liabilities due to special plant closure provisions will be treated as termination benefits. Assume cost of termination benefits is $300,000.

Recognition of Prior Service Cost = $100,000
Change in PBO due to curtailment (assumed) = $0
Unrecognized net (gain) = ($122,500)
Unrecognized net (asset) at transition = ($90,000)
Combined unrecognized net (gain) = ($122,500)+($90,000) = ($212,500)
Curtailment (gain) = $0
Loss from termination benefits = $300,000
Amount recognized in earnings, as a loss = $100,000 + $0 + $300,000 = $400,000
Other changes – amortization of prior service cost eliminated - $10,000
- no further Service Cost, or interest on Service Cost (1.085 x $159,500 = $173,058)

(c) All benefits frozen, so no further Service Cost.

Interest Cost = 8.5% x (($15,060,000 – 0.5 x ($500,000 + 95,000 + 250,000)) = $1,244,188 – round to $1,244,200
Expected return on Assets = ($1,530,000) (no change from original calculation)
Amortization of:
   Unrecognized Net Transition (Asset) = ($100,000)
   Unrecognized Prior Service Cost = $35,000
   Unrecognized (Gains) Losses = 24,800
Net Periodic Pension Cost = ($326,000)

For following year, expected PBO = $15,060,000 + $1,244,200 - $595,000 - $250,000 = $15,459,200
Actual PBO = Expected PBO (assumed)
No gain or loss on PBO
Expected Fair value of Assets = $17,000,000 + $1,530,000 - $595,000 - $250,000
= $17,685,000
Actual Fair value of Assets = Expected Assets (assumed)
No gain or loss on Assets
Unrecognized Losses = $322,500 - $24,800 = 297,700
Assume benefit payments and expense unchanged from previous year
Interest Cost = 8.5% x ($1,549,200 – 0.5 x ($595,000 + $250,000)) = $1,278,120
Expected Return on Assets = 9.0% x ($17,685,000 – 0.5 x ($595,000 + $250,000)) = ($1,553,625)
Amortization of:
  Unrecognized Net Transition (Asset) = ($100,000)
  Unrecognized Prior Service Cost = $35,000
  Unrecognized (Gains) Losses = $297,700/13 = $22,900
Net Periodic Pension Cost = $317,600 (rounded to nearest $100)

(d) For most MainCo Salaried Employees, GiantCo benefits will represent a cut in benefit levels. The normal retirement benefit will be the same for employees earning twice the YMPE, but most earn slightly less than this amount. Therefore, most of their earnings will be subject to the 0.7% accrual rate, versus 1.0% currently. For the high earners, benefit accruals will be higher due to the 1.3% accrual rate on earnings above the YMPE. We aren’t told what the ancillary benefits are under GiantCo, just that they are minimal. We can probably assume that the subsidized early retirement under the MainCo plan will be lost, further reducing benefits for employees. The normal form may or may not be less valuable. If GiantCo makes the Group RRSP contribution rates the same as their 401(k) plan, this will represent a further cut to benefits for MainCo employees (loss of 75% of the match on the first 3% of contributions). All in all, the MainCo employees will suffer a reduction in retirement benefits.

For SubCo Salaried Employees, the GiantCo benefits will represent an overall increase in benefit levels. The 401(k) plan is new, as no defined contribution arrangement was provided before. And while the benefit accrual formula is lower under the GiantCo plan, it is a final average plan, while there was no guarantee that their career average plan would be upgraded periodically.
BritCo, a very large multi-national company headquartered in the UK, has recently purchased controlling interest in MainCo.

BritCo provides a single retirement savings program for all of its worldwide employees. The main provisions of the BritCo plan are as follows:

- **Basic Design:** Defined contribution.
- **Company Contributions:** 3% of base pay plus 100% match of member contributions to 3% of base pay (i.e. 6% maximum).
- **Member contributions:** Up to 6% of base pay.
- **Vesting of company contributions:** 20% per year to 100% after five years.
- **Fund Management:** By BritCo. Members receive average fund rate of return. All investments in worldwide equities.
- **Eligibility:** January 1 following six months of service.

You are the actuary for MainCo and have been asked for your preliminary comments on introducing the BritCo program for all MainCo and SubCo employees effective January 1, 2000.

**a)** Evaluate the advantages and disadvantages of BritCo’s program from the perspective of:

1. MainCo salaried employees
2. MainCo hourly employees

**b)** Critique BritCo’s investment policy with respect to the SubCo salaried employees. Recommend any changes. Justify your recommendations.

**c)** Project the financial impact of this change for a 50-year-old SubCo salaried employee using reasonable assumptions. Justify your assumptions.

**d)** Evaluate the options that BritCo has regarding the current MainCo and SubCo Salaried Employees pension plans given that these employees will be moved to the BritCo plan.
**SOLUTION – QUESTION #6**

a) **Evaluate the advantages and disadvantages of BritCo’s program from the perspective of MainCo salaried and hourly employees.**

- Current employees participate into a Defined Benefits (DB) plan; the proposed new plan is a Defined Contribution (DC) scheme. A DB to DC plan conversion is a major change in retirement benefits design.
- The Canadian context of MainCo will influence to some extent the answer, as country specific provisions may apply. Moreover, Canadian provinces have varying provisions with respect to plan conversions.
- Plan conversion would have to be approved by supervisory authorities.
- This adds a layer of complexity to the retirement benefits communication issue: while a DC plan is usually better understood by plan members, it is not necessarily a better retirement package. A DB plan, such as the one currently in place for MainCo employees, provides for a retirement income promise. The current group RRSP plan provided to salaried employees allows employees some latitude in supplementing the DB plan retirement income provisions. This combination of non-contributory DB plan and Group RRSP is fiscally efficient, provides for a good combination of employer provided benefit safety and facilities for employee retirement savings. The reasons for and the consequences of the transition will have to be properly explained to current plan members.
- The new plan is contributory while the old plan is non-contributory: salaried employees not currently contributing to the Group RRSP will see a decrease in total compensation if they do not contribute to the new plan, due to the employer matching of employee contribution. If they do contribute, the take-home pay will be lessened, and this may not be well perceived.
- The new design may not meet the current retirement needs addressed by the plan already in place: actually, the current design is typical of a good retirement program under current Canadian environment.
- The current Salaried plan has a normal cost of 5.6% of pay, and a pension expense of $45,750,000 on a $1,042,100,000 payroll, or 4.3% of pay.
- The Union plan has an estimated $69,790,000 normal cost, or 2.4% of payroll ($2,960,000,000), while the pension expense is $59,555,000 in 1999, or 2.0% of payroll.
- The proposed plan provides for a 3% Employer Contribution plus a match of Employee contribution resulting in a maximum 6% Employer Contribution. This is much more than the current cost for Union employees and more than the current Salaried plan cost. Considering the assumptions with respect to withdrawal rates and experience gains & losses for both plans related to this assumption, an important part of the future employer contribution to the DC plan will be directed to the RRSP of terminating employees, leaving less retirement resources for employees attaining retirement within the company. This change in allocation of resources from older employees to younger ones is a major change in total compensation and a direct consequence of switching from a DB to a DC plan. This may not be well perceived.
from plan members, a majority of which are older (more than 13,000 out of 20,000 salaried employees are over age 45 according to age/service distribution; Union plan corresponding figures are 48,000 out of 80,000 plan members over age 45).

- The current salaried plan is more generous than the union plan. The proposed change will remove this retirement benefits differential, resulting in dissatisfaction amongst salaried employees (and potential incentive to unionize).
- The Union plan is a collectively bargained pension plan. Changing benefits provisions means opening negotiation, an issue not necessarily desired by MainCo and the Union. Furthermore, providing for more generous benefits unilaterally may send various signals to union officials and employees with respect to total compensation and profitability.
- The new DC plan transfers risks to the plan members. Older plan members are more likely to lose than to gain in such a conversion. Younger members will have a longer accumulation period and more time to adjust their retirement savings strategy.
- Various desirable features of the current plan will be lost if the conversion occurs:
  - post retirement inflation adjustment will be lost or will decrease the initial amount of the annuity bought at retirement;
  - protection from inflation before retirement will be linked to the fund investment performance and not to the pre-retirement salary, which increase the uncertainty related to retirement benefits adequacy;
  - the current early retirement benefits are slightly subsidized (6% per year, some might say approximately actuarially equivalent) for retirement between age 55 and 62 and heavily subsidized for retirement after age 62 (no penalty);
  - union employees will lose the early retirement supplement
  - under the new design, many employees will cling to their employment until their savings are sufficient. This may be in contradiction with the needs of the human resources department with respect to a dignified way to terminate the employment of less productive older employees, and capacity to keep hiring new younger employees.
- There are pension expense reporting issues related to a plan conversion. The cost of conversion will be recognized in full in the year of occurrence of the conversion, and not amortized over a longer period. Combined to legislative requirements with respect to plan conversion and plan curtailment, this recognition may create a significant challenge for the profitability of the company, and may encourage the company not to go forward with the plan conversion.
- The Union plan comprises special benefits on Plant Closure: these benefits would have to be considered upon conversion. The cost associated with this could be significant.
- The vesting rules would have to be changed to comply with legislative requirements (full vesting after 2 years of participation).
- With respect to plan eligibility, some provinces (eg Quebec) may force to consider members with earnings over 35% of YMPE or with more than 700 hours in the preceding year). The salaried plan currently provides for immediate eligibility: the new design is less generous (wait until January 1).
Usual advantages and disadvantages of DC plan vs DB plan would apply in this case:

DC plans:
- easy to set up and administer
- no actuarial valuation required
- easy to understand for plan members and sponsor
- good for young employees, especially for those with high salaries
- fiscal advantage (In Canada, avoid the concept of Defined Benefits Pension Adjustment impact on RRSP contribution)

but
- no protection for early retirement: no subsidy from plan sponsor
- has to pay for spouse protection by having a lower pension, supposing that a DB plan would have a joint and survivor option paid entirely or subsidized by the plan sponsor.
- risk of low/bad rates of returns during investment period borne entirely by employee: no risk transfer to plan sponsor.
- risk of low interest rate at time of retirement when an annuity is bought: less certainty on amount of retirement income: amount can fluctuate a lot if rates fluctuates.
- lose eventual cost-of-living adjustment that a pension plan could provide under an ad-hoc fashion to current pensioners when excess returns / surplus are available in DB plan.

b) **Critique BritCo investment policy. Recommend changes. Justify changes.**

- Investment policy not acceptable from Canadian standpoint: a limit exists on the % of foreign investment allowed in some countries. (20% in Canada, even though there are ways to go around this limit to some extent).
- Bad idea to have the employer decides on investment policy for employees fund
- Employer will be held accountable by employees when returns are low because they had no choices: potential liability or cause for resentment.
- Funds must follow provincial legislative requirements with respect to guidelines for investment policy
- More appropriate to let employees decide their own investment policy for their account, maybe with the employer limiting the options available.
- Imperative that the employee understands that he is responsible for the investment performance of his account, and may not blame the employer if markets go down. This issue will require a communication effort directed to all concerned employees, and a written investment policy stating the limits of the employer responsibility.
- For instance, make available an employer selected subset of stocks, bonds, cash-equivalent, international equities funds with an employer-selected plan administrator, possibly with employer-subsidized administration fees/ fund management fees, such as the current situation for the Group RRSP provided to salaried employees.

- few years to build up a fund until retirement. Usually better under a DB arrangement for older employees.
- Problem of potentially 2 pensions: old arrangement for service prior to transition date and new plan after transition date.
- low employer contribution in new plan, compared to what would be provided in a DB plan funded under Unit-credit or Projected Unit Credit method (even though the employee would not necessarily see the funding part).
- Would result under lower pension when retirement at age 62 is considered.
- A reasonable set of assumptions should be provided in the answer, with an emphasis on expected returns for the next 15 years (age 50 to age 65). Would require interest rate on employee account consistent with the salary increase assumption. Should also take into account inflation assumption, due to post retirement indexation historically provided by current plan.
- should mention that rates of return are quite variable on international equities.
- problem if retirement occurs in a year of low investment return: lower annuity on the market.
- theoretically, DC arrangement are better for long service employees, or younger ones: less time to rebuild assets, after market downturn, before retirement for older employees.
- total of 12% salary contribution: will not fund a large pension for an older employee.
- lose early retirement incentives and other ancillary benefits in current plan, for future service at least.

d) Evaluate options for BritCo, if employees will be moved to new plan.

- Leave old plan in place: does not seem to be an option for the moment, but should strongly be reconsidered, possibly with some plan modification if cost is the main issue.
- adopt a different strategy for Union and Salaried plans to avoid new negotiations: keep current plan in place for Union employees, force Salaried employees into new plan.
- Terminate existing DB plan, or transform it and allocate value of accumulated benefits to tax sheltered accounts.
- Adapt proposed BritCo plan to local while maintaining the general design, especially in term of level of employer contribution and matching.
- consider a grandfather clause for existing employees at transition time (stay in old plan): administrative problems but better for older employees.
- force new employees in new plan or allow election between old and new plan.
- still have to meet promises made for service prior to transition date if pension promises from current plan are not transferred to DC/other arrangement.
QUESTION #7 – (13 points)

SubCo and NewCo have decided to establish a second joint venture company, MetalCo. MetalCo will be located in Sandaneria, a foreign country with an abundance of a particular metal that is used extensively in the production of NewCo and SubCo’s component parts. MetalCo will establish mining facilities in Sandaneria and ship the metal to JointCo production facilities in the U.S. MetalCo is expected to employ approximately 500 workers, all of whom are residents of Sandaneria.

Employer-sponsored retirement programs are rare in Sandaneria and consequently there is no government regulation of private plans. Contributions to such plans do not receive any favored tax treatment. Sandaneria maintains a nation’s defined benefit social insurance program that provides minimal pay-related retirement benefits for its citizens.

The joint venture committee has directed that MetalCo will provide an employer-sponsored retirement program for its Sandanerian employees. This directive is based on mutual agreement between MetalCo management and the committee that MetalCo should provide retirement benefits to MetalCo career employees that allow continuance of the family’s preretirement standard of living into retirement. The committee has recommended the adoption of a retirement program identical to the SubCo Salaried Employees Pension Plan and the SubCo Supplemental Executive Retirement Plan for MetalCo, although modified to take advantage of the lack of plan regulation in Sandaneria.

The new president of MetalCo has recommended that MetalCo adopt a cash balance pension plan, since it is much simpler than the SubCo program, while maintaining the protection for older workers under a defined benefit plan. The president advocates an unfunded plan, which credits a flat percentage of compensation for each year of service.

a) In accordance with the committee’s recommendation, evaluate the areas of the SubCo plan design that could be changed for MetalCo to take advantage of the lack of regulation in Sandaneria.

b) Critique the plan design suggested by MetalCo’s president in light of his stated objectives.

c) Recommend a retirement program for MetalCo, which considers the committee’s recommendation, the president’s recommendation and the unique situation that exists in Sandaneria. Justify your recommendation.

(For Canada: Replace cash balance plan with an age related defined contribution plan.)
SOLUTION–QUESTION #7

a) In accordance with the committee’s recommendation, evaluate the areas of the SubCo plan design that would be changed for MetalCo to take advantage of the lack of regulation in Sandaneria

1. Eligibility/Participation/Coverage – Under the SubCo Plan, all salaried employees participate under the plan immediately. This definition is the most liberal eligibility provision that a plan could have, and would obviously meet any regulatory minimum age/service requirement that is imposed. Employers use minimum waiting periods for plan participation to avoid covering short-service, high-turnover employees under their pension plans. Without regulatory restraints, MetalCo is free to impose any minimum age or service requirement for their new plan.

Further, MetalCo has the option to vary the eligibility for plan participation across various groups of its employees, such as hourly vs. salaried, production vs. management, etc. In countries where there is regulation of pension plans, rules are generally in place to ensure uniform coverage of all employees under employer retirement programs. MetalCo is free to use varying eligibility requirements that reflect different turnover patterns of employee groups, or may choose to exclude certain groups from participation entirely. An example of a group to be excluded may be extremely low-paid employees who receive adequate benefits from the national social insurance program.

2. Vesting – Use of vesting schedules to provide an employee non-forfeitable ownership of pension benefits works in tandem with eligibility provisions to avoid the payment of small pension benefits to short-service, high-turnover employees. The SubCo 5-year cliff vesting schedule would be representative of regulated minimum vesting schedules. MetalCo is free to use a more or less liberal schedule, and can vary the vesting schedule across groups of employees to recognize different turnover patterns. The “extreme” case would be for MetalCo to provide essentially no vesting, where pension benefits are only payable upon reaching a plan event (retirement, death, disability) that results in immediate commencement of benefits.

3. Retirement Ages – The SubCo plan uses a normal retirement age of 65 and early retirement at age 55 with 5 years of service. Minimum normal retirement ages are generally prescribed by regulation, and consist of either a maximum age or a combination of age and years of plan participation. The availability of early retirement is largely employer controlled and not a provision that is mandated by regulation.

MetalCo would have the option to set early/normal retirement ages based on demographics of its employees and on its evaluation of the desirable age for
retirement their employees. Retirement age is another plan design issue that may be appropriately varied across groups of employees. The proper retirement date for mining employees may be quite different for management employees. Also, the age at which national social insurance benefits become available may be important in setting retirement ages for the MetalCo plan.

4. Earnings – The SubCo plan uses total compensation for purposes of plan benefits, which includes overtime, bonuses and commissions. In countries where pension benefits are regulated, plan compensation definitions must meet guidelines that are in place to prevent discrimination among classes of employees. For example, it may not be possible to use an earnings definition that excludes overtime earnings and includes bonuses. Since overtime may be a significant portion of a lower-paid earner’s income, while bonuses constitute a significant portion of a higher-paid worker’s total income, such a earnings definition results in benefits that are relatively less for lower-paid employees as compared to higher-paid employees.

MetalCo is free to choose any definition of compensation that it feels is appropriate for its employees. The actual definition chosen would depend on the extent of earnings paid in addition to base compensation, such as overtime and bonuses. If overtime is not significant and largely voluntary, it may be appropriate to only use base compensation for pension benefit calculation. If mining employees are expected to routinely work overtime to meet NewCo and SubCo production demands, then such earnings become an integral part of annual income and should be considered replaceable in retirement. Bonuses would be treated similarly, i.e. if bonuses are consistent and widespread from year to year, they become a “regular” component of income and should be considered in setting pension plan income replacement goals. If bonuses are more like immediate profit sharing payments occurring with less regularity, it may be appropriate to omit them from the plan compensation definition.

5. Retirement Benefit Amounts and Forms – The design of the SubCo salaried plans provides a uniform 1% career average benefit formula for all participants, with the CEO and COO receiving additional benefits through a SERP. In countries where pension plan benefits are regulated, rules require that benefits be determined uniformly across all plan participants and that they are accrued in a uniform manner over the period of an employee’s participation under the plan. Where benefits are coordinated with other plans, e.g. other employer plans or national social insurance plans, the method and amount of coordination is highly regulated.

Given the lack of regulation, MetalCo has the opportunity to custom tailor the level of benefits under their plan to meet their retirement income objectives. Specifically, they have the option to provide different levels of benefits for different groups of employees and they can fully coordinate or offset the benefits under their plan with Sandanerian social insurance benefits. Under the SubCo
SERP, there are offsets for benefits provided from other plans. For MetalCo, there would be no need to maintain the SERP at all; MetalCo executives could receive benefits under the MetalCo pension plan that match the SubCo SERP benefit levels, with other employees receiving a lesser level of benefits.

Since it is a stated objective that MetalCo provide pension benefits for career employees, MetalCo may take advantage of a back-loaded pension formula that earns higher benefit credits for later years of service. MetalCo would also have “free-reign” to subsidize optional forms of benefit if it so chose. In many regulated environments, optional forms of benefit must be largely actuarial equivalent to basic plan forms. Since it desires to provide family retirement income to its employees, MetalCo may offer significant subsidies under joint and survivor options to ensure continued income to the employee and his or her spouse.

6. Ancillary Benefits – In regulated environments, certain minimum death and termination benefits such as those under the SubCo plan are prescribed. MetalCo would be free to include or exclude such ancillary benefits, as it sees fit. The level of termination benefits would normally be a function of vesting and the retirement benefit formula discussed earlier. Typically a plan would pay the vested amount of retirement benefit at an event that would trigger benefit payment had the employee continued working (e.g. early/normal retirement, death, etc.)

Given the objective of paying family retirement income to its employees, there should be some death benefit payable from the MetalCo pension plan. The level of this benefit would depend on other death benefits payable form MetalCo, e.g. life insurance coverage and the level of retirement benefits payable from the plan.

b) Critique the plan design suggested by MetalCo’s president in light of his stated objectives.

MetalCo’s president may be correct that a cash balance plan is “simpler,” but the rest of his logic is not consistent with his stated objectives and the objectives of the committee.

He advocates a cash balance plan that credits a flat percentage of compensation for each year of service, which will appear to function as a defined contribution plan during an employee’s working years. This design will be perceived as simple and more straightforward by the employee, as they can all understand and appreciate an account where money is set aside and accumulates each year with investment earnings, with the amount payable at any point in time equaling the accumulated lump sum.

In contrast, the SubCo plan is traditional defined benefit, crediting an employee with 1% of earnings each year as an annuity benefit beginning upon attainment of retirement age. While this plan is simple as far as defined benefit plans go, it would
not be perceived by employees to be as simple as the cash balance plan, due to such things as having to attain retirement ages to receive benefits, early retirement reductions, actuarially equivalent annuity options, etc.

A cash balance plan that credits a flat percentage of compensation does not maintain protection for older workers as does the SubCo-style defined benefit plan. Under the president’s design, the value of each year’s cash balance accrual is the same percentage of compensation for all employees, regardless of age. Under the SubCo design, each year’s accrual is relatively more valuable for older workers since they are closer to the date of benefit commencement. Also, since a cash balance plan benefit is communicated in terms of a lump sum accumulation, payouts will likely be elected in lump sum form. Payment of lump sums significantly decreases the likelihood that the plan will provide ongoing retirement income protection, as is the stated objective of both the committee and the president.

Finally, the fact the president wants the plan to be unfunded obviously flies in the face of the retirement income/protection objective. While the tax leveraging of prefunding is not available in Sandaneria, an unfunded plan would provide no retirement security for MetalCo employees and would cause significant accrued accounting liabilities to develop on MetalCo financial statements. A lack of prefunding would be especially difficult for the cash balance design advocated by the president, since the cash flow requirements to pay large lump sum benefits would be significant as MetalCo employees retired.

c) Recommend a retirement program for MetalCo, which considers the committee’s recommendation, the president’s recommendation and the unique situation that exists in Sandaneria. Justify your recommendation.

My recommended plan for MetalCo would be a prefunded defined benefit plan with a benefit formula providing 1% of each year’s earnings for each of the first 15 years of service, plus 2% of earnings for each year of service in excess of 15. All earnings (e.g. base, bonus, overtime, etc.) would be included in “earnings” for purposes of plan benefit computations. MetalCo executives would receive a benefit equal to 2% of final 5-year average pay times years of service up to 25 years.

All employees would be eligible for the plan after 5 years of service, and would become 100% vested upon the completion of 10 years of service. Plan benefits would be payable at age 65 or 10 years of participation under the plan, whichever is earlier. Actuarially reduced early retirement would available as early as age 55 with 10 years of service. Executives could receive unreduced benefits as early as age 60. Benefits would be payable, unreduced, on a 66-2/3% joint and survivor basis, with the participant’s spouse as contingent annuitant. No disability benefits would be payable. Preretirement death benefits would be provided as a life annuity to the surviving spouse equal to the actuarially equivalent of the present value of the employee’s accrued benefit. Upon termination of employment prior to retirement, a
vested employee would be entitled to a deferred annuity at normal retirement, or an actuarially reduced amount at the same early retirement date as for active employees.

My recommended design was chosen to very close to the design of the SubCo retirement program, consistent with the committee’s recommendation and objectives. This design provides for a flat percentage, non-integrated benefit formula that results in a very simple design, as advocated by the MetalCo president. Since national social insurance benefits are minimal and the fact that the SubCo plan is non-integrated, the complications associated with integration are not warranted. Total earnings would be used to avoid the complication associated with alternative earnings definitions.

The recommendation that the plan be prefunded is consistent with MainCo and SubCo’s other plans and the objective that the MetalCo plan provide for a secure retirement for its employees. Further, prefunding will avoid the accumulation of accrued pension liabilities on MetalCo financial statements.

The formula is richer than the SubCo formula, providing double the benefit credit after the first 15 years of service. In light of the objective to continue the preretirement standard of living into retirement, a formula somewhat richer than the SubCo formula was needed. This is particularly justifiable in Sandaneria where national social insurance benefits are minimal compared to the significant social insurance benefits available to SubCo employees. The backloading of the MetalCo formula allows the extra amount of benefit to be earned only by career employees and affords some degree of inflation protection since the later, higher-earnings years will receive the higher benefit credit. Both of these results are consistent with the committee objectives and the SubCo plan design where some inflation increases have been granted. The executive benefits are provided as part of the basic plan, for simplicity as well as security for the executives. With the lack of regulation in Sandaneria, no disclosure to non-executives of the additional executive benefits would be required.

Due to the emphasis on providing retirement benefits to career employees by MetalCo, the 5-year eligibility and 10-year vesting schedule were chosen. Early and normal retirement ages were chosen to dovetail with the vesting schedule and to reflect the SubCo design. These provisions are more restrictive than the SubCo design, but will prevent the provision of significant benefits to short-service, high-turnover groups of employees. Given the further emphasis of MetalCo that the plan should provide income replacement benefits to employees and their families, the unreduced 66-2/3% joint and survivor, as well as the preretirement death benefit, were included.

**Other recommended plan designs, along with supporting justifications, are possible**
QUESTION #8

You are the Chief Financial Officer for Rocks and Trees Inc., a resource company. Rocks and Trees provides a retirement plan for all members with the following features:

- **Defined benefit component (DB)**
  - Non-contributory
  - 1% final earnings benefit with generous early retirement features.
  - Plan is in a small funding deficit position.
  - Investment policy within the following parameters.
    - Stocks 50 – 70% of assets
    - Fixed income 20 – 40% of assets
    - Real estate 10 – 20% of assets
    - Short terms 0 – 10% of assets

- **Defined contribution component (DC)**
  - Members contribute up to 6% of salary.
  - Company matches member contributions at 50%.
  - Three investment options:
    - pooled stock fund
    - pooled bond fund
    - company stock fund

The total assets of the DB and DC components are comparable. A Statement of Investment Policy and Goals (SIPG) was created five years ago. The pension committee of the plan has asked you to review the SIPG.

a) Identify the major components of the SIPG for Rock and Trees retirement plan. (4 points)

b) Compare the fiduciary responsibility of the Pension Committee to the DB component to the fiduciary responsibility associated with the DC component. (3 points)

c) How does the monitoring and evaluating of investment performance differ between the DB and DC components? (2 points)

d) Rocks and Trees is considering winding up the DB component. Members would be given the choice of having their entitlements provided by the purchase of annuity contracts from a life insurance company or by the transfer of the value of their benefit to the DC component. Settlement of benefits is expected to occur in 9 to 12 months. Rocks and Trees wants to reduce investment risk. Discuss the investment risks faced by Rocks and Trees and identify two strategies to reduce investment risk. (3 points)
SOLUTION–QUESTION #8

a) Source
- AMRV – Chapters 20 and 21
- Study note (new) – Statement of Investment Policy

SIPG for DB plan to include:
- Duties and responsibilities of Pension Committee, investment manager, custodian, trustee
- Profile of plan
- Sponsor risk tolerance
- Return expectations
- Qualitative limits
- Quantitative limits
- Allowable investment range
- Conflict of interest policy
- Valuation of investments
- Lending of securities

SIPG for DC plan to include:
- Duties and responsibilities of Pension Committee, investment manager, custodian trustee, administrator
- Profile of plan
- Allowable investment options
- SIPG for each investment option that describes investment objectives, allowable investments, return expectations, investment risk considerations, qualitative limits, quantitative limits, allowable investment range, valuation of fund
- Plan limitations

b) Source: New study note on Fiduciary Liability that replaces SN363-34-94.

DB:
- establish and maintain SIPG
- ensure funding policy and investment policy act to ensure payment of benefits
- act in interest of beneficiaries

DC:
- act with knowledge of GRISA 404(c)
- diversification – 3 alternatives with different objectives
- transfers between options permitted at least quarterly
- investment choice and education
- monitor performance of investment options to ensure they are adhering to their stated objectives
c) Source
- AMVR Chapter 2
- Maginn & Tuttle – Chapter 13

DB monitors fund performance against plan’s SIPG. DC monitors performance of each alternative against objectives for that fund.

Within above overall approach, performance assessed against:
- stated objectives
- continuity of investment management team
- fees and expenses
- competitors with similar objectives
- target or passive portfolio
- individual asset class
- security selection vs. asset mix

d) Source
- AMVR – Chapters 20 and 23
- PR. Regulation – determination of wind up liabilities

Investment Risks
- Liquidity - need for funds within 1 year
- Short Term investment horizon – limited ability for longer-term forces to operate increases business risk as Rocks and Trees is responsible for deficit. Nature of liability has changed.
- Interest Rate – if interest rates decline, cost of settlements through annuity purchases increases:
  - if interest rates increase, value of assets, particularly fixed income assets, declines
  - may not know member elections until settlement approaches
- Market Risk – fall in stock values can create deficit since liability settlements are independent of stock performance. Stock gains provide excess return opportunity.

Investment Actions
1) Estimate liabilities to be settled by annuity purchaser and by transfer. Immunize by investing in long bonds for those liabilities expected to settle by purchase of annuities and short terms for those liabilities expected to settle by transfer.
2) Maintain active investment strategy. Insure risk through purchase/sale of derivatives to protect against interest rate risk.
1. (8 points) You are the actuary for a non-contributory defined benefit pension plan which was established on January 1, 1994. The actuarial cost method used in the initial valuation for this plan was the Projected Unit Credit method (linear proration). The Entry Age Normal method (level percentage of salary) will be used in the next valuation at January 1, 1997.

The initial unfunded accrued liability and any gain or loss due to a change in cost method are amortized over 15 years by annual payments made in advance and calculated at the same rate of interest as assumed in the valuation. All other gains or losses are amortized over 5 years.

You are given:

**Plan Provisions**
- Normal Retirement Age: 65
- Retirement Benefit: 1.5% of final earnings times years of service
- Normal Form of Payment: Life only, payable monthly in advance
- Other Ancillary Benefits: None

**Plan Participants**

<table>
<thead>
<tr>
<th>Employee</th>
<th>Age at 1/1/97</th>
<th>Service at 1/1/97</th>
<th>Earnings in 1997</th>
<th>Earnings in 1994</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>60</td>
<td>30 years</td>
<td>$60,000</td>
<td>$58,000</td>
</tr>
<tr>
<td>B</td>
<td>40</td>
<td>10 years</td>
<td>$40,000</td>
<td>$38,800</td>
</tr>
</tbody>
</table>

**Actuarial Assumptions**
- Interest Rate: 9%
- Salary Scale: 6%, at end of year
- Retirement Age: 65
- Pre-retirement Decrement: None
- $a_{65}^{(12)}$: 9.0
Plan Experience
@ No new members and no terminations have occurred over the 3-year period.
@ The investment returns for the fund for 1994, 1995, and 1996 were 10%, 11%,
and 12%, respectively.
@ Contributions equal to the 1994 Normal Cost and amortization payments for
the initial unfunded liability were made at the beginning of 1994, 1995, and 1996.
@ No payments have been made from the fund.

Determine the plan sponsor’s normal cost and amortization payments as at January 1,

Show all work.

**ANSWER TO QUESTION #1:**

Normal cost (PUC) = \( PVFB_{94} \times \frac{1}{\text{service to (65)}} \)

@ 1.1.94

\[
NC^A = 1.5\% \times \$58,000 \times (1.06)^{64\&57} \times 35 \times 9 \times \nu_{65\&57}^{9\%} \times \frac{1}{35} = \$5,908
\]

\[
NC^B = 1.5\% \times \$38,000 \times (1.06)^{64\&57} \times 35 \times 9 \times \nu_{65\&57}^{9\%} \times \frac{1}{35} = \$2,262
\]

Total \( NC_{94} \) = \$8,170

Accrued Liability (PUC) = \( NC_{94} \times \text{service to 1.1.94} \) Assets = 0 @ 1.1.94

\[\begin{align*}
AL^A &= \$5,908 \times 27 = \$159,516 \\
AL^B &= \$2,262 \times 7 = \$15,834 \\
\text{Total } AL_{94} &= \$175,350 = UAL_o
\end{align*}\]

Amortization Payment @1.1.94 = \( \frac{UAL}{\bar{a}_{15}^{\%}} \times \frac{175,350}{8.78615} = \$21,157 \)

Accrued Liability (PUC) \( @1.1.97 \) = \( PVFB_{97} \times \frac{\text{service to 1.1.97}}{\text{service to (65)}} \)
\( AL_{97}^A \) = \( 1.5\% \times 60,000 \times (1.06)^{64,60} \times 35 \times 9 \times V_{9\%}^{65,60} \times \frac{30}{35} = $199,350 \)

\( AL_{97}^B \) = \( 1.5\% \times 40,000 \times (1.06)^{64,40} \times 35 \times 9 \times V_{9\%}^{65,40} \times \frac{10}{35} = $25,340 \)

Total \( AL_{97} \) = $224,720

Normal Cost (EAN) = \( \frac{PVFB_{\text{hire}}}{PVFS_{\text{hire}}} \times Salary_{97} \)

@1.1.97

\( NC_{97}^A \) = \( 1.5\% \times 60,000 \times (1.06)^{65,57} \times 35 \times 9 \times V_{9\%}^{65,30} \times \frac{1}{35} \) x $60,000  

where \( j \) = \( \frac{1.09}{1.06} \times 1 \)

= 7.408\% \times 60,000

= $4,445

\( NC_{97}^B \) = 7.408\% \times 40,000

= $2,963

Total \( NC_{97} \) = $7,408

Accrued Liability (EAN) = \( NC_{97} \times s_{\text{service to 1.1.97}}^* \)

@ 1.1.97

\( AL_{97}^A \) = $4,445 \times s_{30,00}^*

= 211,583

\( AL_{97}^B \) = $2,963 \times s_{10,00}^*

= $34,662

Total \( AL_{97} \) = $246,245
Loss due to change in cost method = $246,245 - $224,720 = $21,525

Amortization Payment = $21,525 \cdot \frac{\ddot{a}_{15\%}}{8.78615} \cdot \frac{\ddot{a}_{15\%}}{2,450}

Assets @ 1.1.97 = Contribution \cdot (1.10 \times 1.11 \times 1.12 + 1.11 \times 1.12 + 1.12)

= ($8,170 + 21,157) \times (1.10 \times 1.11 \times 1.12 + 1.11 \times 1.12 + 1.12)

= $104,938

Exposed Assets = Contribution \times \dot{a}_{\ddot{a}_{15\%}}

= $100,500

Investment Gains = $104,938 - $100,505 = $4,433

Amortization Reduction: = $4,433 \cdot \frac{\ddot{a}_{15\%}}{4.2397} \cdot \frac{\ddot{a}_{15\%}}{1,046}

Expected Accrued Liability (PUC) = Accrued Liability (PUC) \times \frac{Expected Salary 97}{Actual Salary 97}

\text{Expected } AL^A_{97} = $199,380 \times \left( \frac{58,000 \times 1.06^3}{60,000} \right) = $229,549

\text{Expected } AL^B_{97} = $25,340 \times \left( \frac{38,800 \times 1.06^3}{40,000} \right) = $29,275

Total = $258,824
Salary Gain  =  Expected Accrued Liability (PUC)  =  Accrued Liability (PUC)
@ 1.1.97  @ 1.1.97

=  $258,824 - $224,720

=  $34,104

Amortization Reduction = $34,104 \cdot \frac{34,104}{4.2397} \cdot 8,044

Total amortization payment = $19,958 + 2,450 - 1,046 - 8,044 = $13,318
1.1.97
2. (5 points) You are the consulting actuary for the new Canadian branch of a U.K. employer who wishes to set up a contributory defined benefit pension plan for its single Canadian employee.

You are given:

**Plan Provisions**
- Retirement benefit: 2% of final year’s earnings
- Normal retirement age: 65
- Form of benefit payment: Life only, payable monthly
- Employee contributions: 6% of pay payable at the beginning of the year
- Interest on employee contributions: 7%
- Vesting: 100% immediate

**Termination benefit:** The present value of accrued benefits is payable. In addition, if the member contributions, with interest, exceed 50% of the present value of accrued benefits, this excess would be refunded to the member. (Note, this refund is not applicable at retirement.)

**Participant Data as at 1/1/95**
- Age: 35
- Pay: $35,000

**Actuarial Assumptions and Cost Method**
- Interest rate: 7%
- Salary increase: 5% at end of year
- Retirement age: 65
- Pre-retirement death benefit: None
- Termination rates: 5% at the end of each of the first 3 years, 0% after
- $a_{65}^{(12)}$: 9.0
- Cost method: Aggregate level percent of pay

Calculate the first year employer normal cost.

**Answer to Question #2:**

\[ \text{Employer NC}_t = \frac{PVFB_t \& PVFCont_t \& F_t}{PVFS_t} \times S_t \]
PVFB = 35,000 \times (1.05)^{29} \times 0.02 \times 30 \times (0.95)^3 \times \frac{1}{(1.07)^{30}} \times 9 \%PVFTermben = 87621.15 \%PVFTermben

PV acc ben at age 36 = 0.06 \times 35,000 \times 1.07 \to 2,247.0

Excess age 36 = 2,247 \& \frac{885.54}{2} = 1,804.23

Total ben age 36 = 885.54 + 1,804.23 = 2,689.77

PV acc ben at 37 = 35,000 \times 1.05 \times 0.02 \times 2 \times 9 \times \frac{1}{(1.07)^{28}} = 1,989.82

Acc cont at 37 = 0.06[35,000 \times 1.07^2 \%35,000 \times 1.05 \times 1.07] \to 4,763.64

Excess age 37 = 4,763.64 - \frac{1,989.82}{2} = 3,768.73

Total benefit age 37 = 5,758.55 = 42,217.50

PV acc ben at 38 = 35,000 \times 1.05^2 \times 0.02 \times 3 \times 9 \times \frac{1}{(1.07)^{27}} = 3,353.35

Acc cont at 38 = 0.06 \times 35,000 \times [1.07^3 \%1.05 \times 1.07^2 \%1.05^2 \times 1.07] \to 7,574.41

Excess age 38 = 7,574.41 - \frac{3,353.35}{2} = 5,897.74

Total ben age 38 = 9,251.09

So PVF term ben = 0.05 \times 2,689.77 \times 0.95 \times 0.05 \times 5,758.55 \times 0.95^2 \times 0.05 \times 9,251.09 \times (1.07)^3 \to 705.37

So PVFB = 8,7621.15 + 705.37 = 88,326.52

\[ PVF \ Cont' = 6\% \times 35,000 \times \left\{ 1 \% \frac{0.95^2 \times 1.05}{1.07} \% \frac{0.95^3 \times 1.05^2}{1.07^3} \% \frac{0.95^3}{1.07^3} \right\} \to 42,217.50, \quad \text{where } j' = \frac{1.07}{1.05} \& 1 \]
PVFS = 42,217.50 / .06 = 703,625.00

So NC = \[
\frac{PVFB \times PVFCont}{PVFS} \times S' \times [(88,326.52 \times 42,217.50) \div 703,625] \times 35,000 \]

= 2,293.6
3. (4 points) You are the actuary for a new pension plan. For the first five years the employer wants to fund the plan with aggregate contributions as a level percentage of salaries such that the projected value of the fund at the end of the fifth year will equal the present value of the accrued benefits.

**Plan Provisions**
- Accrued benefit: 1.5% of final salary for each year of service
- Normal retirement age: 65
- Form of payment: Life annuity with annual payments starting on retirement date
- Ancillary benefits: None

**Actuarial Assumptions**
- Interest rate: 7%
- Salary scale: 5% at the end of each year
- Retirement Age: 65
- Pre-retirement decrements: None
- \( \hat{a}_{65} \): 9.0

**Participant Data at Plan Inception**

<table>
<thead>
<tr>
<th>Age</th>
<th>Service</th>
<th>Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kim</td>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>Jean</td>
<td>50</td>
<td>10</td>
</tr>
</tbody>
</table>

a. Calculate the normal cost at the beginning of the first year to achieve the employer's objective.

b. At the end of the fifth year, the actual value of the fund is $75,000. Kim and Jean are still the only participants. They have received 5% salary increases annually. Calculate the level aggregate normal cost at the beginning of the sixth year.

**ANSWER TO QUESTION #3:**

a. Calculate projected accrued benefit in 5 years:

We only take 5 years of salary increase because accrued benefit is related to salary paid.

Kim: \[30000 \times (1.05)^5 \times (15 + 5) \times 1.5% = 11486.53\]

PV of this benefit (at age 40) = \[11486.53 \times 9 \times v^{25} = 19047.45\]

Jean: \[40000 \times (1.05)^5 \times (10 + 5) \times 1.5% = 11486.53\]

PV this benefit (at age 50) = \[11486.53 \times 9 \times v^{15} = 37469.22\]
So PV projected benefit = 19047 + 37469 = 56516.67

We assume $F_0 = 0$

NC aggregate method $\frac{PV_{PB+F}}{PV_{FS}} \cdot OS$

For Kim, PVFS from now to 5 years =

$30000 \times 30000 \times \frac{(1.05)}{1.07} \times \ldots$

$\ddot{a}_{5:20}^{1.05} \times 30000 \times \ddot{a}_{20}^{1.9\%}$

$30000 \times 1.07^{20} \times 4.8165 = 144496$

For Jean, PVFS = $40000 \times \ddot{a}_{5:5}^{1.90\%} = 192660$

So total PVFS = $192660 \times 144496 = 337156$

So NC = $\frac{56516.67 \times 0}{337156} \times (30000 \times 40000) = 11733.94$

b. At the end of 5 years, $F_1 = 75000$

Assumptions are realized

PV of accrued benefits at the end of 5 years: $(56516.67) \times 1.05^5 \times 72131.18$

so fund is okay.

Now we calculate a NC with the projected benefit:

Kim, age 45, service = 20, total service at 65 = 40

Projected Benefit = $30000 \times (1.05)^5 \times (1.05)^{19} \times 1.5\% \times 40 = 58052$

Present Value of PB = $58052 \times 9 \times v^{20} = 135016$

Jean, age 55, service 15
Projected Benefit = 40000 \times (1.05)^5 \times (1.05)^9 \times 1.5\% \times 25 = 29699

Value of PB = 29699 \times 9 \times v^{10} = 135877

Kim PVFS = 30000 \times (1.05)^5 \times a_{20}^{-1.90\%} = 643899

Jean PVFS = 40000 \times (1.05)^5 \times a_{10}^{-1.90\%} = 469644

So total PVFS = 469644 + 643899 = 1113543

\[
NC = \frac{PVFB \& F_i}{PVFS} \times OS
= \frac{(135016 \%135877) \& 75000}{1113543} \times (30000 \%40000) \times (1.05)^5
= \frac{195893}{1113543} \times 89340
= \$15717
\]
4. (8 points) You are the actuary for a pension plan of a small law firm. You have the following information:

**Plan Provisions**
- Normal retirement age: 65
- Normal retirement benefit: 1.5% of final salary for each year of service
- Termination benefit: $200 per year of service
- Vesting: 3 years of service
- Death benefit: None
- Form of payment: Life annuity with annual payments on January 1
- Employee contributions: None

**Assumptions**
- Interest rate: 7%
- Salary scale: 5% at the end of each year
- Retirement age: 65

**Termination rates**

<table>
<thead>
<tr>
<th>Age</th>
<th>Rate</th>
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<tbody>
<tr>
<td>25</td>
<td>10%</td>
</tr>
<tr>
<td>26</td>
<td>8%</td>
</tr>
<tr>
<td>27</td>
<td>6%</td>
</tr>
<tr>
<td>28</td>
<td>4%</td>
</tr>
<tr>
<td>29</td>
<td>2%</td>
</tr>
<tr>
<td>30+</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Other pre-retirement decrements**
None

**Post Retirement Factors**

<table>
<thead>
<tr>
<th>Age (x)</th>
<th>$\ddot{a}_x$</th>
<th>$q_x$</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>9.0</td>
<td>0.0161</td>
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<td>66</td>
<td>8.7</td>
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<td>67</td>
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<td>0.0225</td>
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<tr>
<td>68</td>
<td>8.1</td>
<td>0.0260</td>
</tr>
<tr>
<td>69</td>
<td>7.8</td>
<td>0.0299</td>
</tr>
</tbody>
</table>

**Actuarial Cost Method**
Projected unit credit prorated on service
Participants as of January 1, 1992

<table>
<thead>
<tr>
<th>Active</th>
<th>Age</th>
<th>Service</th>
<th>Salary Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dewey</td>
<td>25</td>
<td>0</td>
<td>$30,000</td>
</tr>
<tr>
<td>Cheatham</td>
<td>28</td>
<td>5</td>
<td>$35,000</td>
</tr>
<tr>
<td>Howe</td>
<td>45</td>
<td>15</td>
<td>$50,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Retired</th>
<th>Age</th>
<th>Annual Pension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smith</td>
<td>65</td>
<td>$6,000</td>
</tr>
<tr>
<td>Wesson</td>
<td>68</td>
<td>$8,400</td>
</tr>
</tbody>
</table>

Active member Cheatham terminated employment on December 31, 1992.


The salary rates of active members Dewey and Howe on January 1, 1993 are $33,000 and $55,000 respectively.

Financial Data

Actuarial value of assets on January 1, 1992 $180,000

Employer contributions paid on December 31, 1992 $  10,300

Actuarial value of assets on January 1, 1993 $192,000

a. (3 points) Calculate the accrued liability and actuarial unfunded liability on January 1, 1992 and January 1, 1993.

b. (5 points) Calculate the gains and losses, by source, for 1992.

ANSWER TO QUESTION #4:

a. **AL 01/01/92**

Dewey $0

Cheatham $(0.04 x 5 x $200) + (0.96 x .02 x 5 x $200) / 1.07 + (1 - 0.04 - 0.96 x 0.020) x 1.5% x 5 x $35,000 x (1.05)\(^{37}\) x 9 / (1.07)^{37} = $11,116

Howe $1.5% x 15 x $50,000 x (1.05)^{20} x 9.0 / (1.07)^{20} = $69,423

Smith $6,000 x 9.0 = $54,000

Wesson $8,400 x 8.1 = $68,040

AL 1/1/92 = $11,116 + $69,423 + $54,000 + $68,040 = $202,579

UL 1/1/92 = $202,579 - $180,000 = $22,579
AL 1/1/93

Dewey  
\[(1 - 0.08 \cdot 0.92 \cdot 0.6) \cdot 0.04 \cdot 1 \cdot 1 \times 200 / (1.07)^2 + 0.96 \times 0.02 \times 1 \times 1 \times 200 / (1.07)^3\]
\[+ 1.5\% \times 1 \times 33,000 \times (1.05)^{39} \times 9.0 / (1.07)^{39} = 1,867\]

Cheatham  
$0$

Howe  
$1.5\% \times 16 \times 55,000 \times (1.05)^{19} \times 9.0 / (1.07)^{19} = 83,008$

Smith  
$6,000 \times 8.7 = 52,200$

AL 1/1/93 = $1,867 + 83,008 + 52,200 = 137,075$

UL 1/1/93 = $137,075 - 192,000 = ($54,925) surplus

b.  
(1) Interest on UL 1/1/92
\[0.07 \times 22,579 = 1,581\text{ (increase in UL)}\]

(2) Investment performance
Actual asset 1/1/93 - Expected asset 1/1/93
\[192,000 - (180,000 \times (1.07) + 10,300 - 14,400 \times (1.07) - 1,200)\]
\[= 5,708\text{ (decrease in UL)}\]

(3) Excess contributions
\[\text{Contribution paid at the end of the year - NC at the end of the year}\]
Dewey  
\[(1 - 0.10 \cdot 0.90 \cdot 0.08 \cdot 0.828 \cdot 0.06) \cdot 0.04 \times 1 \times 200 / (1.07)^4 + 0.96 \times 0.02 \times 200 / (1.07)^4 + 1.5\% \times 30,000 \times (1.05)^{40} \times 9.0 / (1.07)^{40} \times 1.07\]
\[= 1,595\]

Cheatham  
AL 1/1/92 / 5 \times (1.07) = $11,116 / 5 \times 1.07 = $2,379

Howe  
AL 1/1/92 / 15 \times (1.07) = $69,423 / 15 \times 1.07 = $4,952

Excess contributions $10,300 - (1,595 + 2,379 + 4,952) = 1,374\text{ (decrease in UL)}$

(4) Salary increase
\[\text{Expected liability 1/1/93 based on expected salaries - Actual liability 1/1/93}\]
\[\text{Expected liability based on expected salaries}\]
Dewey  
\[\text{AL 1/1/93} \times \frac{30,000 \times (1.05)}{33,000} = 1,782\]

Howe  
\[\text{AL 1/1/93} \times \frac{50,000 \times (1.05)}{55,000} = 79,234\]

\[(1,782 + 79,234) - (1,867 + 83,008) = (3,859)\text{ (increase in UL)}\]
(5) Termination
Actual release on terminations - Expected release at termination
Expected release

Dewey \( 0.01 \times \$1,867 = \$187 \)

Cheatham
\[
0.04 \times \left[ 0.02 \times 6 \times \$200 + 0.98 \times 6 \times 1.5\% \times \$3 \times \frac{(1.05)^{37}}{(1.07)^{36}} \times 9.0 - \$1,200 \right] = \$5,445,000
\]

Actual release \$14,814 - \$1,200 = \$13,614

\$13,614 - (\$187 + \$544) = \$12,883 \text{ (decrease in UL)}

(6) Death
Real release on deaths - Expected release on deaths
Expected release

Smith \( q_{65} \times AL_{66} = 0.0161 \times \$52,200 = \$840 \)

Wesson \( q_{68} \times AL_{69} = 0.0260 \times 7.8 \times \$8,400 = \$1,703 \)

Real release

Smith \( 0 \)

Wesson \( 7.8 \times \$8,400 = \$65,520 \)

\$65,520 - (\$840 + \$1,703) = \$62,977

(7) Reconciliation

<table>
<thead>
<tr>
<th>UAL 1992</th>
<th>22,579</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Interest on UL</td>
<td>1,581</td>
</tr>
<tr>
<td>2. Investment performance</td>
<td>(5,708)</td>
</tr>
<tr>
<td>3. Excess contributions</td>
<td>(1,374)</td>
</tr>
<tr>
<td>4. Salary increases</td>
<td>3,858</td>
</tr>
<tr>
<td>5. Termination</td>
<td>(12,883)</td>
</tr>
<tr>
<td>6. Death</td>
<td>(62,977)</td>
</tr>
</tbody>
</table>

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UAL 1993 (54,923)
5. (5 points) You are the actuary for a pension plan covering two participants. You are considering two possible withdrawal assumptions. You are given:

**Plan Provisions**
- Benefit Formula: 1% of final pay rate times years of service
- Normal Retirement: Age 65
- Form of payment: Life only payable monthly
- Eligibility: Immediate
- Vesting: 2 years of service

**Assumptions & Method**
- Interest Rate: 7%
- Salary Scale: 4% at 1/1 each year
- Retirement: Age 65
- Post-retirement Mortality: Unisex
- Pre-retirement Mortality: None
- Pre-retirement Disability: None
- Withdrawal (at end of year):
  - A: None
  - B: 5% per year through age 42; zero after.
- Cost Method: Projected Unit Credit

**Employee Data at 1/1/99**

<table>
<thead>
<tr>
<th></th>
<th>Participant P</th>
<th>Participant Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Past Service</td>
<td>1 year</td>
<td>8 years</td>
</tr>
<tr>
<td>Pay Rate</td>
<td>40,000</td>
<td>40,000</td>
</tr>
</tbody>
</table>

Valuation Results:
- No Withdrawal
  - Normal Cost: 2063
- 5% Withdrawal through 42
  - Normal Cost: 1845

a. Calculate the 1999 gain/loss under both sets of withdrawal assumptions if both participants quit at the end of 1999.

b. Calculate the 1999 gain/loss under both sets of withdrawal assumptions if neither participant quits and each receives a 4% pay increase on 1/1/2000.
ANSWER TO QUESTION #5:

a. If no withdrawal is assumed:

Participant P:
Expected $AL = (AL_{1999} + NC_{1999}) (1 + i) = (2063 + 2063)(1.07) = 4415$
Actual $AL = 0$
Gain = 4415

Participant Q:
$AL_{1999} = (NC_{1999})(PS) = (2063)(8) = 16,504$
Expected $AL = (AL_{1999} + NC_{1999}) (1+i) = (16,504 + 2063)(1.07) = 19,867$
Actual $AL = (AL_{2000} \text{ without projected salary increase}) =
\frac{(19,867)}{(1.04^{25})} = (19,867 / 2.666) = 7452$
Gain = 19,867 - 7452 = 12,415

Total Gain = 4415 + 12,415 = 16,830

With withdrawal:

Participant P:
Expected $AL = (AL_{1999} + NC_{1999}) (1+i) = (1845 + 1845)(1.07) = 3948$
Actual $AL = (AL_{1999} + NC_{1999}) (1+i) / p_{40} = (1845 + 1845)(1.07) / 95% = 4156$
Loss = 4156 - 3948 = 208

Participant Q:
$AL_{1999} = (NC_{1999})(PS) = (1883)(8) = 15,064$
Expected $AL = (AL_{1999} + NC_{1999}) (1+i) = (15,064 + 1883)(1.07) = 18,133$
Actual $AL = (AL_{2000} \text{ without withdrawal and projected salary increase}) =
\frac{(19,867)}{(1.04^{25})} = (19,867 / 2.666) = 7452$
Gain = 18,133 - 7452 = 10,681

Total Gain = 3948 + 10,681 = 14,629

b. If no withdrawal is assumed:

There is no gain or loss

With withdrawal:

Participant P:
Expected $AL = (AL_{1999} + NC_{1999}) (1+i) = (1845 + 1845)(1.07) = 3948$
Actual $AL = (AL_{1999} + NC_{1999}) (1+i) / p_{40} = (1845 + 1845)(1.07) / 95% = 4156$
Loss = 4156 - 3948 = 208
Participant Q:

\[ AL_{1999} = (NC_{1999})(PS) = (1883)(8) = 15,064 \]
\[ NC_{\text{term } 1999} = 5\% \text{ (NC without withdrawal and projected salary increase)} = 5\% \left( \frac{2063}{1.04^{25}} \right) = 5\% \left( \frac{2063}{2.666} \right) = 38.69 \]
\[ AL_{\text{term } 1999} = (NC_{\text{term } 1999})(PS) = (38.69)(8) = 310 \]

Expected AL = \( AL_{1999} + NC_{1999} \) \( (1+i) = (15,064+1883)(1.07) = 18.133 \)

Actual AL = \[ AL_{1999} + NC_{1999} - (AL_{\text{term } 1999} + NC_{\text{term } 1999}) \] \( (1.07) / 95\% = \frac{[15,064 + 1883 - (310 + 38.69)](1.07) / 95\% = 18,695}{18,695} \]

Loss = 18,695 - 18,133 = 562

Total Loss = 208 + 562 = 770