Funding Financial Risk Models

- Single Premiums/Contributions
  - One Year Term insurance
- Multiple Premiums/Contributions
  - Annual/Semi-annual/Monthly
  - Pay as you go
  - Level Premiums
    - fixed term or life
  - Level Percent of Pay
    - fixed term or life
  - Other Schemes

Example 1

- Determine the annual level premium for a $100,000 whole life policy payable at the moment of death for a 40 year old male, interest rate = 8% and under GAM94M.

Premiums

- Level Premiums – Pay more up front
- Premiums may be for life or for a fixed period of time
  - Premium = PV Insurance/PV Annuity
Example 2
- Determine the semi-annual level premium for twenty years for a $200,000 whole life policy payable at the moment of death for a 50 year old male, interest rate = 8% and under GAM94M.

Example 3
- Determine the semi-annual level premium for a $250,000 10 year term-life policy payable at the moment of death for a 45 year old male, interest rate = 8% and under GAM94M.

Benefit Reserves
- \[ \text{Benefit Reserve} = \text{Actuarial Present Value of Actuarial Present Value of Remaining Insurance} - \text{Actuarial Present Value of Remaining Unpaid Premiums} \]

Example 4 & 5
- Example 4: Find the benefit reserve after 4 years for Example 1
- Example 5: Find the benefit reserve after 3 years for Example 2:
Group Benefit Plans – Actuarial Cost Method

- Present Value of (All) Benefits
  - Actuarial Accrued Liability
  - Present Value of Future Normal Costs

- Normal Cost
  - Annual Allocation of Present Value of Benefits
  - One-Year’s “Piece” of Present Value of Future Normal Costs

Group Benefit Plans – Actuarial Cost Method

- Actuarial Value of Assets
  - Must take Market Value into account
- Unfunded Actuarial Accrued Liability
  - Excess of AAL over Assets
  - Negative if Assets exceed AAL

Some Relationships

- Present Value of Benefits is sum of:
  - Unfunded Actuarial Accrued Liability
  - Assets
  - Present Value of Future Normal Costs
- Annual Contribution is sum of:
  - Normal Cost
  - Payment to (or Credit from) Unfunded Actuarial Accrued Liability
  - Plan Expenses not recognized in Normal Cost
Pay-as-You-Go Funding Method

- Contributions only to Pay Benefits and Expenses.
- No Assets or Reserves
- Usually Results in Escalating Costs
- Examples
  - Social Security pre 83
  - Post Retirement Medical
  - Short Term Insurance
  - Casualty Insurance

Spread Methods

- Spread over Future Service
  - Present Value of Future Service is the value of $1 paid each year a participant is still an active employee
- Spread over Future Salary
  - Present Value of Future Salary is the value of all salary paid in the future while participant is still an active employee.

Present Value of Future Service

- Determined as an adjusted annuity, where the future stream of payments equals 1.

\[
PVFS = \sum_{i=x}^{\infty} v^{i-x} \cdot p_x^{(e)}
\]

Present Value of Future Salary

- Determined as an adjusted annuity, where the future stream of payments equals expected pay. Note \(s_x\) is a salary scale at age \(x\).

\[
PVFS = \text{current pay} \cdot \sum_{i=x}^{\infty} v^{i-x} \cdot p_x^{(e)} \cdot \frac{s_{x+i}}{x}
\]
Aggregate Method

- Actuarial Accrued Liability = Assets
- No Unfunded Actuarial Accrued Liability
- Normal Cost, is determined as a level percent of pay or service by the formula:

\[ NC = PVFNC \cdot \frac{Current \ Pay}{PVFS} \]

Level Premium Method

- Actuarial Accrued Liability = Assets
- No Unfunded Actuarial Accrued Liability.
- Normal Cost is an amortization of the Present Value of Future Normal Costs over a fixed period of time:

\[ NC = \frac{PVFNC}{\dot{a}_m} \]

Entry Age Method

- Normal Cost Calculation = sum of Normal Cost for each individual.
- Normal Cost is determined as a level percent of pay or service from Entry or Hire Age.
- Actuarial Accrued Liability is sum of Past Normal Costs from participants hire or entry age to the valuation date.
- Payment to Unfunded Actuarial Accrued Liability is usually over a fixed period of time.

Unit Credit Method

- Normal Cost Calculation = sum of Normal Cost for each individual.
- Normal Cost is determined as actual cost of one year’s benefit accrual based on current or projected pay.
- Actuarial Accrued Liability is sum of Past Normal Costs from participants hire or entry age to the valuation date.
- Payment to Unfunded Actuarial Accrued Liability is usually over a fixed period of time.