

****BEGINNING OF EXAMINATION 8****
PENSION FUNDING MATHEMATICS SEGMENT

- 1.** (6 points) You are the actuary for a company that sponsors a non-contributory defined benefit pension plan. You are given:

Plan Provisions:

Normal Retirement Benefit:	1.5% of final year's salary times years of service
Normal form of payment:	Life only, payable monthly in advance
Normal retirement age:	Age 65
Earliest retirement age:	Age 55
Early retirement reduction:	Actuarial equivalence
Actuarial equivalence:	Based on valuation assumptions

Actuarial Assumptions and Method:

Interest rate:	6% per annum
Retirement age:	Age 65
Salary increases:	4% per annum
Pre-retirement decrements:	None
Actuarial cost method:	Entry Age Normal (level % of salary)

$$\ddot{a}_{65}^{(12)} = 9.9$$

$$\ddot{a}_{60}^{(12)} = 11.2$$

$${}_5P_{60} = 0.945$$

Sole Participant Data as of January 1, 2004:

Age:	59
Years of service:	29
2004 salary:	\$100,000

At January 1, 2004, the plan is amended to provide for an unreduced early retirement pension at age 60 and the retirement age assumption is changed to age 60.

1. Continued

- (a) Assuming the participant retires on December 31, 2004, determine the increase in the retirement pension as a result of the amendment.
- (b) Calculate the change in the accrued liability and normal cost at January 1, 2004.

Show all work.

2. (4 points) You are the actuary for a company that sponsors a non-contributory defined benefit pension plan for one of its executives. You are given:

Plan Provisions:

Normal Retirement Benefit:	2% of final year's earnings times years of service, less the pension that can be provided with the balance in a notional account
Normal Retirement Age:	Age 65
Normal form of payment:	Life only, payable monthly in advance
Early retirement age:	Age 55
Early retirement reduction:	3% per year for benefit commencement prior to age 65
Ancillary benefits:	None

Actuarial Assumptions and Method:

Retirement age:	Age 65
Interest rate:	6.5% per annum
Pre-retirement decrements:	None
Salary increases:	None
Rate of annuitization of notional account:	6.5% per annum
Actuarial cost method:	Projected Unit Credit (linear pro-ration)

$$\ddot{a}_{65}^{(12)} \text{ at } 6.5\% = 9.55$$

$$\ddot{a}_{65}^{(12)} \text{ at } 6\% = 9.87$$

$$\ddot{a}_{62}^{(12)} \text{ at } 6.5\% = 10.32$$

$$\ddot{a}_{62}^{(12)} \text{ at } 6\% = 10.69$$

2. Continued

Sole Participant Data as of January 1, 2004:

Age:	61
Years of service:	25
2003 earnings:	\$400,000
Projected value of notional account at age 65:	\$1,450,000

Additional Data as of January 1, 2005:

2004 earnings:	\$400,000
Value of notional account on January 1, 2005:	\$1,150,000

- (a) Determine the plan's actuarial liability as at January 1, 2004.
- (b) Using a valuation interest rate of 6% per annum, calculate the actuarial gain or loss on liabilities on January 1, 2005 assuming the executive retires at that time.

Show all work.

3. (6 points) You are the actuary for a company that sponsors a non-contributory defined benefit pension plan. You are given:

Plan Provisions:

Normal Retirement Benefit:	\$M per month per year of service
Normal form of payment:	Life only, payable monthly in advance
Bridge benefit:	\$100 per month, payable monthly in advance until age 65
Normal Retirement Age:	Age 62
Actuarial equivalence:	Based on valuation assumptions

Actuarial Assumptions and Method:

Interest rate:	6.0% per annum
Retirement age:	Age 62
Pre-retirement decrements:	None
Mortality:	Unisex (50% male/50% female)
Actuarial cost method:	Unit Credit

3. Continued

Factors Based on Post-Retirement Assumptions:

$$\begin{array}{lll} \ddot{a}_{60}^{(12)} = 12.0783 & \ddot{a}_{62:62}^{(12)} = 9.8213 & {}_3p_{62} = 0.9733 \\ \ddot{a}_{62}^{(12)} = 11.6067 & \ddot{a}_{65:65}^{(12)} = 9.0345 & {}_3p_{65} = 0.9619 \\ \ddot{a}_{65}^{(12)} = 10.8657 & & \end{array}$$

Sole Participant Data as of January 1, 2004:

Age:	60
Years of service:	10
Spouse's age:	60
Accrued liability before plan change:	\$1,400M

Plan Provision Changes on January 1, 2004:

Normal form of payment for married members: J% joint and survivor annuity without reduction

Bridge benefit: None

- Calculate M.
- Determine J such that the accrued liability remains unchanged at January 1, 2004.
- J is set to 50% and the change in liability is amortized over expected years until retirement. Calculate the normal cost and amortization for 2004 at January 1, 2004.

Show all work.

4. (4 points) You are the actuary for a company that established a non-contributory defined benefit pension plan as at January 1, 2004. You are given:

Plan Provisions:

Normal Retirement Benefit:	1% of final salary times years of service
Normal form of payment:	Five year certain and life, payable monthly in advance
Normal Retirement Age:	Age 65
Early retirement age:	Age 55
Early retirement reduction:	5% per year for benefit commencement prior to age 65
Other ancillary benefits:	None

Actuarial Assumptions and Method:

Interest rate:	6% per annum
Salary increases:	3% per annum
Retirement age:	Age 60
Pre-retirement decrements:	None
Actuarial cost method:	Frozen Initial Liability
Amortization of unfunded actuarial liability:	5 years

$$\ddot{a}_{65}^{(12)} = 10$$

$$\ddot{a}_{60}^{(12)} = 11$$

$${}_5p_{60} = 0.95$$

Participant Data as of January 1, 2004:

<u>Employee</u>	<u>Age</u>	<u>Service</u>	<u>2004 Salary</u>
A	42	12	\$40,000
B	30	2	\$25,000

- (a) Determine the normal cost and amortization for 2004 as at January 1, 2004.
- (b) Assuming the company contributed \$15,000 as at January 1, 2004, the fund earned 10% during 2004 and all other assumptions were realized in 2004, determine the normal cost as at January 1, 2005.

Show all work.

5. (4 points) You are the actuary for a company that sponsors a non-contributory defined benefit pension plan established on January 1, 2004. You are given:

Plan Provisions:

Normal Retirement Benefit: \$30 per month per year of service
 Normal form of payment: Life only, payable monthly in advance
 Normal Retirement Age: Age 65
 Ancillary benefits: None

Actuarial Assumptions and Method:

Interest rate: 7% per annum
 Retirement age: Age 65
 Pre-retirement decrements: None
 Actuarial cost method: Individual Level Premium (level dollar)

$$\ddot{a}_{65}^{(12)} = 10.5$$

Participant Data as of January 1, 2005:

Employee	Age	Service
X	45	15
Y	30	0

On January 1, 2005, the Normal Retirement Benefit is changed to \$32 per month per year of service.

Calculate the employer Normal Cost for 2005 as at January 1, 2005.

Show all work.

6. (6 points) You are the actuary for a company that sponsors a non-contributory defined benefit pension plan. You are given:

Plan Provisions:

Normal Retirement Benefit:	2% of final year's earnings times years of service
Normal form of pension:	Life only, payable monthly in advance
Normal Retirement Age:	Age 65
Vesting schedule:	100% vesting after 5 years of service

Actuarial Assumptions and Method:

Interest rate:	7.0% per annum
Salary increases:	None
Retirement age:	Age 65
Pre-retirement decrements:	None
Actuarial cost method:	Projected Unit Credit (linear pro-ration)

$$\ddot{a}_{65}^{(12)} = 10.1 \qquad {}_3|\ddot{a}_{67}^{(12)} = 7.0$$
$$\ddot{a}_{67}^{(12)} = 9.6 \qquad {}_2|\ddot{a}_{68}^{(12)} = 7.6$$
$$\ddot{a}_{68}^{(12)} = 9.4$$

Financial Information:

Assets at January 1, 2004:	\$1,000,000
Contribution on July 1, 2004:	Normal Cost plus 15% of Unfunded Actuarial Liability as at January 1, 2004.
Fund rate of return in 2004:	10.0%

6. Continued

Participant Data as of January 1, 2004:

	Participant A	Participant B	Participant C
Age:	67	52	41
Service:	N/A	10	4
2003 Earnings:	N/A	\$100,000	\$40,000
Date of Retirement:	January 1, 2002	N/A	N/A
Monthly Retirement Benefit:	\$10,000	N/A	N/A
Form of Benefit:	Five year certain and life	N/A	N/A

You are given the following 2004 experience:

- Participant A died on September 15, 2004.
 - Participant C terminated non-vested on August 1, 2004.
 - 2004 Earnings for Participant B are \$105,000.
- (a) Calculate the amount of the July 1, 2004 contribution.
- (b) Calculate the Unfunded Actuarial Liability at January 1, 2005.
- (c) Calculate the gains and losses by source for 2004.

Show all work.

****END OF EXAMINATION****