November 2002
Society of Actuaries

BEGINNING OF EXAMINATION 8
PENSION FUNDING MATHEMATICS SEGMENT

1. *(5 points)* You are the actuary for a company that sponsors a non-contributory, final pay, defined benefit pension plan. You are given:

Actuarial Assumptions and Methods

Interest rate:	6.0% per annum
Salary increases:	4.0% per annum
Retirement age:	65
Pre-retirement decrements:	None
Actuarial cost method:	Aggregate
Actuarial value of assets:	Market value

Financial Information as at January 1, 2002

Market value of assets: $13,500

Participants as at January 1, 2002

Name	Status	Age	Present Value of Future Benefits (PVFB)	2002 Salary
Pat	Active	60	$50,000	$50,000
Chris	Active	40	$10,000	$30,000
Kelly	Retired	65	$ 7,500	N/A

(a) Calculate the normal cost as at January 1, 2002.

(b) Calculate the January 1, 2002 normal cost under the Individual Aggregate method assuming that assets for active participants are allocated in proportion to their PVFB.

(c) Evaluate the appropriateness of Aggregate vs. Individual Aggregate if the plan is expected to be terminated in five years when Pat retires.

Show all work.

2. *(7 points)* Your client maintains a non-contributory defined benefit pension plan with one member. You are given:

Plan Provisions

Normal retirement benefit:	1.0% of final year's earnings times credited service
Normal form of pension:	5-year certain, life thereafter
Normal retirement age:	Age 65
Early retirement eligibility:	Age 55
Early retirement bridge benefit:	Temporary benefit equal to 0.5% of final year's earnings times credited service, payable until the earlier of death and age 65
Early retirement reduction:	5% per year that retirement precedes age 65, applied to both the normal and bridge benefits
Other ancillary benefits:	None

Actuarial Assumptions and Method

Interest rate:	6.0% per annum
Salary increases:	3.0% per annum
Retirement rates:	50% at age 62 and 100% at age 65
Actuarial cost method:	Entry Age Normal (level percent of earnings)

Pre-retirement commutation factors:

Age	${}^{s}D_x$	${}^{s}N_x$
32	396	8084
47	250	3234
62	119	287
65	54	54

Annuity factors and survival probability factors:

$\ddot{a}_{62}^{(12)} = 10.7$ $\quad {}_3p_{62} = 0.96$

$\ddot{a}_{65}^{(12)} = 9.9$ $\quad {}_5p_{62} = 0.93$

$\ddot{a}_{67}^{(12)} = 9.4$ $\quad {}_5p_{65} = 0.90$

$\ddot{a}_{70}^{(12)} = 8.5$

2. **Continued**

Participant Data as at January 1, 2002

Age:	47
Credited service:	15 years
2001 Earnings:	$60,000

Calculate the accrued liability and normal cost at January 1, 2002.

Show all work.

3. *(4 points)* Your client maintains a non-contributory defined benefit pension plan.

You are given:

Plan Provisions

	Current	Proposed
Normal retirement benefit:	$20 per month per year of service	1% of final earnings times years of service
Normal form of payment:	Life only	Married: Joint and 75% survivor, without reduction Unmarried: Life only
Normal retirement age:	65	60
Ancillary benefits:	None	None

Actuarial Assumptions and Method

Interest rate:	6.5% per annum
Salary increases:	4.5% per annum
Pre-retirement decrements:	None
Retirement age:	Normal retirement age
Post-retirement mortality:	Unisex
Probability of being married at retirement:	85%
Spouse age:	5 years younger than participant
Actuarial cost method:	Projected Unit Credit (pro-rated on service)

Annuity factors

$\ddot{a}_{55}^{(12)} = 11.8$

$\ddot{a}_{60}^{(12)} = 10.8$

$\ddot{a}_{65}^{(12)} = 9.6$

$\ddot{a}_{60:55}^{(12)} = 9.7$

3. **Continued**

Participant Data as at January 1, 2002

Age:	47
Service:	10 years
2001 Earnings:	$36,000

Calculate the increase in the accrued liability and normal cost as at January 1, 2002 if the proposed provisions are adopted.

Show all work.

4. *(7 points)* You are the actuary for a company with a non-contributory defined benefit pension plan established on January 1, 2002. You are given:

Plan Provisions

Retirement benefit:	1% of final salary times years of service
Normal form of payment:	Life only, payable monthly in advance
Normal retirement age:	60
Ancillary benefits:	None

Actuarial Assumptions

Interest rate:	6.5% per annum
Salary increases:	4.0% per annum
Retirement age:	60
Pre-retirement decrements:	None

$\ddot{a}_{60}^{(12)} = 11.4$

Financial Information

There are no assets in the plan at January 1, 2002.

Participant Data as at January 1, 2002

Employee	A	B
Age	35	55
Service (years)	5	25
2001 Salary	$30,000	$50,000

The company will contribute, at the beginning of each year, an amount equal to the normal cost plus a payment to amortize any unfunded accrued liability over 15 years.

(a) Determine the company contribution at January 1, 2002 using each of the following methods:

(i) Individual Level Premium, and

(ii) Modified Aggregate.

(b) Assuming that the fund earns 0% and that salaries increase by 10% during 2002, calculate the accrued liability and company contribution at January 1, 2003 under the above methods.

Show all work.

5. *(7 points)* You are the actuary for a company that sets up a new non-contributory defined benefit pension plan on January 1, 2002. You are given:

Plan Provisions

Retirement benefit:	\$50 per month times years of service
Normal form of payment:	Life only, payable monthly in advance
Normal retirement age:	65
Earliest retirement age:	55
Early retirement benefit:	Accrued pension, reduced 4% per year that retirement precedes age 65
Other ancillary benefits:	None

Actuarial Assumption and Methods

Interest rate:	6.5% per annum
Retirement age:	62
Pre-retirement decrements:	None
Actuarial cost method:	Attained Age Normal
Actuarial value of assets:	Market value

$\ddot{a}_{55}^{(12)} = 12.0$

$\ddot{a}_{62}^{(12)} = 11.0$

Financial Information

Assets at January 1, 2002:	\$0
Assets at January 1, 2003:	\$17,500

The company contributed \$15,000 on January 1, 2002.

Participant data as at January 1, 2002

Member	Age	Service (years)
X	54	20
Y	30	4

5. Continued

(a) Determine the accrued liability and normal cost as at January 1, 2002.

(b) On December 31, 2002, Member X retires. Calculate the accrued liability and normal cost as at January 1, 2003.

(c) Reconcile the change in the normal cost by source.

Show all work.

****END OF EXAMINATION****