MATH 3630
Actuarial Mathematics I
Class Test 1
Wednesday, 29 September 2010
Time Allowed: 1 hour
Total Marks: 100 points

Please write your name and student number at the spaces provided:

Name: ________________________ **Student ID:** __________________

- **There are ten (10) written-answer questions here and you are to answer all ten. Each question is worth 10 points.**
- **Please provide details of your workings in the appropriate spaces provided; partial points will be granted.**
- **Please write legibly.**
- **Anyone caught writing after time has expired will be given a mark of zero.**

Question No. 1:

A class of species follows a mortality pattern described by

$$S_X(x) = \left(\frac{2}{2+x}\right)^2, \text{ for } x \geq 0,$$

where x is measured in years.
Calculate $\mathring{e}_1$ and interpret this value.

Question No. 2:

Assume the Uniform Distribution of Death (UDD) assumption holds between integral ages. You are given:

$$_{0.5}q_{50} = 0.005$$

$$_{0.4}q_{51} = 0.008$$

Calculate the probability that a life (50) will survive the next two years.

Question No. 3:

A cohort of newborn currently has mortality pattern described by

$$\mu_x = \begin{cases} 0.015, & \text{for } 0 < x \leq 35 \\ 0.04, & \text{for } x > 35 \end{cases}$$

A medical breakthrough will reduce the force of mortality for age beyond 35 by 25%, but will not affect mortality prior to, and including, age 35.

Calculate the percentage improvement in the probability of a 30-year-old reaching to age 65 as a result of this medical breakthrough.

Question No. 4:

Assume mortality follows the *Illustrative Life Table*.

Suppose that constant force of mortality assumption holds between integral ages.

Calculate ${}_{1.5|0.75}q_{40}$ and interpret this probability.

Question No. 5:

For a portfolio of life insurance policies, you are given that *substandard* lives have force of mortality twice that of *standard* lives. You are given that mortality for *standard* lives is described according to

$$\ell_x = 500(110 - x), \text{ for } 0 \leq x \leq 110.$$

Calculate the probability that a *substandard* life (30) will die within 10 years.

Question No. 6:

Suppose you are given the following select-and-ultimate mortality table:

$[x]$	$\ell_{[x]}$	$\ell_{[x]+1}$	$\ell_{[x]+2}$	ℓ_{x+3}	x+3
20	35,600	35,591	35,583	35,572	23
21	35,587	35,576	35,562	35,553	24
22	35,574	35,561	35,547	35,534	25

Calculate the probability that a life with select age 20 will survive for two years but die the following two years.

Question No. 7:

You are given:

$$S_X(x) = 1 - \frac{1}{8}x, \text{ for } 0 \leq x \leq 8.$$

Calculate ${}_2m_4$.

Question No. 8:

The following Generalized de Moivre's law holds:

$$S_X(x) = \left(1 - \frac{x}{\omega}\right)^{1/2}, \text{ for } 0 \leq x \leq \omega.$$

In addition, you are given that the probability a life (25) survives another 10 years is 0.8944. Calculate ω.

Question No. 9:

You are given:

- Mortality follows de Moivre's law.
- $\mathring{e}_{20} = 35$.

Compute q_{30}.

Question No. 10:

You are given:

$$_{k|}q_x = \frac{1}{9}(2k+1), \quad \text{for } k = 0, 1 \text{ and } 2.$$

Suppose UDD holds between integral ages.

Calculate the probability that a life (x) will survive another 1.5 years.

EXTRA PAGE FOR ADDITIONAL OR SCRATCH WORK