ASSIGNMENT 6

For handing in on **7 March 2002**

Write your name and student number at the top of your assignment before handing it in. Staple all pages together. Post the assignment in the blue post-box on the second floor in the Maths building before 9:45 on Thursday.

This assignment is based on the material covered in Lectures 18-24. Additional reading: Bowers et al. pp. 93 – 103.

1. A life age 40, who is subject to the mortality described the A1967-70 life assurance table (select part), effects a pure endowment policy with a term of 20 years and a sum assured of £1. Assuming interest at the rate of 4% per annum, calculate the expectation and the standard deviation of the present value of the benefit payment. Give your answers to 6 d.p. How will these answers alter if the benefit payment is increased to £10000?

2.(from the 1998-1999 exam paper) A population is subject to mortality described by English Life Table No. 12 – Males.

(a) Consider a pure endowment policy for a boy, effected at his birth, which provides £6,000 for the boy on his 18th birthday. Write down the present value of the benefit payment under this policy, regarding it as a random variable. Calculate its mean value and standard deviation (the square root of variance) to 2 decimal places.

Assume the effective interest rate of 10% per annum.

(b) A life company withdraws benefit payments from an investment fund earning interest of 10% per annum effectively. Suppose that the company has just sold a block of 100 pure endowment policies identical to that one in (a). Using the results obtained in (a), calculate the minimum amount to be invested by the company at the present time so that the probability is approximately 0.95 that sufficient funds will be on hand to withdraw the benefit payment for each boy; use a normal approximation for the total present value of the benefit payments.

(If N has the standard normal distribution then $P(N < 1.645) = 0.95$.)

3. Assume De Moivre's Law of mortality with a lifespan of 120 years (i.e. $s(x) = \frac{1}{120}(120-x)$ if $0 \leq x \leq 120$ and zero otherwise) and interest at the rate of 10% per annum.

(a) Calculate $\mathring{e}_{40}$; **(b)** Calculate $\bar{A}_{40}$ to 2 decimal places.

4. Consider the present value z of unit benefit payment payable on the survival of (x) to age $x+n$. The expectation of z is denoted by $A_{x:\overline{n}|}^{1}$. In lectures, I obtained expressions for $E(z)$ and var (z) in terms of ${}_np_x$, ${}_nq_x$, and v. Use these expressions to obtain the following general relation

$$\text{var}\,(z) = A^{*}_{x:\overline{n}|}{}^{1} - \left[A_{x:\overline{n}|}^{1}\right]^2,$$

where "$*$" refers to the interest rate such that $v^* = v^2$.