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Life Contingencies - Exercise Sheet 1

Presentation: Friday, 24th of October.

Exercise 1

In a certain population, you are given the following facts:

(i) The probability that two independent lives, respectively aged 25 and 45, both survive 20 years is 0.7.

(ii) The probability that a life aged 25 will survive 10 years is 0.9.

Then find the probability that a life aged 35 will survive to age 65.

Exercise 2

Suppose that a sum of \$1000 is borrowed for 5 years at 5%, with interest deducted immediately in a lump sum from the amount borrowed, and principal due in a lump sum at the end of the 5 years. Suppose further that the amount received is invested and earns 7%. What is the value of the net profit at the end of the 5 years ? What is its present value (at 5%) as of time 0 ?

Exercise 3

Suppose that an individual aged 20 has random lifetime Z with continuous density function

$$f_Z(t) = \frac{1}{360}(1 + \frac{t}{10}), \quad \text{for } 20 \leq t \leq 80$$

and 0 for other values of t.

(a) If this individual has a contract with your company that you must pay his heirs $\$10^6 \cdot (1.4 - Z/50)$ at the exact date of his death if this occurs between ages 20 and 70, then what is the expected payment ?

(b) If the value of the death-payment described in (a) should properly be discounted by the factor $\exp(-0.08 \cdot (Z - 20))$ (i.e. by the nominal interest rate of $e^{0.08} - 1$ per year) to calculate the present value of the payment, then what is the expected present value of the payment under the insurance contract ?

Exercise 4

Suppose that you are negotiating a car-loan of \$10,000. Would you rather have an interest rate of 4% for 4 years, 3% for 3 years, 2% for 2 years, or a cash discount of \$500 ? Show how the answer depends upon the interest rate with respect to which you calculate present values, and give numerical answers for present values calculated at 6% and 8%. Assume that all loans have monthly payments paid at the beginning of the month (e.g., the 4 year loan has 48 monthly payments paid at time 0 and at the ends of 47 succeeding months).