

INSTITUTE AND FACULTY OF ACTUARIES

EXAMINATION

13 September 2022 (am)

Subject CM1 – Actuarial Mathematics Core Principles

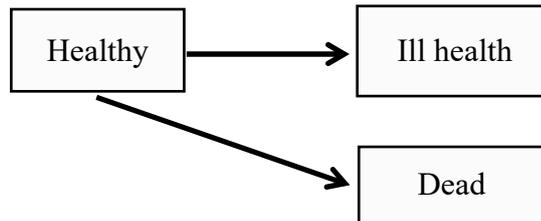
Paper B

Time allowed: One hour and fifty minutes

In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator.

If you encounter any issues during the examination please contact the Assessment Team on T. 0044 (0) 1865 268 873.

- 1** An insurance company has estimated the independent probabilities of two decrements in a population of healthy lives. These are set out in the worksheet ‘Q1 Base’. Transitions can occur out of the healthy state into one of two absorbing exit states: ill health or dead.



Forces of decrement are assumed to be independent and constant over individual years of age.

- (i) Construct a double decrement table, using the template provided, for integer ages from 50 to 110. Assume a radix of $(al)_{50} = 100,000$. [7]
- (ii) Evaluate the probability that a healthy individual aged 65 exact will leave the population by ill health or death before their 71st birthday. [2]

The insurance company offers a temporary assurance policy to a healthy individual aged 52 exact. Details of the policy and the premium basis are set out in the worksheet ‘Q1 Base’.

- (iii) Calculate the premium for this policy, expressed as a percentage of salary, using the equivalence principle. [25]

[Total 34]

- 2** A life insurance company has a portfolio of identical single premium endowment assurances with a combined sum assured of \$1.5m. The outstanding term of the portfolio is exactly 20 years. The endowment assurance death benefit is payable at the end of the year of death. The endowment assurances were paid for by single premiums at the outset of the policies. The current age of all policyholders is 30 exact.

The company holds three assets (A, B and C) to meet its liabilities in respect of this portfolio. The basis used by the company to value its liabilities, together with details of the assets held, is set out in worksheet 'Q2 Base'.

- (i) Determine the present value of the insurance company's portfolio of endowment assurances and the present value of total assets held in respect of the portfolio. [12]
- (ii) Determine the volatility of the portfolio of endowment assurances and the volatility of total assets held in respect of the portfolio. [9]

The company now wishes to re-balance its holdings of assets B and C such that the portfolio is immunised against small changes in the rate of interest. The holding of asset A will remain unchanged.

- (iii) (a) Determine the new holdings of assets B and C.
- (b) Demonstrate that Redington's conditions for immunisation are met with these new holdings. [17]
- (iv) Explain, without performing any further calculations, how the relative values of the assets and liabilities will change if the interest rate decreases slightly. [4]

[Total 42]

3 The Finance Director of a company has been presented with two potential projects.

Project A streamlines financial processes. Further details of this project, including expected cashflows, are set out in worksheet ‘Q3 ProjectA Data’.

Project B is the development of a new finance administration system. Further details of this project, including expected cashflows, are set out in worksheet ‘Q3 ProjectB Data’.

The Finance Director wants to implement one of the two projects and has asked you for a recommendation.

The company has a policy of using an annual effective target rate of return of 6% p.a.

(i) Determine the Net Present Value (NPV) for each project. [16]

(ii) Explain which project you will recommend, based on your answers to part (i). [2]

Despite your recommendation, the Finance Director decides to implement the other project.

(iii) Suggest reasons for the Finance Director’s decision. [6]

[Total 24]

END OF PAPER