

# INSTITUTE AND FACULTY OF ACTUARIES

## EXAMINATION

18 April 2011 (pm)

### Subject ST2 — Life Insurance Specialist Technical

*Time allowed: Three hours*

#### **INSTRUCTIONS TO THE CANDIDATE**

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*
2. *You have 15 minutes at the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have three hours to complete the paper.*
3. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all five questions, beginning your answer to each question on a separate sheet.*
6. *Candidates should show calculations where this is appropriate.*

#### **AT THE END OF THE EXAMINATION**

*Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.*

<p><i>In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator from the approved list.</i></p>
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- 1** (i) Describe the restrictions that may be applied to life insurance companies by governments or regulators. [6]
- (ii) Discuss how these restrictions might influence a life insurance company when designing a product. [6]
- [Total 12]

- 2** (i) Discuss how expenses can be a source of risk to a life insurance company. [3]

A life insurance company has decided to reduce sales of one of its products substantially. Prior to this decision, this product accounted for 40% of the company's new business sales and approximately 30% of its in-force reserves.

- (ii) Discuss the measures that the company may take in order to reduce its expenses in these circumstances. [7]
- (iii) Explain why the company may need to review the expense assumptions used in pricing its products, as a result of the decision to reduce the sales of this product. [4]
- [Total 14]

- 3** A proprietary life insurance company currently prices its without profits immediate annuity business as follows:

$$\text{Premium} = (\text{annuity} \times \ddot{a}_x + \text{expenses} \times \ddot{a}'_x + \text{cost of capital}) \times 1.02$$

Where:

“annuity” is the annual annuity payment.

$\ddot{a}_x$  is the annuity factor for an annuity payable annually in advance for a life aged  $x$  using a best estimate mortality assumption and a discount rate equal to the expected earned rate. This earned rate is set equal to current yields on corporate bonds of appropriate term less a prudent allowance for credit risk.

$\ddot{a}'_x$  is the same as  $\ddot{a}_x$  except that the discount rate is reduced to allow for expense inflation.

“expenses” are best estimate per policy annual maintenance expenses. There are no initial expenses.

“cost of capital” =  $0.03 \times \text{average term of the contract} \times (\text{initial reserves} - \text{annuity} \times \ddot{a}_x - \text{expenses} \times \ddot{a}'_x)$

The 1.02 multiplier represents the margin for profit and risks.

The local reserving basis requires the benefits and expenses to be discounted at a risk free rate of return, which is significantly lower than the rate used in pricing.

The company has decided to launch a new “profit-sharing” immediate annuity product which is priced as follows:

$$\text{Premium} = \text{initial reserves} \times 1.02$$

The contract will offer policyholders an initial starting annuity that is lower than that under the current contract, but with the potential for higher annuity payments if experience is favourable.

The assets will be invested in the same corporate bonds as the existing annuity business. Each year, a calculation will be performed to assess the total surplus arising, and this surplus will be used to benefit policyholders. Annuity benefits can reduce from one year to the next, but cannot be less than the initial annuity. Any negative surplus is carried forward to offset future positive surpluses.

The total surplus arising over year  $t$  will be calculated as:

Reserves at time  $t-1$  (or premium, if  $t = 1$ ) + investment income – annuity payments – expenses – reserves at time  $t$ .

- (i) Explain why it is appropriate for the company to use different bases for pricing and reserving. [2]
- (ii) Discuss the suitability of the various methods that are available to distribute the surpluses to the policyholders. [8]

The marketing director believes that under this proposed new product policyholders should expect to receive higher annuity payments than under the existing product.

- (iii) Discuss this suggestion. [5]

The marketing director has asked how the profitability of the two types of annuity product compare.

- (iv) Discuss how the various criteria for measuring profit could be used to answer the marketing director’s question. [7]

[Total 22]

- 4** For a number of years a life insurance company has sold a unit-linked endowment assurance product designed to provide a savings policy for a child, which is taken out by the parents on the child's birth. The maturity proceeds are paid to the child on reaching age 18.

The marketing manager has suggested adding an option to new policies. The proposed option would be to convert the endowment policy, at maturity, into a level temporary annuity payable for five years from that date, or until the earlier death of the child. A guaranteed annuity conversion rate would be specified at the outset of the endowment policy. The aim would be to fund the child's university fees and provide support during the first few years of employment. The policy may not be surrendered once the annuity had started. The annuity would only be available to children who were going to university. The option would be charged for by increasing the annual management charge.

- (i) Outline the benefits to the policyholder of the addition of this option. [2]
- (ii) Outline the risks that remain with the policyholder, in relation to both the endowment and the annuity. [4]
- (iii) Discuss the risks to which the company would be exposed in respect of the proposed option. [4]
- (iv) Discuss how the company could minimise these risks. [4]
- (v) Describe the different methods that the company could use to price the option. [5]

The marketing manager has suggested adding a further feature that would guarantee that all university fees would be met by the insurance company if the policyholder paid in more than a certain amount of total premium throughout the full term of the endowment.

- (vi) Discuss this suggestion. [5]
- [Total 24]

- (i) State the principles of investment.

[2]

A life insurance company has an in-force portfolio of level and index-linked without profits immediate annuities, conventional without profits term assurances and unit-linked contracts.

The results of the previous valuation are summarised in the following balance sheet:

<i>Assets</i>		<i>Liabilities</i>	
Fixed Interest		Immediate Annuities	
- Government Bonds	14,000	- Level	20,000
- Corporate Bonds	10,000	- Index-linked	5,000
- Index-linked Bonds	7,000	Term Assurances	5,000
		Unit-linked Contracts	
Equities		- Unit reserves	50,000
- Domestic	10,000	- Non-unit reserves	2,000
- Overseas	5,000		
		Solvency Requirement	5,000
Unit-linked Funds	45,000	Free Surplus	13,000
Cash	9,000		
Total	100,000	Total	100,000

- (ii) Describe an appropriate investment strategy for each of the items on the liability side of the balance sheet. [11]
- (iii) Discuss whether the assets held at the balance sheet date reflect an appropriate investment strategy. [7]
- (iv) Describe how a model may be used to determine an appropriate investment strategy. [8]

[Total 28]

**END OF PAPER**