**COURSE DETAILS**

**Course Code:** F70LB  
**Full Course Title:** Life Insurance Mathematics B  
**SCQF Level:** 10  
**SCAF Credits:** 15  
**Available as Elective:** No

**DELIVERY LEVEL**

<table>
<thead>
<tr>
<th>Undergraduate:</th>
<th>Yes</th>
<th>Postgraduate Taught:</th>
<th>No</th>
<th>Postgraduate Research:</th>
<th>No</th>
</tr>
</thead>
</table>

**Additional Information:**

**COURSE AIMS**

To introduce some more advanced topics in life insurance mathematics, and complete the material covered in subject CM1.

**LEARNING OUTCOMES – SUBJECT MASTERY**

On completion of this course the student should be able to:

- define Markov life-history models in terms of states, transitions and transition intensities;  
- state and prove Kolmogorov’s forward equations, state Thiele’s differential equations, and use an Euler scheme to solve both numerically, for a general Markov multiple-state model;  
- define models for the joint life histories of two individuals; (a) as a multiple-state model; and (b) in terms of random future lifetimes;  
- calculate expected present values, premiums and policy values for the following types of joint-life policies: first-death and second-death assurances and annuities, reversionary annuities, and contingent assurances;  
- describe the main features of disability insurance and long-term care insurance;  
- define multiple-state models representing life histories involving disability and long-term care, and show how these introduce duration dependence, hence semi-Markov models;  
- derive integro-differential equations for the occupancy probabilities needed to compute actuarial quantities in special cases of semi-Markov models;  
- give expressions for expected present values, premiums and policy values in special cases of semi-Markov models;  
- understand possible sources of heterogeneity, its effect on the analysis of insurance data, and its possible impact on insurance business;  
- construct single figure indices to summarise mortality and other experiences, and understand the strengths and weakness of each;  
- explain mathematical and component methods of population projection;  
- describe the main benefit provisions of UK pension schemes;  
- calculate the profit vector, profit signature, net present value, profit margin, discounted payback period, and internal rate of return for conventional policies;  
- describe the effect on the profit vector of changes in the premium, valuation, and experience bases;  
- describe the operation of the unit price and the charging structure for unit-linked and unitised with profits policies;  
- calculate the unit fund, sterling fund, sterling reserve, and measures of profit for unit-linked policies.

**LEARNING OUTCOMES – PERSONAL ABILITIES**
F70LB Life Insurance Mathematics B

Participants will develop facility with the main actuarial models and calculations used in life insurance, health insurance and concepts of pensions.

They will gain practical experience with the numerical methods through the coursework and project work, which will mainly be based on the main tool used in insurance companies and consultancies, Excel.

SYLLABUS

- Markov multiple-state models
- Insurances written on multiple lives
- The features of disability and long-term care insurance contracts
- Duration dependence and semi-Markov models
- Heterogeneity and selection
- Single-figure indices
- Population projections
- Profit testing conventional insurance contracts
- Profit testing unit-linked contracts

COURSE RELATIONSHIPS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Level</th>
<th>Title</th>
<th>School</th>
<th>Type</th>
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</thead>
<tbody>
<tr>
<td>F78AA</td>
<td>8</td>
<td>Actuarial and Financial Mathematics A</td>
<td>School of Math and Comp Sci.</td>
<td>Pre-Requisite</td>
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<tr>
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<td>Taught</td>
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LOCATION AND ASSESSMENT METHODS

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<tr>
<th>Edi</th>
<th>SBC</th>
<th>Ork</th>
<th>Dub</th>
<th>Malay</th>
<th>IDL</th>
<th>COLL</th>
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<th>Exam Mins</th>
<th>Type</th>
<th>Diet</th>
<th>Synoptic Course</th>
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<tbody>
<tr>
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<td>Examination</td>
<td>70</td>
<td>120</td>
<td>Assessment</td>
<td>Semester 2</td>
<td>F70LA</td>
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Note: Synoptically linked with F70LA on all degrees if F70LA is to be assessed in the same academic year. However, where a candidate chooses to register for F70LA in an earlier academic year, or not at all, then F70LB is not linked to any other course.

| Y   | Y   |     |     |       |     |      |     |     | Coursework | 30     | 30        | Assessment | Semester 2 | F70LA |

Note: Synoptically linked with F70LA on all degrees if F70LA is to be assessed in the same academic year. However, where a candidate chooses to register for F70LA in an earlier academic year, or not at all, then F70LB is not linked to any other course.

| Y   |     |     |     |       |     |      |     |     | Examination | 100    | 120       | Reassessment | Semester 3 | F70LA |

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