## COURSE DETAILS

<table>
<thead>
<tr>
<th>Course Code:</th>
<th>F70LB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Course Title:</td>
<td>Life Insurance Mathematics B</td>
</tr>
<tr>
<td>SCQF Level:</td>
<td>10</td>
</tr>
<tr>
<td>SCAF Credits:</td>
<td>15</td>
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<tr>
<td>Available as Elective:</td>
<td>No</td>
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## DELIVERY LEVEL

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

## COURSE AIMS

To introduce some more advanced topics in life insurance mathematics, and complete the material covered in subject CT5
## LEARNING OUTCOMES – SUBJECT MASTERY

On completion of this module 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 retirement and death-in-service lump sum benefits found in a defined benefit pension scheme in the UK;
- derive commutation functions to perform valuations of the main retirement benefits, death-in-service lump sum benefits, and future contributions;
- 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 policies;
- calculate the unit fund, sterling fund, sterling reserve, and measures of profit for unit-linked policies.

## LEARNING OUTCOMES – PERSONAL ABILITIES

Participants will develop facility with the main actuarial models and calculations used in life insurance, health insurance and 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,
- pension fund mathematics,
- profit testing conventional insurance contracts,
- profit testing unit-linked contracts.

Note below: F70LB is to be assessed in the same academic year. However, where a candidate chooses to register for F70LA in an earlier academic year then F70LB is not linked to any other courses.

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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<tbody>
<tr>
<td>F70LA</td>
<td>10</td>
<td>Life Insurance mathematics A</td>
<td>School of Math and Comp Sci.</td>
<td>Taught Synoptic</td>
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<td>F78AA</td>
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<td>Actuarial and Financial Mathematics A</td>
<td>School of Math and Comp Sci.</td>
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<td>Actuarial and Financial Mathematics B</td>
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LOCATION AND ASSESSMENT METHODS

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<tr>
<th>Edi</th>
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<th>Malay</th>
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