# LIFE INSURANCE MATHEMATICS 2

## COURSE DETAILS

**Course Code:** F71BF  
**Full Course Title:** Life Insurance Mathematics 2  
**SCQF Level:** 11  
**SCAF Credits:** 15  
**Available as Elective:** No

## DELIVERY LEVEL

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

## 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
LEARNING OUTCOMES – PERSONAL ABILITIES

At the end of this module students should be able to:

• Demonstrate the ability to learn independently
• Manage time, work to deadlines and prioritise workloads
• Perform numerical calculations using a suitable computer package, or other available tools
• Present results in a way which indicates that they have understood the concepts involved.

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.

COURSE RELATIONSHIPS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Level</th>
<th>Title</th>
<th>School</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>F71BF</td>
<td>11</td>
<td>Life Insurance Mathematics 2</td>
<td>School of Math and Comp Sci.</td>
<td>Linked</td>
</tr>
</tbody>
</table>

LOCATION AND ASSESSMENT METHODS

<table>
<thead>
<tr>
<th>Edi</th>
<th>SBC</th>
<th>Ork</th>
<th>Dub</th>
<th>Malay</th>
<th>IDL</th>
<th>COLL</th>
<th>ALP</th>
<th>OTH</th>
<th>Method</th>
<th>Weight</th>
<th>Exam Mins</th>
<th>Type</th>
<th>Diet</th>
<th>Synoptic Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Examination</td>
<td>60</td>
<td>120</td>
<td>Assessment</td>
<td></td>
<td>Semester 2</td>
</tr>
</tbody>
</table>

Examination will be at least 60% and no more than 80%.

| Y   |     |     |     |       |     |      |     |     | Coursework | 40     |          | Assessment |      | Semester 2      |

Coursework will be at least 20% and no more than 40%.

| Y   |     |     |     |       |     |      |     |     | Examination | 100    | 120       | Reassessment|      | Semester 2      |

Re-assessment in the next academic year.