Programme-specific Section of the
Curriculum for the MSc Programme in
Actuarial Mathematics
at the Faculty of Science, University of Copenhagen
2010 (Rev. 2018)

Contents

1 Title, affiliation and language .......................................................... 2
   1.1 Title ......................................................................................... 2
   1.2 Affiliation ............................................................................... 2
   1.3 Corps of external examiners ....................................................... 2
   1.4 Language ............................................................................... 2

2 Academic profile ............................................................................. 2
   2.1 Purpose ................................................................................... 2
   2.2 General programme profile ...................................................... 2
   2.3 General structure of the programme ......................................... 2
   2.4 Career opportunities ............................................................... 2

3 Description of competence profiles ................................................. 3
   3.1 Competence profile ................................................................. 3

4 Admission requirements ................................................................. 3
   4.1 Applicants with a Bachelor’s degree in Actuarial Mathematics .... 3
   4.2 Applicants with a closely related Bachelor’s degree ................. 4
   4.3 Applicants with a related Bachelor’s degree ............................. 4
   4.4 Other applicants .................................................................... 4
   4.5 Language requirements ......................................................... 4
   4.6 Supplementary subject elements ......................................... 4

5 Prioritisation of applicants ............................................................... 5

6 Structure of the programme ............................................................ 5
   6.1 Programme components ......................................................... 5

7 Exemptions ....................................................................................... 6

8 Commencement etc. ........................................................................ 6
   8.1 Validity .................................................................................... 6
   8.2 Transfer ................................................................................... 6
   8.3 Amendments .......................................................................... 6

Appendix 1 Tables ............................................................................... 8
Appendix 2 Interim arrangements ....................................................... 9
Appendix 3 Description of objectives for the thesis ............................. 17
1 Title, affiliation and language
A shared section that applies to all BSc and MSc Programmes at the Faculty of Science is linked to this programme-specific curriculum.

1.1 Title
The MSc Programme in Actuarial Mathematics leads to a Master of Science (MSc) in Actuarial Mathematics with the Danish title: Cand.act. (candidatus/candidata actuariae).

1.2 Affiliation
The programme is affiliated with the Study Board of Mathematics and Computer Science, and the students can both elect, and be elected, to this study board.

1.3 Corps of external examiners
The following corps of external examiners is used for the central parts of the MSc Programme:
- Corps of External Examiners for Mathematics (matematik).

1.4 Language
The language of this MSc Programme is English.

2 Academic profile
2.1 Purpose
The MSc programme in Actuarial Mathematics is a research-based programme, the objective of which is to provide the student with the mathematical knowledge and insights required to work independently and in a professionally sound manner within the insurance profession and contribute to the further development of this theoretical field.

2.2 General programme profile
The programme provides a general introduction to both life and non-life insurance mathematics. The student can subsequently specialise in one of these disciplines or in fields such as stochastic processes, risk management, financial theory and statistical analysis.

Actuarial mathematics, probability theory, finance, statistics and computer science are the key subject areas of the programme.

2.3 General structure of the programme
The MSc Programme is set at 120 ECTS.

There are no defined specialisations in this programme.

2.4 Career opportunities
The MSc Programme in Actuarial Mathematics qualifies students to become professionals within business functions and/or areas such as:
- A PhD programme
- Actuarial functions in insurance companies.
- Regulative authorities.
- Specialized software development.
3 Description of competence profiles

Students following the MSc Programme acquire the knowledge, skills and competences listed below. Students will also acquire other qualifications through elective subject elements and other study activities.

3.1 Competence profile

On completion of the programme, an MSc in Actuarial Mathematics has acquired the following:

Knowledge about:
- General theory for stochastic processes, including various special classes of processes: Martingales, Counting Processes, Renewal Processes, Stochastic Integrals and more.
- Stochastic differential equations with applications to finance.
- Risk measures and extreme value theory.
- Ruin theory, in particular the Cramér-Lundberg model.
- Credit modelling and operational risk modelling.
- Claim reservation.
- Term structure theory and market reserves.
- Parametric and non-parametric statistical models for insurance applications.
- Selected research-active fields with life and non-life insurance mathematics.

Skills in/to:
- Read and understand actuarial mathematical and statistical original literature.
- Communicate actuarial mathematical issues on a scientific basis.
- Account orally and in writing for inquiries into open actuarial mathematical issues.
- Derive and solve differential equations describing actuarial problems.
- Determine arbitrage free prices for financial claims.
- Compute ruin probabilities and value-at-risk.
- Analyse statistical models for insurance applications.

Competences in/to:
- Structure an inquiry into open actuarial mathematical issues, regarding both life and non-life insurance mathematics and divide it into smaller easily accessible challenges.
- Further develop and adapt probabilistic and statistical models for real-life challenges.
- Conduct independent, stringent argumentation.
- Independently take responsibility for his or her own professional development and specialisation.
- Reflect on methodologies for analysing and solving actuarial mathematical issues at a scientific level.

4 Admission requirements

With a Bachelor’s degree in Actuarial Mathematics from the University of Copenhagen the student is granted reserved access and guaranteed a place on the MSc Programme in Actuarial Mathematics if the student applies before the application deadline during the first application period after the completion of the Bachelor’s degree.

4.1 Applicants with a Bachelor’s degree in Actuarial Mathematics

Applicants with a Bachelor’s degree in Actuarial Mathematics from the University of Copenhagen may be admitted if their programme includes the following:
- Subject elements in advanced probability (at least 15 ECTS)
4.2 Applicants with a closely related Bachelor’s degree
Applicants with a Bachelor’s degree in Mathematics-Economics or Mathematics from the University of Copenhagen may also be admitted if their programme includes the following:

- Subject elements in life insurance mathematics (at least 7.5 ECTS).
- Subject elements in non-life insurance mathematics (at least 7.5 ECTS).
- Subject elements in statistics on a measure-theoretical basis (at least 15 ECTS).
- Subject elements in advanced probability (at least 15 ECTS)

4.3 Applicants with a related Bachelor’s degree
Applicants with a Bachelor’s degree in the following:

- Computer Science, Physics or Chemistry from the University of Copenhagen or other Danish or international universities.
- Mathematics or Mathematics-Economics from other Danish or international universities.

may also be admitted if their programme includes the following elements:

- Subject elements in mathematical analysis, including measure theory at least 22.5 ECTS credits
- Subject elements in linear algebra at least 7.5 ECTS credits
- Subject elements in life insurance mathematics at least 7.5 ECTS credits
- Subject elements in non-life insurance mathematics at least 7.5 ECTS credits
- Subject elements in statistics on a measure-theoretical basis at least 15 ECTS credits
- Subject elements in advanced probability at least 15 ECTS credits

4.4 Other applicants
The Faculty may also admit applicants who, after an individual academic assessment, are deemed to possess educational qualifications equivalent to those required in Subclauses 4.1-3.

4.5 Language requirements
Applicants must as a minimum document English language qualifications comparable to a Danish upper secondary school English B level or English proficiency corresponding to the tests and scores required. Accepted tests and required minimum scores are published online at www.science.ku.dk.

4.6 Supplementary subject elements
The qualifications of an applicant to the MSc program are assessed exclusively on the basis of the qualifying bachelor’s degree. Supplementary subject elements passed between the completion of the bachelor’s program and the admission to the MSc program cannot be included in the overall assessment.

However, subject elements passed before the completion of the bachelor’s program may be included in the overall assessment. This includes subject elements completed as continuing education as well as subject elements completed as part of a former higher education program. A maximum of 30 ECTS supplementary subject elements can be included in the overall assessment.

Subject elements passed before completing the BSc programme which are to form part of the MSc programme to which the student has a legal right of admission (§9-courses) cannot be included in the overall assessment.
5 Prioritisation of applicants
If the number of qualified applicants to the programme exceeds the number of places available, applicants will be prioritised as follows:

1) Applicants with a Bachelor’s degree in Actuarial Mathematics from the University of Copenhagen seeking admission by way of direct extension of their completed BSc programme.
2) Applicants with a Bachelor’s degree in Actuarial Mathematics from the University of Copenhagen.
3) Applicants with a Bachelor’s degree in Mathematics or Mathematics-Economics from the University of Copenhagen.
4) Other applicants.

If the number of qualified applicants within a category exceeds the number of places available, applicants will be prioritised according to the following criteria (listed below in prioritised order):

- Total number of ECTS within actuarial mathematics.

6 Structure of the programme
The compulsory subject elements, restricted elective subject elements and the thesis constitute the central parts of the programme (Section 21 of the Ministerial Order on Bachelor and Master’s Programmes (Candidatus) at Universities).

6.1 Programme components
The programme is set at 120 ECTS and consists of the following:

- Compulsory subject elements, 45 ECTS.
- Restricted elective subject elements, 15 ECTS
- Elective subject elements, 30 ECTS.
- Thesis, 30 ECTS.

6.1.1 Compulsory subject elements
All of the following subject elements are to be covered (45 ECTS):

- NMAA05115U Stochastic Processes in Life Insurance (LivStok) Block 1 7.5 ECTS
- NMAA05113U Continuous Time Finance (FinKont) Block 2 7.5 ECTS
- NMAA06052U Topics in Life Insurance (Liv2) Block 3 7.5 ECTS
- NMAA06068U Topics in Non-Life Insurance (Skade2) Block 4 7.5 ECTS
- NMAA05117U Stochastic Processes in Non-Life Insurance (SkadeStok) Block 1 7.5 ECTS
- NMAK10020U Quantitative Risk Management (QRM) Block 2 7.5 ECTS

6.1.2 Restricted elective subject elements
15 ECTS are to be covered by subject elements from the following list:

- NMAK18000U An Introduction to Large Deviations Block 1 7.5 ECTS
- NMAK16015U Optimal Stopping with Applications Block 1 7.5 ECTS
- NMAK16004U Computational Finance Block 1 7.5 ECTS
- NMAK18003U Beyond the Classic Markov Chain Life Insurance Setting Block 2 7.5 ECTS
- NMAK18010U Topics in Stochastic Calculus Block 2 7.5 ECTS
- NMAK16006U Consumption-Investment-Insurance Problems Block 3 7.5 ECTS
- NMAK18007U Pension Systems Block 4 7.5 ECTS
6.1.3 Elective subject elements
30 ECTS are to be covered as elective subject elements. All subject elements at MSc level may be included as elective subject elements in the MSc Programme.

BSc subject elements corresponding to 15 ECTS may be included in the MSc Programme.

Projects outside the course scope may be included in the elective section of the programme with up to 15 ECTS. The regulations are described in Appendix 5 to the shared section of the curriculum.

Projects in practice may be included in the elective section of the programme with up to 15 ECTS. The regulations are described in Appendix 4 to the shared section of the curriculum.

6.1.4 Thesis
The MSc Programme in Actuarial Mathematics includes a thesis corresponding to 30 ECTS, as described in Appendix 2 to the shared curriculum. The thesis must be written within the academic scope of the programme.

6.1.5 Academic Mobility
For students admitted in September the academic mobility for the MSc Programme in Actuarial Mathematics is placed in block 1+2 of the 2nd year.

For students admitted in February the academic mobility for the MSc Programme in Actuarial Mathematics is placed in block 3+4 of the 1st year.

Academic mobility requires that the student follows the rules and regulations regarding pre-approval and credit transfer.

In addition the student has the possibility to arrange similar academic mobility in other parts of the programme.

7 Exemptions
In exceptional circumstances, the study board may grant exemptions from the rules in the curriculum specified solely by the Faculty of Science.

8 Commencement etc.
8.1 Validity
This subject specific section of the curriculum applies to all students enrolled in the programme – see however Appendix 2.

8.2 Transfer
Students enrolled on previous curricula may be transferred to the new one as per the applicable transfer regulations or according to an individual credit transfer by the study board.

8.3 Amendments
The curriculum may be amended once a year so that any changes enter into force on the start of the academic year. Amendments must be proposed by the study board and approved by the Dean.
Notification about amendments that tighten the admission requirements for the programme will be published online at www.science.ku.dk one year before they come into effect.

If amendments are made to this curriculum, an interim arrangement may be added if necessary to allow students to complete their MSc Programme according to the amended curriculum.
Appendix 1 Tables

Tables for students admitted to the programme in September (summer):

Table – MSc Programme in Actuarial Mathematics

<table>
<thead>
<tr>
<th></th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year</td>
<td>Stochastic Processes in Non-life Insurance</td>
<td>Quantitative Risk Management</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td></td>
<td>Stochastic Processes in Life Insurance</td>
<td>Continuous Time Finance</td>
<td>Topics in Life Insurance</td>
<td>Topics in Non-life Insurance</td>
</tr>
<tr>
<td>2nd year</td>
<td>Restricted Elective</td>
<td>Restricted Elective</td>
<td>Elective</td>
<td>Thesis</td>
</tr>
<tr>
<td></td>
<td>Elective</td>
<td>Elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The table illustrates the recommended academic progression. The student is allowed to plan an alternative progression within the applicable rules.

Table for students admitted to the programme in February (winter):

Table – MSc Programme in Actuarial Mathematics*

<table>
<thead>
<tr>
<th></th>
<th>Block 3</th>
<th>Block 4</th>
<th>Block 1</th>
<th>Block 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year</td>
<td>Elective</td>
<td>Elective</td>
<td>Stochastic Processes in Non-Life Insurance</td>
<td>Quantitative Risk Management</td>
</tr>
<tr>
<td></td>
<td>Elective</td>
<td>Topics in Non-Life Insurance</td>
<td>Stochastic Processes in Life Insurance</td>
<td>Continuous Time Finance</td>
</tr>
<tr>
<td>2nd year</td>
<td>Topics in Life Insurance</td>
<td>Elective</td>
<td>Restricted Elective</td>
<td>Restricted Elective</td>
</tr>
<tr>
<td></td>
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<tr>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thesis</td>
<td></td>
</tr>
</tbody>
</table>

The table illustrates the recommended academic progression. The student is allowed to plan an alternative progression within the applicable rules.

*This table is only relevant for students who begin the MSc Programme in February (block 3).
Appendix 2 Interim arrangements

The Shared Section of the BSc and MSc Curricula for Study Programmes applies to all students.

The interim arrangements below only consist of parts where the current curriculum differs from the rules and regulations that were previously valid. Therefore, if information about relevant rules and regulations are missing, it can be found in the curriculum above.

1. General changes for students admitted in the academic year 2017/18

Students admitted to the MSc Programme in the academic year 2017/18 must finish the programme as listed in the curriculum above with the following exceptions.

1.1 When Stochastic Processes 2 or Stochastic Processes 3 (or both) is passed as part of the BSc Programme

From the academic year 2015/16, the courses Stochastic Processes 2 and Stochastic Processes 3 were added as compulsory subject elements to the BSc Programme in Actuarial Mathematics (forsikringsmatematik). Stochastic Processes 2 and Stochastic Processes 3 are equivalent to the two compulsory subject elements Advanced Probability Theory 1 and Advanced Probability Theory 2 in the MSc Programme in Actuarial Mathematics.

From the academic year 2018/19, Advanced Probability Theory 1 (NMAK11003U) and Advanced Probability Theory 2 (NMAK11011U) are no longer official parts of the MSc Programme in Actuarial Mathematics. Those students, who have passed Stochastic Processes 2 and Stochastic Processes during their BSc Programme, are now required to pass 15 ECTS restricted elective subject elements instead.

Structure of the programme

Determined by whether students have passed one or both BSc courses, the structure of the programme will vary accordingly:

- If Stochastic Processes 2 is passed, students are required to complete Advanced Probability Theory 2 and 7.5 ECTS restricted elective subject elements

  The programme will consist of:
  - Compulsory 52.5 ECTS
  - Restricted Elective 7.5 ECTS
  - Elective subject elements, 30 ECTS.
  - Thesis, 30 ECTS

- If Stochastic Processes 3 is passed, students are required to complete Advanced Probability Theory 1 and 7.5 ECTS restricted elective subject elements

  The programme will consist of:
  - Compulsory 52.5 ECTS
  - Restricted Elective 7.5 ECTS
  - Elective subject elements, 30 ECTS.
  - Thesis, 30 ECTS

- If neither of the BSc courses are completed, students are required to complete both Advanced Probability Theory 1 and Advanced Probability Theory 2 as compulsory subject elements
The programme will consist of:
- Compulsory 60 ECTS
- Elective subject elements, 30 ECTS.
- Thesis, 30 ECTS

Table – MSc Programme in Actuarial Mathematics (if both are passed)

<table>
<thead>
<tr>
<th>Year</th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Restricted elective</td>
<td>Restricted elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td></td>
<td>Stochastic Processes in Life Insurance</td>
<td>Continuous Time Finance</td>
<td>Topics in Life Insurance</td>
<td>Topics in Non-Life Insurance</td>
</tr>
<tr>
<td>2nd</td>
<td>Stochastic Processes in Non-Life Insurance</td>
<td>Quantitative Risk Management</td>
<td></td>
<td>Thesis</td>
</tr>
<tr>
<td></td>
<td>Elective</td>
<td>Elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table – MSc Programme in Actuarial Mathematics (Stochastic Processes 2 is passed)

<table>
<thead>
<tr>
<th>Year</th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Restricted elective</td>
<td>Advanced Probability Theory 2</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td></td>
<td>Stochastic Processes in Life Insurance</td>
<td>Continuous Time Finance</td>
<td>Topics in Life Insurance</td>
<td>Topics in Non-Life Insurance</td>
</tr>
<tr>
<td>2nd</td>
<td>Stochastic Processes in Non-Life Insurance</td>
<td>Quantitative Risk Management</td>
<td></td>
<td>Thesis</td>
</tr>
<tr>
<td></td>
<td>Elective</td>
<td>Elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table – MSc Programme in Actuarial Mathematics (Stochastic Processes 3 is passed)

<table>
<thead>
<tr>
<th>Year</th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Advanced Probability Theory 1</td>
<td>Restricted elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td></td>
<td>Stochastic Processes in Life Insurance</td>
<td>Continuous Time Finance</td>
<td>Topics in Life Insurance</td>
<td>Topics in Non-Life Insurance</td>
</tr>
<tr>
<td>2nd</td>
<td>Stochastic Processes in Non-Life Insurance</td>
<td>Quantitative Risk Management</td>
<td></td>
<td>Thesis</td>
</tr>
<tr>
<td></td>
<td>Elective</td>
<td>Elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The table illustrates the recommended academic progression. The student is allowed to plan an alternative progression within the applicable rules.
## Table – MSc Programme in Actuarial Mathematics (if none are passed)

<table>
<thead>
<tr>
<th></th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year</td>
<td>Advanced Probability Theory 1</td>
<td>Advanced Probability Theory 2</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td></td>
<td>Stochastic Processes in Life Insurance</td>
<td>Continuous Time Finance</td>
<td>Topics in Life Insurance</td>
<td>Topics in Non-Life Insurance</td>
</tr>
<tr>
<td>2nd year</td>
<td>Stochastic Processes in Non-Life Insurance</td>
<td>Quantitative Risk Management</td>
<td></td>
<td>Thesis</td>
</tr>
<tr>
<td></td>
<td>Elective</td>
<td>Elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                   | Compulsory | Restricted elective | Elective | The table illustrates the recommended academic progression. The student is allowed to plan an alternative progression within the applicable rules. |

**Restricted elective subject elements**

15 ECTS are to be covered as restricted elective subject elements from the following list if both Stochastic Processes 2 and Stochastic Processes 3 are passed as part of the BSc programme.

7.5 ECTS are to be covered as restricted elective subject elements from the following list if either Stochastic Processes 2 or Stochastic Processes 3 is passed as part of the BSc programme.

- Restricted elective subject elements offered as part of this curriculum (see above)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Block</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMAK16004U</td>
<td>Computational Finance (AAM)</td>
<td>Block 1</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAK17007U</td>
<td>Monte Carlo Methods in Insurance and Finance*</td>
<td>Block 1</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAK13005U</td>
<td>Introduction to Extreme Value Theory (IntroExtremValue)*</td>
<td>Block 2</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAK17005U</td>
<td>Machine Learning Methods in Non-Life Insurance*</td>
<td>Block 3</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAK17003U</td>
<td>Inference, Market Consistent Valuation and Pricing in Life Insurance*</td>
<td>Block 4</td>
<td>7.5 ECTS</td>
</tr>
</tbody>
</table>

*The courses are not offered in 2018/2019

### 2 General changes for students admitted in the academic year 2016/17 or 2015/16

Students admitted to the MSc Programme in the academic year 2015/16 and 2016/17 must finish the programme as listed in the curriculum above with the following exceptions.

The required amount of restricted elective subject elements has been reduced from 15 to 0 ECTS, and correspondingly, the amount of elective subject elements has been increased from 15 to 30 ECTS. All subject elements previously passed as restricted elective will count as elective.

#### 2.1 When Stochastic Processes 2 or Stochastic Processes 3 (or both) is passed as part of the BSc Programme

From the academic year 2015/16, the courses Stochastic Processes 2 and Stochastic Processes 3 were added as compulsory subject elements to the BSc Programme in Actuarial Mathematics (*forsikringsmatematik*). Stochastic Processes 2 and Stochastic Processes 3 are equivalent to the two compulsory subject elements Advanced Probability Theory 1 and Advanced Probability Theory 2 in the MSc Programme in Actuarial Mathematics.
From the academic year 2018/19, Advanced Probability Theory 1 (NMAK11003U) and Advanced Probability Theory 2 (NMAK11011U) are no longer official parts of the MSc Programme in Actuarial Mathematics. Those students, who have passed Stochastic Processes 2 and Stochastic Processes during their BSc Programme, are now required to pass 15 ECTS restricted elective subject elements instead.

**Structure of the programme**

Determined by whether students have passed one or both BSc courses, the structure of the programme will vary accordingly:

- If Stochastic Processes 2 is passed, students are required to complete Advanced Probability Theory 2 and 7.5 ECTS restricted elective subject elements

  The programme will consist of:
  - Compulsory 52.5 ECTS
  - Restricted Elective 7.5 ECTS
  - Elective subject elements, 30 ECTS.
  - Thesis, 30 ECTS

- If Stochastic Processes 3 is passed, students are required to complete Advanced Probability Theory 1 and 7.5 ECTS restricted elective subject elements

  The programme will consist of:
  - Compulsory 52.5 ECTS
  - Restricted Elective 7.5 ECTS
  - Elective subject elements, 30 ECTS.
  - Thesis, 30 ECTS

- If neither of the BSc courses are completed, students are required to complete both Advanced Probability Theory 1 and Advanced Probability Theory 2 as compulsory subject elements

  The programme will consist of:
  - Compulsory 60 ECTS
  - Elective subject elements, 30 ECTS.
  - Thesis, 30 ECTS

**Table – MSc Programme in Actuarial Mathematics (if both are passed)**

<table>
<thead>
<tr>
<th>1st year</th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Restricted elective</td>
<td>Restricted elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td></td>
<td>Stochastic Processes in</td>
<td>Continuous Time</td>
<td>Topics in Life Insurance</td>
<td>Topics in Non-Life</td>
</tr>
<tr>
<td></td>
<td>Life Insurance</td>
<td>Finance</td>
<td></td>
<td>Insurance</td>
</tr>
<tr>
<td>2nd year</td>
<td>Stochastic Processes in</td>
<td>Quantitative Risk</td>
<td></td>
<td>Thesis</td>
</tr>
<tr>
<td></td>
<td>Non-Life Insurance</td>
<td>Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elective</td>
<td>Elective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Compulsory
- Restricted elective
- Elective
### Table – MSc Programme in Actuarial Mathematics (Stochastic Processes 2 is passed)

<table>
<thead>
<tr>
<th></th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st year</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Restricted elective</td>
<td>Advanced Probability Theory 2</td>
<td>Elective</td>
<td>Elective</td>
<td></td>
</tr>
<tr>
<td>Stochastic Processes in Life Insurance</td>
<td>Continuous Time Finance</td>
<td>Topics in Life Insurance</td>
<td>Topics in Non-life Insurance</td>
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<tr>
<td><strong>2nd year</strong></td>
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<tr>
<td>Stochastic Processes in Non-Life Insurance</td>
<td>Quantitative Risk Management</td>
<td>Thesis</td>
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<tr>
<td>Elective</td>
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<table>
<thead>
<tr>
<th>Compulsory</th>
<th>Restricted elective</th>
<th>Elective</th>
</tr>
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</table>

### Table – MSc Programme in Actuarial Mathematics (Stochastic Processes 3 is passed)

<table>
<thead>
<tr>
<th></th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st year</strong></td>
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<tr>
<td>Advanced Probability Theory 1</td>
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<td>Stochastic Processes in Life Insurance</td>
<td>Continuous Time Finance</td>
<td>Topics in Life Insurance</td>
<td>Topics in Non-Life Insurance</td>
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</tr>
<tr>
<td><strong>2nd year</strong></td>
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<tr>
<td>Stochastic Processes in Non-Life Insurance</td>
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<table>
<thead>
<tr>
<th>Compulsory</th>
<th>Restricted elective</th>
<th>Elective</th>
</tr>
</thead>
</table>

### Restricted elective subject elements

7.5 ECTS are to be covered as a restricted elective subject element from the following list if either Stochastic Processes 2 or Stochastic Processes 3 is passed as part of the BSc programme.

15 ECTS are to be covered as restricted elective subject elements from the following list if both Stochastic Processes 2 and Stochastic Processes 3 are passed as part of the BSc programme:

- Restricted elective subject elements offered as part of this curriculum (see above)
  - NMAK16004U Computational Finance (AAM) Block 1 7.5 ECTS
  - NMAK17007U Monte Carlo Methods in Insurance and Finance** Block 1 7.5 ECTS
  - NMAK13005U Introduction to Extreme Value Theory (IntroExtremValue)** Block 2 7.5 ECTS
  - NMAK17005U Machine Learning Methods in Non-Life Insurance** Block 3 7.5 ECTS
  - NMAK17003U Inference, Market Consistent Valuation and Pricing in Life Insurance Block 4 7.5 ECTS
  - NMAK16006U Consumption-Investment-Insurance problems Block 3 7.5 ECTS
  - NMAK16017U Statistical Inference for Markov Processes Discontinued* 7.5 ECTS
  - NMAK16014U Introduction to Multivariate Extreme Value Theory (AAM) Discontinued* 7.5 ECTS
  - NMAK16015U Optimal Stopping with Applications Block 1 7.5 ECTS
  - NMAK14013U Modelling Dependence in Discrete Time (AAM) Discontinued* 7.5 ECTS

*See course specific change below.
**The courses are not offered in 2018/2019
3 General changes for students admitted in the academic year 2014/2015 or earlier
Students admitted to the MSc Programme in the academic year 2014/15 or earlier must finish the programme as listed in the curriculum above with the following exceptions.

Structure of the programme
The programme is set at 120 ECTS and consists of the following:
- Compulsory subject elements, 60 ECTS.
- Restricted elective subject elements, 15 ECTS
- Elective subject elements, 15 ECTS.
- Thesis, 30 ECTS.

<table>
<thead>
<tr>
<th></th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year</td>
<td>Advanced Probability Theory 1</td>
<td>Advanced Probability Theory 2</td>
<td>Elective</td>
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<td>Continuous Time Finance</td>
<td>Topics in Life Insurance</td>
<td>Topics in Non-life Insurance</td>
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<tr>
<td>2nd year</td>
<td>Stochastic Processes in Non-Life Insurance</td>
<td>Quantitative Risk Management</td>
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<td>Thesis</td>
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<tr>
<td></td>
<td>Restricted elective</td>
<td>Restricted elective</td>
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</tbody>
</table>

Restricted elective subject elements
15 ECTS may be covered by subject elements from the following list:
- Subject elements that have the abbreviation “AAM” (advanced actuarial mathematics)
- Projects outside the course scope with the principal supervisor from the Department of Mathematical Sciences

<table>
<thead>
<tr>
<th>Subject code</th>
<th>Subject title</th>
<th>Block</th>
<th>ECTS</th>
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</thead>
<tbody>
<tr>
<td>NMAK16004U</td>
<td>Computational Finance (AAM)</td>
<td>Block 1</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAK17007U</td>
<td>Monte Carlo Methods in Insurance and Finance**</td>
<td>Block 1</td>
<td>7.5 ECTS</td>
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<tr>
<td>NMAK16015U</td>
<td>Optimal Stopping with Applications</td>
<td>Block 1</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAK15019U</td>
<td>Phase-type Distributions: Theory and Applications</td>
<td>Block 1</td>
<td>7.5 ECTS</td>
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<tr>
<td>NMAK13005U</td>
<td>Introduction to Extreme Value Theory (IntroExtremValue)**</td>
<td>Block 2</td>
<td>7.5 ECTS</td>
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<td>NMAK17005U</td>
<td>Machine Learning Methods in Non-Life Insurance**</td>
<td>Block 3</td>
<td>7.5 ECTS</td>
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<tr>
<td>NMAK16006U</td>
<td>Consumption-Investment-Insurance Problems</td>
<td>Block 3</td>
<td>7.5 ECTS</td>
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<tr>
<td>NMAK17003U</td>
<td>Inference, Market Consistent Valuation and Pricing in Life Insurance**</td>
<td>Block 4</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAK15011U</td>
<td>Control Theory in Finance</td>
<td>Discontinued*</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAK15024U</td>
<td>Topics in Financial Risk Management</td>
<td>Discontinued*</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAK15018U</td>
<td>Modelling Dependence in Non-Life Insurance</td>
<td>Discontinued*</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAK14022U</td>
<td>Statistics for Non-Linear Time Series Models</td>
<td>Discontinued*</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAK16017U</td>
<td>Statistical Inference for Markov Processes</td>
<td>Discontinued*</td>
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<tr>
<td>NMAK16014U</td>
<td>Introduction to Multivariate Extreme Value Theory (AAM)</td>
<td>Discontinued*</td>
<td>7.5 ECTS</td>
</tr>
<tr>
<td>NMAK14013U</td>
<td>Modelling Dependence in Discrete Time (AAM)</td>
<td>Discontinued*</td>
<td>7.5 ECTS</td>
</tr>
</tbody>
</table>

*See course specific changes below
**The courses are not offered in 2018/2019

Competence profile
On completion of the programme, an MSc in Actuarial Mathematics enrolled in 2014/2015 or earlier has acquired the following:

Knowledge about:
- Selected research-active fields within life and non-life insurance mathematics.

Skills in/to:
- Read and understand actuarial mathematical and statistical original literature.
- Communicate actuarial mathematical issues on a scientific basis.
- Account orally and in writing for inquiries into open actuarial mathematical issues.

Competences in/to:
- Structure an inquiry into open actuarial mathematical issues, regarding both life and non-life insurance mathematics and divide it into smaller easily accessible challenges. Further develop and adapt probabilistic and statistical models for real-life challenges.
- Conduct independent, stringent argumentation.
- Independently take responsibility for his or her own professional development and specialisation.
- Reflect on methodologies for analysing and solving actuarial mathematical issues at a scientific level.

4 Course specific changes

<table>
<thead>
<tr>
<th>Discontinued course</th>
<th>Interim arrangement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Theory in Finance (NMAK15011U)</td>
<td>The course was a restricted elective subject element in the academic year 2015/16.</td>
</tr>
<tr>
<td></td>
<td>The course was offered for the last time in the academic year 2015/16 and a third exam was offered in the academic year 2016/17.</td>
</tr>
<tr>
<td>Modelling Dependence in Discrete Time (AAM) (NMAK14013U), 7.5 ECTS</td>
<td>The course was a restricted elective subject element in the academic year 2016/17 or earlier.</td>
</tr>
<tr>
<td></td>
<td>The course was offered for the last time in the academic year 2016/17 and a third exam was offered in the academic year 2017/18.</td>
</tr>
<tr>
<td>Modelling Dependence in Non-Life Insurance (NMAK15018U)</td>
<td>The course was a restricted elective subject element in the academic year 2015/16.</td>
</tr>
<tr>
<td></td>
<td>The course was offered for the last time in the academic year 2015/16 and a third exam was offered in the academic year 2016/17.</td>
</tr>
<tr>
<td>Introduction to Multivariate Extreme Value Theory (AAM) (NMAK16014U), 7.5 ECTS</td>
<td>The course was a restricted elective subject element in the academic year 2016/17 or earlier.</td>
</tr>
<tr>
<td></td>
<td>The course was offered for the last time in the academic year 2016/17 and a third exam was offered in the academic year 2017/18.</td>
</tr>
<tr>
<td>Course</td>
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<tr>
<td>Statistical Inference for Markov Processes (NMAK16017U)</td>
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<tr>
<td>Statistics for Non-Linear Time Series Models (NMAK14022U)</td>
<td></td>
</tr>
<tr>
<td>Topics in Financial Risk Management (NMAK15024U)</td>
<td></td>
</tr>
</tbody>
</table>

**AAM courses:**
- A300: Enmer I large divations (NMAA09033U)
- AS200: Ekstremværditeori (NMAA09013U)
- Statistiske metoder i forsikringsmatematik (NMAK10029U)
- Monte Carlo Methods in Insurance Finance (NMAA06013U)
- Levy processer i finansiering (NMAA07010U)
- Forbruges- og portefølgevalgsproblemer i finans og forsikring (NMAK11018U)
- Statistiske metoder i skadeforsikring (NMAK11023U)
- Mathematical Demography (NMAK11026U)
- Asset-liability management for pensionskasser (NMAA09010U)
- Stokastisk analyse med anvendelser i forsikring og/eller i finans (NMAK10032U)
- Topics in Life Insurance Mathematics (NMAK13021U)
- Levy Processes in Finance (NMAK13012U)
- Bayes metoder og kredibilitet i skadesforsikring (NMAK12015U)
- Consumption-Investment-Insurance Problems (NMAK14010U)
- Statistics for Non-Linear Time Series Models (NMAK14022U)
- Optimal Investment (NMAK14017U)
- Monte Carlo Methods in Insurance and Finance (NMAK14014U)
- Modeling Dependence in Discrete Time (NMAK14013U)
- Introduction to Extreme Value Theory (NMAK13005U)

For students admitted in the academic year 2014/2015 or earlier the restricted elective subject elements are designated by the abbreviation ’AAM’ (Advanced Actuarial Mathematics).

These restricted elective subject elements have previously been designated by the following parenthesis after the course title: ’(Topics in insurance mathematics)’. 
Appendix 3 Description of objectives for the thesis

After completing the thesis, the student should have:

Knowledge about:
- Scientific problems within the study programme’s subject areas.
- A suitable combination of methodologies/theories based on international research for use in his/her work with the problem formulation.
- Theories/models on the basis of an organised value system and with a high degree of independence.

Skills in/to:
- Apply and critically evaluate theories/methodologies, including their applicability and limitations.
- Assess the extent to which the production and interpretation of findings/material depend on the theory/methodology chosen and the delimitation chosen.
- Discuss academic issues arising from the thesis.
- Draw conclusions in a clear and academic manner in relation to the problem formulation and, more generally, considering the topic and the subject area.
- Discuss and communicate the academic and social significance, if any, of the thesis based on ethical principles.

Competences in/to:
- Initiate and perform academic work in a research context.
- Solve complex problems and carry out development assignments in a work context.