Financial and Actuarial Mathematics

Syllabus for a Master Course

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1. General goal of the course

The course provides students with an advanced academic education in Mathematical Finance and Actuarial Science. The students will be able to apply it in practice and will have a base for continuing their education in this field.

Students will be able to solve the basic problems in Financial and Actuarial fields. They will be able to integrate Actuarial, Statistical and Financial techniques in modeling and to take the right decisions in the area of insurance and financial practice.

The course gives a base for the students interested in a further PhD degree in Mathematical Modelling and Applications in Economics, Finance and Insurance.

2. Overview on the course modules
PART I: Mathematical Finance (30 units)

<table>
<thead>
<tr>
<th>Module</th>
<th>No. of units</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Binomial Pricing Model.</td>
<td>2</td>
<td>One-period Binomial model. Multiperiod Binomial model.</td>
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<tr>
<td>5. Stochastic Calculus and Ito’s formula.</td>
<td>5</td>
<td>Brownian Martingales. Exponential Processes. Change of measure and Girsanov’s Theorem. Martingale Representation Theorem.</td>
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### PART II: Insurance Risk Theory (30 units)

<table>
<thead>
<tr>
<th>Module</th>
<th>Units</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>13. Ruin probability in the presence of heavy tails.</strong></td>
<td>3</td>
<td>Subexponential distributions. Ruin when claim sizes are heavy tailed. Ruin when both claim sizes and inter-arrival times are heavy tailed.</td>
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<tr>
<td><strong>15. Reinsurance.</strong></td>
<td>4</td>
<td>Reinsurance policies. Investment in risky assets. On minimizing the ruin probability by investment and reinsurance. Approximation of ruin probability under optimal investment and reinsurance.</td>
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**Total no. of units** 60
3. References:


4. Teaching

The course should be accompanied by homework exercises. The students can work on their completion during at most 2 of the afternoon sessions. The major part of the afternoon sessions should be spent by working independently in teams. The results also should be presented in the afternoon sessions. During the afternoon sessions the lecturer should be available for questions and be present in order to get an impression on the performance of the students.

The course is planned to last 4 weeks, with lectures from Monday to Friday. This implies that there will be 3 teaching units (45 minutes each) per day. The following schedule is proposed for each day:

- 8:00 till 11:00: three units with breaks in between;
- 11:30 till 12:30: discussion with the lecturer;
- 15:00 till 17:30 work on homework exercises,
  - work in teams on problems posed by the lecturer,
  - presentation of results.
5. Grading

The basis for grading is provided by the performance of the students in the following items:

a) Homework exercises will be regularly given in order to achieve a better understanding of the lectures.

b) During each week of the course a project should be performed by the students. They should work in teams of 4 – 5 persons. The results obtained have to be presented by the teams.

c) An oral examination is planned to take place. It can consist of several parts taken during the course.

In order to obtain the grade for the course the following weights will be used for the items a) – c) from above:

- Homework exercises: 20%
- Projects: 50%
- Oral examination: 30%

The European Credit Transfer System (ECTS) is used for the grading of all performance assessments.