BACHELOR THESIS IN MATHEMATICAL STATISTICS

SA104X, SA105X

1. General information

Each student is responsible for finding a relevant project for their thesis and for acquiring relevant data. The topic of the thesis must be in one of the areas listed below in Section 3. The work is preferably carried out together with another student, but may also be carried out individually. In the former case, the examiner should ensure that each student’s effort meets the requirements for an individual bachelor thesis. Groups of three or more students is not allowed. The work will be reported in writing and orally in English or Swedish.

There are a number of mandatory deadlines, listed in Section 2 below. Note in particular that Peer review seminar I and Peer review meeting II are mandatory for all students and that the revised project description (5.) and the report for approval (9.) will receive a pass/fail grade. If the project is failed at either stage, then the final grade will be a fail (F).

2. Important dates and deadlines

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Room</th>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 20</td>
<td>08:15-10:00</td>
<td>D2/D3</td>
<td>1. Info meeting</td>
<td>Meeting</td>
</tr>
<tr>
<td>Feb 18</td>
<td>23:59</td>
<td>Bilda</td>
<td>2. Preliminary title uploaded</td>
<td>Deadline</td>
</tr>
<tr>
<td>Mar 2</td>
<td>23:59</td>
<td>Bilda</td>
<td>3. Project description uploaded</td>
<td>Deadline</td>
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<tr>
<td>Mar 6</td>
<td>13:15-17:00</td>
<td>TBA</td>
<td>4. Peer review seminar I</td>
<td>Mandatory seminar</td>
</tr>
<tr>
<td>Mar 10</td>
<td>23:59</td>
<td>Bilda</td>
<td>5. Revised project description uploaded</td>
<td>Deadline</td>
</tr>
<tr>
<td>Mar 30</td>
<td>23:59</td>
<td>Bilda</td>
<td>6. Disposition and skeleton uploaded</td>
<td>Deadline</td>
</tr>
<tr>
<td>May 1</td>
<td>23:59</td>
<td>Bilda</td>
<td>7. Preliminary report uploaded</td>
<td>Deadline</td>
</tr>
<tr>
<td>May 8</td>
<td>TBA</td>
<td>TBA</td>
<td>8. Peer review seminar II</td>
<td>Mandatory seminar</td>
</tr>
<tr>
<td>May 18</td>
<td>12:00-18:00</td>
<td>TBA</td>
<td>10. Final presentation</td>
<td>Presentation</td>
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<tr>
<td>May 19</td>
<td>08:00-12:00</td>
<td>TBA</td>
<td>10. Final presentation</td>
<td>Presentation</td>
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</table>

1. Info meeting.

2. Preliminary title uploaded. Upload a pdf-document on Bilda containing

   (1) Tentative title of the thesis
   (2) Author(s)

By the deadline for "Preliminary title uploaded", the topic of the thesis and the authors (project group) is final.
3. **Project description uploaded.** A project description for peer review must be uploaded in pdf on Bilda before the deadline. The project description is a brief (1-2 pages, A4) description of the project containing the following:

- **Tentative title**
- **General description of the project.** What is to be done? Why and how? Formulate the research question addressed in your project.
- **Motivation and impact of the project.** Why is the project relevant? For whom is the project relevant? What is the potential impact of your project?
- **Methodology.** What methods will be used in the project? Brief description of methods and relevant reference literature.
- **Data.** Describe the kind of data (if applicable) that will be used in the project and comment on its availability.
- **Feasibility.** Motivate the feasibility of the project. What can reasonably be expected to be achieved? Is the relevant data available? What kind of problems (delays) can you expect to run into? What new techniques and methods must you learn (identify references)?

Your project description will be evaluated with regards to Relevance, Engineering quality and Feasibility.

4. **Peer review seminar I.** Each project group will present their project proposal (10 min) and receive feedback from their peers. Each project group will be assigned two other project proposals to evaluate, both in writing and orally.

The evaluation must address the project’s relevance, engineering quality and feasibility. The evaluation must also contain a grade on the scale (1 = inadequate, 3 = good, 4 = very good, 5 = outstanding) on each of the of the three items relevance, engineering quality and feasibility and a motivation for the grade.

- The oral feedback is given to the group after their project presentation.
- The written evaluation (approx 1/2 page) must be brought to the Peer review seminar I in 3 copies.

5. **Revised project description uploaded.** After the Peer review seminar I the authors may take into account the feedback received from their peers and advisor and submit a revised project proposal. The revised project proposal will be evaluated by the advisor (Pass/Fail) and must be receive a Pass in order for the group to continue their project work.

6. **Disposition and skeleton uploaded.** A disposition and skeleton in pdf must be uploaded on Bilda. The skeleton is a tentative report containing a complete (or almost complete) table of contents, named sections and subsections along with a brief description of the planned contents of each section/subsection.

7. **Preliminary report uploaded.** A complete report in pdf for peer review must be uploaded on Bilda before the deadline. The report must contain an abstract, introduction, methodology, results, conclusions and a complete list of references.

8. **Peer review seminar II.** Each group will be assigned (approximately) two other reports to evaluate. Both in writing and orally. Each evaluation (of approx 1-2 pages) must address the report’s quality of writing and engineering/scientific quality along with suggestions for improvement. The groups meet individually to deliver their feedback.
9. Report for approval uploaded. A complete report in pdf, taking into account the suggestions during the peer-review process, must be uploaded on Bilda before the deadline. The report must be complete to such an extent that its contents can be presented at the "Final presentation".

The report will be evaluated by the advisor (Pass/Fail) and must be receive a Pass in order for the group to present their thesis at the "Final presentation".

10. Final presentation. The thesis is presented orally in its final form.

11. Final thesis uploaded. Minor corrections may be made to the report after the final presentation and the final thesis, to be graded, must be uploaded in pdf on Bilda before the deadline.

3. Project areas and prerequisites

The student must select one of the following project areas in which to pursue the Bachelor thesis. Stated prerequisites are mandatory, that is, the required courses must be completed with a passing grade before the writing of the Bachelor thesis begins.


Prerequisites: SF1901 Probability theory and statistics and all mandatory courses in mathematics.

Description. The projects in applied mathematical statistics are directed towards analysis and prediction based on multiple regression analysis. It is highly recommended that the student pursuing a project in applied mathematical statistics takes the course

\[ SF2950 - Applied Mathematical Statistics (Tillämpad Matematisk Statistik) \]

in period 3 to learn the appropriate methods.

The projects in applied mathematical statistics can usually be divided into one of the categories prediction or structural interpretation.

Projects on prediction involves the construction of a multiple regression model, based on real data, and a number of potential explanatory variables. By selection of the explanatory variables an interpretable model is constructed that can be used for forecasting. The analysis may include transformation of variables, test of normality and heteroscedasticity, censored variables and methods to select the best possible model. Examples include forecasting of real estate prices, wine prices, salaries of professional athletes etc.

Projects on structural interpretation uses mainly the same techniques as mentioned above, but the objective is to investigate if the explanatory variables affects the dependent variable. For instance if physical exercise affects the grades of students. The analysis must address the issue that there may be alternative explanations for observed correlation, for instance, that students who exercise are less likely to smoke and drink alcohol.

3.2. Markov processes.

Prerequisites. SF1904 Markov processes, SF1901 Probability theory and statistics and all mandatory courses in mathematics.
Description. Projects on Markov processes are directed towards theory and application of Markov processes and must be based on the theory of Markov processes at the level of SF1904 or higher. Markov processes are used in a wide variety of applications, for instance in bioinformatics, computer science, economics, finance, genetics, linguistics, queueing theory, etc.

In previous years there have been projects on Markov processes directed towards credit risk models in finance, linguistics, and limit order books.

3.3. Financial mathematics.

Prerequisites. SF2701 Financial mathematics, SF1901 Probability theory and statistics and all mandatory courses in mathematics.

Description. Projects in financial mathematics must be based on the theory of mathematical finance at the level of the course SF2701 or higher. Projects must address theoretical or applications of financial mathematics, for instance, pricing of derivatives, model evaluation, model extensions, etc.

4. Supervision

Each project will be assigned a thesis advisor. The thesis advisor will organize the peer review seminars, give feedback to the students and follow the students performance. If needed the advisor may offer individual meetings to assist the students. The extent and format for individual supervision is decided by each advisor.

5. Grades

The thesis will be assessed according to the following criteria in the assessment: process, engineering and scientific content, and presentation. The grade is determined by the examiner as a whole after the final thesis report has been reviewed for plagiarism. To pass, the thesis must read as a whole and not as one of the three assessment criteria. The grading criteria should be seen as a tool to support students in working towards a high goal through clarifying the demands and expectations.

Students who do not finish their work within eight months are likely to fail the course. Decisions are made where appropriate after consultation with the examiner and the program director.

Process.

Excellent. Independently plan and execute work within agreed timeframes, show good initiative and open to coaching and criticism, independently identify their own needs for new knowledge and to obtain these skills, and demonstrate an ability to get acquainted with new work and formulate appropriate and constructive criticism.

Good. Plan and execute work within agreed deadlines, show initiative and be open to coaching and criticism, ability to acquire new skills, and demonstrate an ability to get acquainted with new work and formulate relevant criticism.

Sufficient. Carry out work within agreed timeframes, show some initiative and be open to coaching and criticism, show some ability to acquire new skills, and show some ability to familiarize themselves with new work and formulate criticism.

Fail. Lack of respect for agreements, significant dependent component, or disobedience of the instruction. Inability or unwillingness to acquire new skills.
Engineering and scientific content.

*Excellent.* Based on the research problem and methodology, show very good ability to systematically apply engineering and scientific skills to the problem definition, modeling, analysis, development and evaluation. Where relevant to the task, demonstrate an awareness of social and ethical aspects, including economically, socially and ecologically sustainable development.

*Good.* Based on the research problem and methodology, demonstrate the ability to systematically apply engineering and scientific skills to the problem definition, modeling, analysis, development and evaluation. Where relevant to the task, demonstrate an awareness of social and ethical aspects, including economically, socially and ecologically sustainable development.

*Sufficient.* Based on the research problem and methodology, show some ability to apply engineering and scientific skills such as modeling, analysis, development and evaluation. Where relevant to the task, show some awareness of social and ethical aspects, including economically, socially and ecologically sustainable development.

*Fail.* Major deficiencies in engineering or scientific skills, and significant remaining gaps in methodology, despite requests.

Presentation.

*Excellent.* Demonstrate a well set report with the explicit statement of work, results, analysis, and reasoned arguments, as well as good language processing and formal and scientific accuracy. Show the ability to orally present with clear arguments and analysis and the ability to discuss work.

*Good.* Demonstrate a well set report with the explicit statement of work, results, analysis, and argumentation, as well as good language processing and formal accuracy. Show the ability to orally present and discuss work.

*Sufficient.* Present a written report with an acceptable structure, formality and language analysis. Show ability to orally present work.

*Fail.* Remaining gaps in the written report, despite requests, or substantial inability to orally present and discuss work.