

GENERAL SYLLABUS FOR DOCTORAL STUDIES IN MATHEMATICAL STATISTICS

incl. general syllabus for programmes leading to a licentiate degree

Most admissions to doctoral studies at Stockholm University should be to programmes leading to a doctoral degree.

National regulations concerning doctoral studies can be found in the *Higher Education Ordinance*, Chapters 5-7, 10, 12 and Appendix 2. In addition, the following rules and regulations are in effect at Stockholm University: *Admission Regulations for Doctoral Studies at Stockholm University*, *Regulations for Third-Cycle Education and Examinations at Stockholm University*, and *Local System of Qualifications for Stockholm University*.

This general syllabus was adopted by the Board of Science on 2017-07-01 and revised on 2017-06-21.

1 Subject description

Mathematical statistics deals with mathematical methods for analyzing random phenomena. The subject can roughly be divided in two parts: probability theory and statistical inference. The first part concerns modeling and computation of probabilities while the latter concerns methods for drawing conclusions about models from data. The subject contains theoretical parts as well as more applied parts adjusted to different areas of application.

2 Programme objectives

In addition to the provisions for first- and second-cycle studies, third-cycle (doctoral) studies should provide the knowledge and skills required to be able to conduct independent research.

The programme leads to a licentiate or doctoral degree. The objectives defined for these degrees in the *Higher Education Ordinance* are presented in sections 5 and 6 below.

3 Prerequisites and entry requirements

Admission to doctoral studies requires that the applicant meets the general and specific entry requirements, in addition to being otherwise capable of completing the training.

3.1 General entry requirements

In order to meet the general entry requirements for doctoral studies, the applicant must have completed a second-cycle degree, completed courses equivalent to at least 240 higher education credits (of which 60 credits must be in the second cycle), or have otherwise acquired equivalent knowledge in Sweden or elsewhere.

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The academic area board may permit an exemption from the general entry requirements for an individual applicant under special circumstances.

3.2 Specific entry requirements

In order to meet the special entry requirements for doctoral studies in mathematical statistics, the applicant must have completed courses equivalent to at least 60 higher education credits in mathematical statistics. These courses shall include elements of probability theory, stochastic processes and statistical inference corresponding to the contents of Probability Theory II (7.5 hp), Stochastic Processes II (7.5 hp), Statistical Inference (7.5 hp) and Linear Statistical Models (7.5 hp). The content roughly corresponds to Gut: An Intermediate Course in Probability Theory, Grimmet and Stirzaker: Probability and Random Processes, Ross: An Introduction to Probability Models, Lindgren: Statistical Theory, Casella and Berger: Statistical Inference.

The applicant must also have completed a thesis of at least 15 credits in a mathematical statistical subject. It is desirable that the thesis belongs to the second cycle.

The scientific literature in the area is to a large extent written in English. Good knowledge in English is hence a prerequisite for pursuing a doctoral degree in mathematical statistics.

4 Selection and admission

The selection between candidates who meet the entry requirements will be made with reference to their ability to benefit from the training. However, the fact that an applicant is deemed able to transfer credits from previous training or professional experience may not alone give the applicant priority over other applicants in the selection process. Admission decisions are made in accordance with current delegation policies.

Criteria that are used to judge the ability to benefit from the training is: the applicants documented knowledge with relevance to the research area, written and oral communication skills, ability of analytical thinking, creativity, sense of initiative, independence and collaborative skills. The judgement is based on previous studies and grades, quality of the thesis, references, relevant experience, the written application and interviews.

5 Programmes leading to a doctoral degree

5.1 General provisions

Programmes leading to a doctoral degree require four years of full-time study (240 higher education credits). The program consists of a course component including at least 100 higher education credits, and a thesis component comprising at least 120 higher education credits.

Although the course component precedes the thesis component, the student is encouraged to discuss the topic of the thesis at an early stage.

Objectives for doctoral degrees according to the Higher Education Ordinance

Knowledge and understanding

For a Degree of Doctor, the doctoral student must:

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- demonstrate broad knowledge in, and a systematic understanding of, the field of research, together with deep and current specialist knowledge in a defined part of this field;
- demonstrate familiarity with research methodology in general and the methods of the specific field of research in particular.

Skills and abilities

For a Degree of Doctor, the doctoral student must:

- demonstrate an ability to engage in scholarly analysis and synthesis, as well as in independent, critical review and assessment of new and complex phenomena, issues, and situations;
- demonstrate an ability to identify and formulate issues critically, independently, creatively, and with scholarly precision; to plan and conduct research and other advanced tasks using appropriate methods within specified time limits; and to review and evaluate such work;
- demonstrate an ability to make a substantial contribution to the development of knowledge through their own research in a thesis;
- demonstrate an ability, in both national and international contexts, orally and in writing, to present and discuss research and research findings authoritatively in dialogue with the scholarly community and society in general;
- demonstrate an ability to identify areas where further knowledge is required;
- demonstrate the potential to contribute to social development and support the learning of others, both in the fields of research and education and in other qualified professional contexts.

Judgement and approach

For a Degree of Doctor, the doctoral student must:

- demonstrate intellectual independence and scholarly integrity, as well as an ability to make ethical assessments relating to research;
- demonstrate specialised insight into the potential and limitations of research, its role in society, and the responsibility of the individual for how it is used.

5.2 Individual study plan

An individual study plan must be drawn up for each doctoral student. The individual study plan should include:

- a research plan, including a timetable;
- information relating to how the supervision is organised;
- a plan of which courses/what type of courses the doctoral student is going to take;
- a description of other academic activities, such as participation in seminars and reading courses;
- a description of other obligations the student and the department may have during the training period;
- a financial plan covering the entire period of study;
- if the training is not funded by means of employment, the financial plan should specify what social benefits apply to the type of funding in question, for example in the event of illness or parental leave.

The individual study plan should be drawn up in consultation with the doctoral student and his or her supervisor, and be reviewed at least once a year. The individual study plan should be adopted and

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reviewed in accordance with current delegation policies. When the individual study plan is reviewed, it should be specified how the doctoral studies relate to the qualitative targets outlined in the *Higher Education Ordinance*.

5.3 Courses and instruction

The course component must comprise at least 100 higher education credits. It contains a compulsory general part consisting of:

1. At least 20 higher education credits in probability theory.
2. At least 15 higher education credits in statistical inference theory.

Certain modification in the general part can be allowed after consultation with the supervisor and the director of graduate studies. In particular, a student with a clear probabilistic focus can decrease the general course part in statistics to 10 higher education credits, and a student with a clear statistical focus can decrease the general course part in probability theory to 15 higher education credits.

The student must complete the course 'Ethics in research and proper scientific conduct' which aims at ensuring the requirements of good knowledge in ethics and scientific conduct in the higher education ordinance. The student must also complete at least one pedagogical course.

The remaining courses are chosen after consultation with the supervisor. One or more courses can be in a different subject, provided that they are relevant to doctoral training in mathematical statistics. It is also possible to include at most 12.5 hp of statistical consultancy work (documented by written reports or oral presentations), at most 7.5 hp of research presentations at conferences and a course in writing and presenting mathematical texts. Furthermore, study circles and self-study courses with different types of examination can be included.

Doctoral students are expected to participate actively in seminars discussing current research findings. Courses or instruction may be provided in collaboration with other departments. Doctoral students are expected to make use of the provided opportunities to attend guest lectures, both in their own and adjacent subject areas.

5.4 Thesis

As part of the training, the student will write an academic thesis. The thesis should reflect the doctoral student's ability to complete the selected research task in a scholarly and independent manner, with or without collaboration. The thesis should be of such quality that it could be considered to meet reasonable requirements for publication in an academic journal of good quality. The doctoral thesis should be written either as a unified, coherent academic work (monograph) or as a compilation of academic papers with a summary. The papers may be co-authored with other people, but the doctoral student's contributions must be clearly distinguishable.

The thesis should be written in English. The department is responsible for the English summary of the thesis being translated into Swedish.

5.5 Supervision

Each doctoral student should be assigned a principal supervisor and at least one assistant supervisor. At least one of the supervisors should have a docentship and at least one should have received training

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in supervision or be considered to have corresponding qualifications. At least one of the supervisors should have a permanent position at the Department of Mathematics, Stockholm University. Decisions regarding supervisors are made in accordance with current delegation policies.

A doctoral student is entitled to change supervisors upon request to the departmental board, in which case the individual study plan should be revised.

5.6 Examination and public defence

In order to receive a degree, the student must have received a passing grade on the thesis and the examinations included in the programme. Each course is usually concluded with a written or oral examination. In some cases, continuous examination may take place during teaching sessions or laboratory work. Examinations are assessed using the grades Pass or Fail.

The thesis should be defended orally at a public defence seminar. The defence seminar should follow the regulations of the Academic Area of Science at Stockholm University.

7.7 Credit transfer

Provisions concerning credit transfer can be found in the *Higher Education Ordinance*, Chapter 6, sections 6-8.

Courses that were part of the specific entry requirements cannot be given credit for as part of the doctoral degree.

Decisions regarding credit transfer are made in accordance with current delegation policies.

6 Programmes leading to a licentiate degree

Under special circumstances, the academic area board may decide to allow admissions to programmes that lead to a licentiate degree worth at least 120 higher education credits. An assessment that funding can be secured for the time required to complete a licentiate degree, but not a doctoral degree, does not alone constitute such a special circumstance.

Decisions to admit students to programmes that lead to a licentiate degree are made in accordance with current delegation policies.

In cases where a student who has been admitted to a programme leading to a licentiate degree student wishes to pursue a doctoral degree, a new academic review and an analysis of the financial plan will be carried out before a decision to admit the student to a programme leading to a doctoral degree can be made in accordance with current delegation policies.

6.1 General provisions

A third-cycle programme comprising at least 120 credits, or a part comprising at least 120 credits of a third-cycle programme leading to a doctoral degree, may be completed with a licentiate degree. The program consists of a thesis component comprising at least 60 credits, and a course part consisting of at least 50 credits.

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Although the course component precedes the thesis component, the student is encouraged to discuss the topic of the thesis at an early stage.

Objectives for licentiate degrees according to the Higher Education Ordinance

Knowledge and understanding

For a Degree of Licentiate, doctoral students must:

- demonstrate knowledge and understanding in the field of research, including current specialist knowledge in a limited area of this field, as well as specialised knowledge of research methodology in general and the methods of the specific field of research in particular.

Skills and abilities

For a Degree of Licentiate, doctoral students must:

- demonstrate an ability to critically, independently, creatively, and with scholarly precision identify and formulate issues, and to plan and, using appropriate methods, complete a limited research project and other qualified tasks within specified time limits, so as to contribute to the development of knowledge and to evaluate this work;
- demonstrate an ability to present and discuss research and research findings clearly, in dialogue with the scholarly community and society in general, orally and in writing, in both national and international contexts;
- demonstrate the skills required to participate independently in research and development and to work independently in other advanced contexts.

Judgement and approach

For a Degree of Licentiate, doctoral students must:

- demonstrate an ability to make assessments of ethical aspects of their own research;
- demonstrate insight into the possibilities and limitations of research, its role in society, and our responsibility for how it is used;
- demonstrate an ability to identify their need of further knowledge and to take responsibility for developing their knowledge.

6.2 Individual study plan

The individual study plan should be written the same way as for a doctoral degree, see 5.2.

6.3 Courses and instruction

The course component must include at least 10 credits in probability theory and stochastic processes (7.5 credits for a student with a clear statistical focus) and at least 7.5 credits in statistical inference (5 credits for a student with a clear probability focus). The student must complete the course 'Ethics in research and proper scientific conduct' which aims at ensuring the requirements of good knowledge in ethics and scientific conduct in the higher education ordinance. The remaining courses will be selected in consultation with the supervisor. At most 7.5 credits for statistical consultancy work (documented by written reports or oral presentations) can be included, and at most 3 credits for research presentations at conferences.

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Doctoral students are expected to participate actively in seminars discussing current research findings. Courses or instruction may be provided in collaboration with other departments. Doctoral students are expected to make use of the provided opportunities to attend guest lectures, both in their own and adjacent subject areas.

6.4 Thesis

As part of the training, the student will write a licentiate thesis. The thesis should be of such quality that it could be considered to meet reasonable requirements for publication in an academic journal of good quality.

6.5 Supervision

See 5.5.

6.6 Examination

The first paragraph of 5.6 also applies to licentiate degrees. The examination of a licentiate thesis takes place in connection with a publicly advertised licentiate seminar and should follow the regulations of the Academic Area of Science at Stockholm University.

6.7 Credit transfer

Provisions concerning credit transfer can be found in the *Higher Education Ordinance*, Chapter 6, sections 6-8.

Courses that were part of the specific entry requirements cannot be given credit for as part of the licentiate degree.

Decisions regarding credit transfer are made in accordance with current delegation policies.

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