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UMEÅ UNIVERSITY

General syllabus for doctoral studies in computational mathematics and statistics

with doctoral degree as goal

Scope: 240 ECTS credits
The Degree: Doctoral degree
Study level: Third-cycle
Established by: General syllabus established by the Faculty of Science and Technology Board on October 20th, 2025
Enters into force: November 1st, 2025
Responsible body: Faculty of Science and Technology
This document has been translated from Swedish into English. If the English version differs from the original, the Swedish version takes precedence.

1. Subject description and delimitation

Computational mathematics and statistics, in the sense of this syllabus, is the general scientific field that develops and applies computational methods for studies of phenomena in science and engineering. The subject involves mathematical and statistical modelling, development of numerical methods for computer solutions or simulation of such models, implementation in software, and application to specific application areas. The subject covers the full range of computational, mathematical, and statistical methods. Techniques for evaluating and assessing the efficiency and reliability of computational methods play a key role in the field.

Holders of a doctoral degree in computational mathematics and statistics are expected to have acquired good overall expertise in the subject and deep knowledge in their area of specialisation. The latter is demonstrated by the ability to conduct research that significantly contributes to the field, as outlined above.

2. Objectives of the education

2.1 Description of education at the current level

The education is at the third-cycle level. The goals for third-cycle study programmes are in the Higher Education Act, Chapter 1, Section 9a.

2.2 National learning outcomes for the degree

The national learning outcomes for the degree can be found in Appendix 2 of the Higher Education Ordinance.

The learning outcomes for the doctoral degree in computational mathematics and statistics are those specified by the Higher Education Ordinance, Chapter 6, Sections 4 and 5 (see Appendix A), where the terms *research field* and *area of specialisation* refer to computational mathematics and statistics (as defined above) and the doctoral student's specialization, respectively. These learning outcomes are complemented by the gender and equal opportunities perspective, integrated in the content and organisation of the programme. It provides the student with additional insights into how the upholding of inequality by traditional structures and perspectives can be counteracted.

3. Entry requirements and prerequisites

To be admitted for studies at doctoral level, the applicant must meet both general and specific entry requirements described below and be deemed to have the necessary ability to benefit from the education. (Higher Education Ordinance, Chapter 7, Section 35)

General entry requirements

To fulfil the general entry requirements, the applicant must have qualifications equivalent to a completed degree at advanced level (second-cycle) or completed course requirements of at least 240 ECTS credits, including at least 60 ECTS credits at advanced level, or has otherwise acquired essentially equivalent knowledge within or outside Sweden. The faculty board may, in the case of a specific applicant, consent to an exemption from the general entry requirements if there are special reasons. (Higher Education Ordinance, Chapter 7, Section 39)

Specific entry requirements

To fulfil the specific entry requirements to be admitted for studies at the doctoral level in computational mathematics and statistics, the applicant must have completed at least 90 ECTS credits within the subject of computational mathematics and statistics (including computer science, mathematics, mathematical statistics, and closely related fields), of which at least 30 ECTS credits shall have been acquired at advanced level.

The entry requirements specified above are also considered fulfilled by applicants who have acquired essentially equivalent knowledge through other means.

4. Selection process

Selection among applicants who meet the entry requirements shall be made with consideration of their ability to benefit from doctoral education. It shall be based on the following assessment criteria:

- personal suitability
- previous academic achievements, and
- other qualifications

However, during selection, the fact that an applicant is deemed able to have previous education or professional experience credited towards the programme shall not give that applicant priority over others. (Higher Education Ordinance, Chapter 7, Section 41)

Decisions regarding admission to the doctoral studies leading to a doctoral degree are made in accordance with Umeå University's rules of delegation.

5. Content and structure

5.1 General

An individual study plan shall be established for each doctoral student, specifying details such as funding, supervision, coursework, and thesis work. The programme comprises 240 ECTS credits for a doctoral degree. A doctoral student admitted to a programme leading to a doctoral degree may, if they so wish, pursue a licentiate degree as an intermediate goal. The requirements for the licentiate degree are described in the corresponding general syllabus.

Doctoral education leading to a Doctoral degree corresponds to four years of full-time study. It consists of coursework amounting to 60-90 ECTS credits and a doctoral thesis equivalent to 150-180 ECTS credits.

5.2 Content

The programme consists of coursework and thesis work. The coursework component consists of compulsory courses common to all doctoral students in the subject and a variable number of individually selected courses based on each student's specific needs. The compulsory courses provide generic skills, offer insight into the subject and its scientific methodology, and address issues of gender equality and equal opportunities as an integrated part of the curriculum. The elective courses provide skills relevant to the dissertation topic and general competence in computational mathematics and statistics.

The annual review of the doctoral student's individual study plan ensures an appropriate selection of courses and other activities to achieve the national goals for doctoral education.

The programme has a strong international orientation. Many doctoral students participate in international collaborations, and all are expected to present their research findings in international contexts.

5.2.1 Courses

Compulsory Courses:

The following courses are compulsory for all doctoral students in computational mathematics and statistics.

Courses developing generic skills:

- Introduction to Doctoral Studies at the Faculty of Science and Technology, 1 ECTS credit
- Writing Science, 5 ECTS credits
- Oral Presentation, 1 ECTS credit
- Science, Ethics, and Society, 4 ECTS credits

Courses developing general competence in Mathematics and Mathematical Statistics:

- Seminars and Research Presentation, 7.5 ECTS credits

Additional compulsory course requirements for the individual doctoral student may be added and specified in the admission decision.

Elective Courses:

The remaining course requirements are fulfilled by taking elective courses that broaden or deepen the doctoral student's expertise in the subject (comprising at least 30 ECTS credits) or provide generic skills.

5.2.2 Doctoral thesis

Through the thesis, the doctoral student shall demonstrate that the national learning outcomes for the doctoral degree have been achieved.

The doctoral thesis shall comprise at least 150 ECTS credits. It may be presented either as a coherent and unified scientific work (*monograph thesis*) or as a compilation of scientific papers accompanied by an introduction, summary, and discussion (*compilation thesis*), which must also include a description of the author's contribution to each paper. The thesis must also contain a popular-science summary aimed at readers outside academia.

The doctoral dissertation shall be defended orally as a public disputation and is assessed with one of the grades, *Pass* or *Fail*. The assessment takes into account both the content of the thesis and its oral defence.

6. Examination

The doctoral degree is awarded after the doctoral student has completed a doctoral programme of 240 ECTS credits as specified above, obtained a *Pass* grade in all examinations included in the programme, and written and publicly defended a doctoral thesis that the examining committee has approved. The degree certificate is issued upon application to the Student Services/Examination Office.

7. Other instructions

The provisions that apply in respect of doctoral studies can be found in:

- The Higher Education Ordinance: Chapter 5 Employment of doctoral students, Chapter 6 Courses and study programmes, and Chapter 7 Admission to courses and study programmes, Annex 2 Qualifications ordinance.
- Admission regulations for doctoral education at Umeå University.
- Local degree ordinance at Umeå University.
- Rules for doctoral education at Umeå University.
- Handbook for doctoral studies at the Faculty of Science and Technology at Umeå University.

Appendix A

Learning outcomes for the doctoral degree

(Higher Education Ordinance, Chapter 6, Sections 4 and 5)

Knowledge and understanding

For the doctoral degree, the doctoral student shall

- demonstrate broad knowledge and systematic understanding of the research field as well as advanced and up-to-date specialised knowledge in a limited area of this field, and
- demonstrate familiarity with research methodology in general and the methods of the specific field of research in particular.

Competence and skills

For the doctoral degree, the doctoral student shall

- demonstrate the capacity for scholarly analysis and synthesis, as well as to review and assess new and complex phenomena, issues and situations autonomously and critically
- demonstrate the ability to identify and formulate issues with scholarly precision, critically, autonomously and creatively, and to plan and use appropriate methods to undertake research and other qualified tasks within predetermined time frames and to review and evaluate such work
- demonstrate through a dissertation the ability to make a significant contribution to the formation of knowledge through their research
- demonstrate the ability in both national and international contexts to present and discuss research and research findings authoritatively in speech and writing, and in dialogue with the academic community and society in general
- demonstrate the ability to identify the need for further knowledge and
- demonstrate the capacity to contribute to social development and support the learning of others, both through research and education, and in some other qualified professional capacity.

Judgement and approach

For the doctoral degree, the doctoral student shall

- demonstrate intellectual autonomy and disciplinary rectitude, as well as the ability to make assessments of research ethics and
- demonstrate specialised insight into the possibilities and limitations of research, its role in society, and the individual's responsibility for how this is used.