Master's Programme in Statistics and Machine Learning

120 credits

Master's Programme in Statistics and Machine

Learning

F7MSL

Valid from: 2020 Autumn semester

Determined by
Board of the Faculty of Arts and Sciences

Date determined	**Revision date**
2017-11-24	2019-06-13; 2020-06-08

Introduction

The rapid IT development has led to the overwhelming of society with enormous volumes of information generated by large or complex systems. Information can be stored in large databases, it can come in a streaming manner or it can be a result of the interaction between the system and the learning environment. This advanced level programme meets the challenges of learning from these complex information volumes by means of models and algorithms which enable for efficient prediction, analysis and decision making. Statistical modelling and analysis is integrated with machine learning, data mining and data management into a solid basis for professional work with the information modelling and analysis of data in large or complex systems. The program also provides excellent qualifications for a career in research. The programme leads to master degree in Statistics.

Aim

National Qualifications according to the Swedish Higher Education Act

Knowledge and understanding

For a Degree of Master (120 credits) the student shall

- demonstrate knowledge and understanding in Statistics, including both broad knowledge of the field and a considerable degree of specialised knowledge in certain areas of the field as well as insight into current research and development work, and
- demonstrate specialised methodological knowledge in Statistics.

Specialized knowledge in machine learning shall include modern powerful techniques for classification and regression, prediction, methods for statistical simulation and optimization, Bayesian methods and methods for analysis of large databases.

Competence and skills

For a Degree of Master (120 credits) the student shall

- demonstrate the ability to critically and systematically integrate knowledge and analyse, assess and deal with complex phenomena, issues and situations even with limited information
- demonstrate the ability to identify and formulate issues critically, autonomously and creatively as well as to plan and, using appropriate methods, undertake advanced tasks within predetermined time frames and so contribute to the formation of knowledge as well as the ability to evaluate this work
- demonstrate the ability in speech and writing both nationally and internationally to report clearly and discuss his or her conclusions and the knowledge and arguments on which they are based in dialogue with different audiences, and
- demonstrate the skills required for participation in research and

development work or autonomous employment in some other qualified
capacity.

Judgement and approach

For a Degree of Master (120 credits) the student shall

- demonstrate the ability to make assessments in statistics informed by
  relevant disciplinary, social and ethical issues and also to demonstrate
  awareness of ethical aspects of research and development work
- demonstrate insight into the possibilities and limitations of research, and
  especially research in statistics its role in society and the responsibility of
  the individual for how it is used, and
- demonstrate the ability to identify the personal need for further knowledge
  and take responsibility for his or her ongoing learning.

Local aims

Upon completing the programme the students shall be able to:

- model information volumes that are generated by large or complex systems
- select a suitable model in a given context
- extract and organize large volumes of complexly structured data
- explore, summarize and present large and complex data sets by static,
  interactive and dynamic graphical facilities
- use advanced software to analyse large or complex data volumes
- implement models suitable for data analysis, prediction and decision
  making in some computer language
- combine data information with other sources of prior information to
  improve inference and prediction performance
- give examples of application areas where it is required to model
  information volumes that emerge from large or complex systems.
- uncover and statistically verify previously unknown patterns and trends in
  the data
- present a written thesis with a theoretical or an applied study of large or
  complex systems or data sets by means of methods from statistics and
  machine learning.

Content

The programme is organized as an education in data analytics that is relevant in different application areas. The profile in data analytics is created as a synergy of courses in statistics, machine learning and computer science. The programme comprises introductory, obligatory, complementary, profile courses and a master thesis.

Introductory courses are offered to prepare the students for the programme's other courses. Obligatory courses contain theoretical and practical tools that are necessary for solving various analytical problems. Profile courses are courses in Statistics that include models and methods which give a deeper probabilistic understanding of machine learning and data analysis. Complementary courses have diverse nature connected to statistics or machine learning and directed towards a specific application area or an advanced methodological domain. During semester 3, a possibility to exchange semester is given.

Master thesis covering 30 ECTS makes it possible for the students to apply their theoretical and practical knowledge in order to solve a relevant practical data analysis problem or going deeper into a research-oriented project.

The heading 'Curriculum' contains a list of courses included in the programme. The course syllabuses for these describe in more detail the contents, teaching and working methods, and examination.

Teaching and working methods

Ordinary courses have lectures, seminars, and computer exercises. The lectures are devoted to presentations of theories, concepts, and methods. The seminars comprise presentations and discussions of assignments. The computer exercises provide practical experience of data analysis and other methods taught in the programme. The courses that are named projects have supervision only.

The course syllabuses describe in more detail the contents, teaching and working methods, and examination.

Entry requirements

- Bachelor's degree equivalent to a Swedish Kandidatexamen within statistics, mathematics, applied mathematics, computer science, engineering or a similar degree.
- Completed courses with passing grade in following subjects:
  - calculus
  - linear algebra
  - statistics
  - programming
- English corresponding to the level of English in Swedish upper secondary education (Engelska 6)
  Exemption from Swedish

Threshold requirements

The student must have passed at least 6 ECTS credits of the first semester, in order to get access to the second semester of the programme.

The student must have passed at least 30 ECTS credits of the first year, including the course Machine Learning, 9 ECTS credits, in order to to get access to the third semester of the programme.

The student must have passed at least 60 ECTS credits of the programme, including the course Machine Learning, 9 ECTS credits, in order to get access to the fourth semester of the programme.

Degree requirements

The student will be awarded the degree of Master of Science (120 ECTS credits) in Statistics provided all course requirements are completed and that the student fulfils the general and specific eligibility requirements including proof of holding a Bachelor's (kandidat) or a corresponding degree.

To be awarded the degree the students must have passed 90 ECTS credits of courses including 42 ECTS credits of the compulsory courses, a minimum of 6 ECTS credits of the introductory courses, a minimum of 12 ECTS credits of the profile courses, and, possibly, some amount of complementary courses. The students must also have successfully defended a master's thesis of 30 ECTS credits.

Completed courses will be listed in the degree certificate.

A degree certificate is issued by the Faculty Board on request.

A Diploma Supplement will be attached to the degree certificate.

Degree in Swedish

Filosofie masterexamen med huvudområde statistik

Degree in English

Degree of Master of Science with a major in Statistics

Specific information

Transferring credit

Decisions about transferring credit are taken by the faculty board, or by a person designated by the board, after application from the student.

Teaching language

The teaching language is English.

Curriculum

Semester 1 (Autumn 2020)

Course code	Course name	Credits	Level	Weeks	ECV
732A60	Advanced Academic Studies	3	A1X	v202034-202044	C
732A93	Statistical Methods	6	A1N	v202035-202044	E
732A94	Advanced Programming in R	6	A1X	v202035-202044	E
732A98	Visualization	6	A1N	v202036-202044	E
732A90	Computational Statistics	6	A1X	v202045-202102	C
732A99	Machine Learning	9	A1X	v202045-202102	C

Semester 2 (Spring 2021)

Course code	Course name	Credits	Level	Weeks	ECV
732A55	Neural Networks and Learning System	6	A1N	v202103-202112	E
732A56	Web programming	6	A1N	v202103-202112	E
732A74	Introduction to Python	3	A1N	v202103-202112	C
732A75	Advanced Data Mining	6	A1N	v202103-202112	C
732A97	Multivariate Statistical Methods	6	A1N	v202103-202112	E
732A54	Big Data Analytics	6	A1N	v202113-202122	C
732A78	Deep Learning	3	A1F	v202113-202122	C
732A91	Bayesian Learning	6	A1N	v202113-202122	C

Semester 3 (Autumn 2021)

Course code	Course name	Credits	Level	Weeks	ECV
732A63	Probability Theory	6	A1N	v202135-202143	E
732A80	Time Series and Sequence Learning	6	A1N	v202135-202143	E
732A96	Advanced Machine Learning	6	A1N	v202135-202143	E
732A98	Visualization	6	A1N	v202135-202143	E
732A66	Decision Theory	6	A1N	v202135-202202	E
732A76	Research Project	6	A1N	v202135-202202	E
732A51	Bioinformatics	6	A1N	v202144-202202	E
732A57	Database Technology	6	A1N	v202144-202202	E
732A92	Text Mining	6	A1N	v202144-202202	E

Semester 4 (Spring 2022)

Course code	Course name	Credits	Level	Weeks	ECV
732A64	Master Thesis in Statistics	30	A1X	v202203-202222	C

ECV = Elective / Compulsory /Voluntary
*Kursen läses över flera terminer

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