



ÖREBRO UNIVERSITY

SWEDISH BUSINESS SCHOOL AT
ÖREBRO UNIVERSITY

Programme Syllabus¹
Reg. no. CF 52-498/2008

Page 1 (10)

MASTERPROGRAM I STATISTIK, 120 HÖGSKOLEPOÄNG

Master in Applied Statistics, 120 higher education credits

The study programme was instituted on 5 September 2006, by the Faculty Board of Humanities and Social Sciences. The programme syllabus was last amended on 9 October 2008, by the Faculty Board of Economics, Management and Innovation.

1 GENERAL

The master programme in applied statistics provides qualifications to work independently as a statistician and for developing methods in order to adapt them to better suit the situation at hand. A statistician almost always works in teams with non-statisticians and then often has the role of internal consultant. The ability to communicate with colleagues or clients in different professions is therefore an important quality for a statistician: partly to identify the statistical perspective on a current project by identifying and formulating questions in terms of statistical concepts and a suitable statistical approach for the data analysis; partly to be able to communicate the assumptions behind and limitations of the chosen statistical approach; as well as to be able to communicate the results of the analysis in a clear way. These elements are practiced through application throughout the programme.

The programme prepares for a career as a professional statistician but also provides a basis for doctoral studies in statistics. It provides a wide knowledge in statistics with the prospect of working in all kinds of fields of application. Within the programme, it is also possible to opt for a profile within econometrics, biostatistics or official statistics/survey sampling.

¹ The English translation of the programme syllabus was last amended on 7 January, 2009.

2 AIMS AND OBJECTIVES

2.1 General aims for second level education

Second level education shall essentially build on the knowledge that students acquire in first level education or corresponding knowledge.

Second level education shall involve a deepening of knowledge, skills and abilities relative to first level education and, in addition to what applies to first level education, shall

- further develop the students' ability to independently integrate and use knowledge;
- develop the students' ability to deal with complex phenomena, issues and situations; and
- develop the students' potential for professional activities that demand considerable independence or for research and development work.

(Chapter 1, Section 9, Higher Education Act)

2.2 Objectives for the Master Programme in Applied Statistics

Objectives (in addition to the general aims stated in Chapter 1, Section 9 of the Higher Education Act)

Knowledge and understanding

For a Degree of Master (Two Years) students must

- demonstrate knowledge and understanding in their main field of study, including both broad knowledge in the field and substantially deeper knowledge of certain parts of the field, together with deeper insight into current research and development work; and
- demonstrate deeper methodological knowledge in their main field of study.

Skills and ability

For a Degree of Master (Two Years) students must

- demonstrate an ability to critically and systematically integrate knowledge and to analyse, assess and deal with complex phenomena, issues and situations, even when limited information is available;
- demonstrate an ability to critically, independently and creatively identify and formulate issues and to plan and, using appropriate methods, carry out advanced tasks within specified time limits, so as to contribute to the development of knowledge and to evaluate this work;
- demonstrate an ability to clearly present and discuss their conclusions and the knowledge and arguments behind them, in dialogue with different groups, orally and in writing, in national and international contexts; and
- demonstrate the skill required to participate in research and development work or to work independently in other advanced contexts.

Judgement and approach

For a Degree of Master (Two Years) students must

- demonstrate an ability to make assessments in their main field of study, taking into account relevant scientific, social and ethical aspects, and demonstrate an awareness of ethical aspects of research and development work;
- demonstrate insight into the potential and limitations of science, its role in society and people's responsibility for how it is used; and
- demonstrate an ability to identify their need of further knowledge and to take responsibility for developing their knowledge.

(Appendix 2, Higher Education Ordinance)

In addition to the above, Örebro University has the objective that students on completion of the study programme shall:

- be confident in the statistician's professional role and responsibility.
- be able to work as a statistical consultant and advisor to researchers and users of statistical methods in other fields.

3 PROGRAMME DETAILS

3.1 General organisation and content of the programme

The programme starts with two semesters of compulsory courses. During semester 1 the basics necessary for further studies are introduced: statistical theory and methods for effective statistical calculation.

Semester 2 provides further basics for continued studies. The courses in econometrics mainly discuss regression models and the problems that can arise when studying observational data. The Bayesian approach to statistical inference is introduced and the basics of sampling are covered. In the course *Statistical Consulting*, which is also taken during semester 3, the statistician's role is practiced.

During semester 3, optional courses are available which provide an opportunity to widen the studies or give them a profile. Students who want a profile towards biostatistics or econometrics take the profile courses *Biostatistics* or *Micro Econometrics* and choose freely among the optional courses. Students who want to focus on official statistics take the profile course *Non-response* and the optional course *Model Assisted Survey Sampling II*. During the later part of the semester the thesis work starts parallel to the profile courses.

Semester 4 begins with more profile courses, *Clinical Trials* for biostatisticians, *Financial and Macro Economic Time Series Models* for econometrics and *Register Statistics and Production of Official Statistics* for students focusing on official statistics. These courses are part-time courses and are taken parallel to the thesis work, which during the later part of the semester turns into a full-time course.

Students who wish to complete their studies with a Degree of Master (One Year), study *Econometrics I* and one of the courses *Bayesian Statistics* and *Model Assisted Survey Sampling I* during semester 2. The thesis work of 15 higher education credits is integrated with the course *Statistical Consulting* where the seminar part gives 1.5 higher education credits.

Students who wish to complete their studies with a Degree of Master (Two Years) are offered the opportunity to write two theses of 15 higher education credits each, thus meeting the independent project qualification requirement of 30 higher education credits. The student will then take the thesis course intended for the one-year master in the first year of the programme and write a thesis of 15 higher education credits for the two-year master in the second year. These students shall during semesters 3 and 4 choose a further two courses within the programme compared to students who opt to write a singular thesis of 30 higher education credits for the two-year master degree.

[In the programme overview below, *higher education credits* is shortened to *he credits*. Translator's comment.]

Programme overview

Semester 1 (autumn semester)	
Mathematics for Statistical and Economic Analysis, 7.5 he credits (Design of experiments is studied by students with adequate knowledge of mathematics)	
Statistical Theory I, Probability, 7.5 he credits	
Statistical Theory II, Inference, 7.5 he credits	
Computational Statistics, 7.5 he credits	

Semester 2 for students who complete their studies with a Degree of Master (One Year) (spring semester)			
Econometrics I, 7.5 he credits			Statistical Consulting, 1.5 he credits
<i>Optional course of 6 he credits each, 1 of</i>		Master (One Year) Thesis, 15 he credits	
Bayesian Statistics	Model Assisted Survey Sampling I		

Semester 2 for students who continue their studies to a Degree of Master (Two Years) (spring semester)			
Econometrics I, 7.5 he credits			Statistical Consulting I, 3 he credits
Econometrics II, 7.5 he credits			
Bayesian Statistics, 6 he credits			
Model Assisted Survey Sampling I, 6 he credits			

Semester 3 (autumn semester)				
<i>Elective courses of 6 he credits each, 2 of (the available courses can vary over time)</i>			Statistical Consulting II, 3 he credits	
Multivariate Data Analysis	Design of Experiments	Nonparametric Methods		Model Assisted Survey Sampling II
<i>Profile courses of 7.5 he credits each, 1 of</i>				Master (Two Years) Thesis, 7.5 he credits
Micro Econometrics	Biostatistics	Non-response		

Semester 4 (spring semester)		
<i>Profile courses of 7.5 he credits each, 1 of</i>		Master (Two Years) Thesis
Financial and Macro Economic Time Series Models	Clinical Trials	
Master Thesis, totalling 22.5 he credits during the spring semester		

3.2 Courses within the programme

All courses are offered within the main field of study, statistics.

Mathematics for Statistical and Economic Analysis, second level, 7.5 higher education credits

The following topics are included in the course: functions of one variable, derivatives, limits, optimisation, matrix algebra, functions of several variables, partial derivatives, constrained optimisation, dynamic optimisation.

Statistical Theory I, Probability, second level, 7.5 higher education credits

The following topics are included in the course: independence and conditioning, Bayes' theorem, discrete distributions, variance, continuous distributions, functions of random variables, multivariate distributions, quadratic forms, and sampling distributions.

Statistical Theory II, Inference, second level, 7.5 higher education credits

The following topics are included in the course: point estimation, confidence intervals, asymptotic theory, different modes of convergence, theory of point estimation, small sample properties, large sample properties, hypothesis testing, Neyman-Pearson, LR, LM (score) and Wald tests.

Computational Statistics, second level, 7.5 higher education credits

The following topics are included in the course: floating point numbers and computer arithmetic, numerical linear algebra, numerical optimisation, numerical integration, bootstrap and simulation methods.

Econometrics I, second level, 7.5 higher education credits

The following topics are included in the course: linear regression, endogeneity and instrumental variables estimation, generalised method of moments (GMM) and multivariate regression models.

Econometrics II, second level, 7.5 higher education credits

The following topics are included in the course: systems of simultaneous equations, panel data models, and univariate and multivariate time series.

Bayesian Statistics, second level, 6 higher education credits

The following elements are included in the course: subjective probability, decision theoretic foundations, Bayes' theorem, Bayesian estimation, hypothesis testing and model choice, conjugate distributions, linear regression, MCMC methods, panel data models, time series models, and calculating the marginal likelihood.

Model Assisted Survey Sampling I, second level, 6 higher education credits

The course discusses design-based estimation when sampling finite populations. Concepts and methods included in the course are: design, inclusion probability, indicator variables, Horvitz-Thompson-estimator, estimation of ratios and medians, general difference and regression estimators, domain estimators and the theory of two-phase sampling.

Statistical Consulting I, second level, 3 higher education credits /Statistical Consulting II, second level, 3 higher education credits /Statistical Consulting, second level, 1.5 higher education credits

These courses run over the whole semester and comprise a series of seminars where the professional role of the statistician is discussed and students meet with practising statisticians. The courses also contain a project where students take on the role of statistical consultants in a statistical study.

Multivariate Data Analysis, second level, 6 higher education credits

This course covers principal components, factor analysis, canonical correlation, discriminant and cluster analysis.

Design of Experiments, second level, 6 higher education credits

The following topics are included in the course: randomised experiments, ANOVA, randomised block experiments, roman squares, multi factor experiments, 2^k -designs, fractional designs, and response surface regressions.

Nonparametric Methods, second level, 6 higher education credits

The following topics are covered in the course: classical nonparametric methods, order statistics and methods based on ranks, methods of analysis for one, two and multiple samples with dependent and independent data, density estimation, semi-parametric and nonparametric regression.

Model Assisted Survey Sampling II, second level, 6 higher education credits

The following topics are included in the course: general regression estimation on linear group models, regression estimation on cluster, two-stage and two-phase samples, optimal sampling designs, alternative variance estimation techniques, introduction to the analysis of non-response and measurement errors.

Micro Econometrics, second level, 7.5 higher education credits

The following topics are included in the course: models for binary dependent variables, discrete choice, truncated and censored regression models, selection bias, and count data models.

Biostatistics, second level, 7.5 higher education credits

The course discusses statistical problem solving of complex questions that arise in biomedicine. Focus lies on the relation between question, design, type of data and choice of statistical approach. The possibilities, limitations and data requirements of different approaches are discussed. The course is problem based and the statistical methods for analysis and modelling of independent and dependent data material in one and multiple sample cases is discussed in the context of different applications.

Non-response, second level, 7.5 higher education credits

The course discusses different methods for handling non-response in surveys. Methods such as subsampling of non-respondents, weighting and calibration are discussed. In addition, sample selection models are studied. These methods are used with unit non-response. Imputation methods for use with partial or item non-response are surveyed.

Financial and Macro Economic Time Series Models, second level, 7.5 higher education credits

During this course, basic time series models (ARIMA) are reviewed, financial time series: ARCH/GARCH and stochastic volatility models; macroeconomic time series: structural VAR models, cointegration and equilibrium correction.

Clinical Trials, second level, 7.5 higher education credits

The course discusses the research and measurement process, choice of variables – primary and secondary variable, design, blinding, interim analysis, adjusting for multiple tests, intention to treat, on treatment-analysis, statistical methods for analysis of parallel group experiments, cross-over experiments and repeated measurements.

Register Statistics and Production of Official Statistics, second level, 7.5 higher education credits

Data from administrative registers are used more and more in the production of official statistics. The course discusses the special demands on and conditions for the production of official statistics, as well as how register statistics can be used for the production of statistics. The course focuses on the problem of statistical analysis based on register data.

Thesis for the Degree of Master (Two Years) [Master Thesis], 30 higher education credits

In this course the student shall complete an independent project. The student shall perform a theoretical or empirical analysis demonstrating that he or she has acquired knowledge of statistical methods and is able to use this to analyse relevant problems. The thesis shall be defended in a seminar with a discussant. The course also requires that the student acts as a discussant of another student's thesis, as well as the attendance of thesis seminars.

Thesis for the Degree of Master (One Year) [Paper], 15 higher education credits

In this course the student shall complete an independent project. The student shall perform a theoretical or empirical analysis which shows that he or she has acquired knowledge of statistical methods and is able to use this to analyse relevant problems. The thesis shall be defended in a seminar with a discussant. The course also requires that the student acts as a discussant of another student's thesis, as well as the attendance of thesis seminars.

Thesis for the Degree of Master (Two Years), 15 higher education credits

In this course the student shall complete an independent project. The student shall perform a theoretical or empirical analysis demonstrating that he or she has acquired knowledge of statistical methods and is able to use this to analyse relevant problems. The thesis shall be defended in a seminar with a discussant. The course also requires that the student acts as a discussant of another student's thesis, as well as the attendance of thesis seminars.

3.3 Teaching methods

Teaching is mainly provided through lectures and seminars. Assignments and independent projects (papers) are to a large extent required. The study programme is designed to stimulate critical reflection, the ability to seek out and evaluate information, the ability to independently follow the development of knowledge, and the ability to communicate orally and in writing. For further information, see individual course syllabuses.

4 INTERNATIONAL STUDENT EXCHANGE

The programme is open for international student exchange.

5 GRADES AND EXAMINATION

Unless otherwise prescribed in the course syllabus, a grade is to be awarded on completion of a course. The grade is to be determined by a teacher specifically appointed by the higher education institution (an examiner) (Chapter 6, Section 18, Higher Education Ordinance).

Unless the higher education institution prescribes another grading system, one of the following grades is to be used: fail, pass or pass with distinction (Chapter 6, Section 19, Higher Education Ordinance).

The Vice-Chancellor has decided that all schools hosting foreign exchange students shall report grades using both the Swedish grading scale and the ECTS grading scale (Vice-Chancellor Decision no. 26/2002, reg. no. 42-2002).

In case the Vice-Chancellor allows departure from the three-step grading scale this is clear from the syllabus.

For some modules, hand-in assignments are compulsory. For details regarding compulsory modules and their scope, see individual course syllabuses.

For further information, see local examination regulations.

6 QUALIFICATIONS

Degree of Master (One Year) (with a major in Statistics)

A Degree of Master (One Year) (with a major in...) is obtained after the student, in addition to having obtained a first level qualification, has completed course requirements of 60 higher education credits, including

- at least 45 higher education credits on the second level, including
 - at least 30 higher education credits with in-depth studies within a main field of study;
 - an independent project (degree project) of at least 15 higher education credits within the main field of study.

Degree of Master (Two Years) (with a major in Statistics)

A Degree of Master (Two Years) (with a major in...) is obtained after the student, in addition to having obtained a first level qualification, has completed course requirements of 120 higher education credits, including

- at least 90 higher education credits on the second level, including
 - at least 60 higher education credits with in-depth studies within a main field of study;
 - an independent project (degree project) of at least 30 higher education credits within the main field of study.

Objectives, see section 2.2.

For further information, see local qualifications regulations.

7 ELIGIBILITY REQUIREMENTS

7.1 Eligibility requirements on admission to the programme

To be eligible for the programme applicants must have

- 1) a completed bachelor degree comprising at least 180 higher education credits (or a corresponding foreign degree) with
 - a. at least 90 higher education credits in statistics, or
 - b. at least 30 higher education credits in statistics and 60 higher education credits in mathematics.
- 2) "English Course B" from the Swedish Upper Secondary School.
Applicants with foreign qualifications, whose first language is not English, must have their knowledge of English documented by an internationally recognised proficiency test, such as TOEFL, and enclose the test results in their application.

For further information, see local admission regulations.

7.2 Eligibility requirements on admission to courses within the programme

In order to gain admission to courses within the programme, students must meet the prescribed special eligibility requirements. The special eligibility requirements are stated in the individual course syllabuses.

8 SELECTION

The selection of students is performed by ranking the students fulfilling the admission requirements based on their academic merits: content, length, depth, grades and width of previous studies. An important factor for the selection is the degree project/independent project. Extensive knowledge of English is a merit.

9 TRANSFER OF CREDITS FROM PREVIOUS STUDIES

Decisions regarding transfer of credits for a course in a general qualification are, if the evaluation is made in connection with a request for a degree certificate and if the evaluation is regarded as a routine matter, made by the process manager of Student Services (see in delegations in education matters).

Decisions regarding transfer of credits in all other cases are made by the head of school in question (see delegations in education matters).

For further information, see local credit transfer regulations.

10 MISCELLANEOUS

The scope of the total number of courses offered will depend upon the students' choices and the financial conditions for the programme. It is possible that optional courses in addition to those offered at Örebro University can be offered in co-operation with other universities and university colleges.

The language of instruction for courses within the programme is English and the thesis shall be written in English.

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**ENTRY-INTO-FORCE AND TRANSITIONAL PROVISIONS (CHAPTER 6,
SECTION 17, HIGHER EDUCATION ORDINANCE)**

This programme syllabus shall be in effect from the autumn semester 2009.

Students who commenced the programme in the autumn semester of 2007 have the right to complete their studies in accordance with the programme syllabus established on 5 September 2006 (including the amendment of 15 June 2007), until the end of the spring semester of 2010.

Students who commenced the programme in the autumn semester of 2008 have the right to complete their studies in accordance with the programme syllabus established on 5 September 2006 (including the amendment of 15 June 2007), until the end of the spring semester of 2011.