



Eidgenössische Technische Hochschule Zürich  
Ecole polytechnique fédérale de Zurich  
Politecnico federale di Zurigo

## Departments of Mathematics and Physics (D-MATH/D-PHYS)

# Study Guide to the Master Program in Statistics

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# 1. Objectives of the Master in Statistics

Statistics as a science involves the study of concepts and methods suitable for drawing conclusions from empirical data. Statistics is traditionally anchored in mathematics – especially in probability theory. The latter provides appropriate models for the interpretation of data that can be construed as being partly the result of chance. Based on these models, useful methods for analysing and interpreting the relevant data can be developed and their properties subjected to theoretical analysis.

Statistics is closely linked to its areas of application. Many successful statisticians did not obtain their first degree in mathematics, but switched to statistics at a later date.

ETH Zurich therefore not only trains mathematicians specializing in applied mathematics, particularly statistics, but aims with this Master of Science program to provide those who have previously taken courses incorporating a sufficient mathematical component with an in-depth knowledge of statistics. They will be given the opportunity to learn about the mathematical principles that underlie statistics. Students who already possess this knowledge will be able to learn more about a particular area of application. The methods of applied statistics will then be taught building on this basic foundation. In the key subjects students will have the choice of attending lectures that are directed to a more mathematically or application-oriented audience.

The Master in Statistics is a "specialized Master", i.e. it represents a suitable further training option for those with Bachelor's degrees from numerous disciplines.

## Job profile and training objective

Statistics is a very useful tool for many assignments in research, development or management. In job descriptions, statistical tasks are often described as modeling, data mining, or data analysis. Statistics is important primarily in applied research in all scientific disciplines. In business, statisticians can be found particularly

- in the pharmaceutical industry, where statistics has a long tradition and has become firmly established as a result of legislation relating to the introduction of medicines;
- in public statistics, the oldest branch, from which statistics also derives its name,
- in industrial development, where improvements in quality and productivity and the development of new products are increasingly reliant on targeted experiments and in-depth data analysis;
- in the insurance and financial services sectors, where investigating optimal strategies and assessing risks are crucial to success;
- in large service companies for the processing of customer data and for formulating marketing strategies;

- in environmental management.

This list shows the numerous professional opportunities that a training in statistics opens up.

The objective of the program leading to the Master in Statistics is to enable students to identify and categorise statistical problems as such, learn and apply the most important methods, interpret the corresponding results appropriately and to understand the literature on statistical methods and results.

**Academic title.** The following academic title is conferred on students who successfully complete the program of study:

German:	Master of Science ETH in Statistik Abbreviated title: <b>MSc ETH Statistik</b>
English:	Master of Science ETH in Statistics Abbreviated title: <b>MSc ETH Statistics</b>

Students can major in one of the following three specialist areas, which will be duly recorded as a “Major” field on their Master degree certificate:

**a. Statistical methodology.** The emphasis here is on general statistical models and methods and their bases in mathematics. This specialisation is particularly suitable for students with a good grounding in mathematics who wish to learn about more complex methods and their mathematical principles and write a methodology based Master thesis.

**b. Applied statistics.** In scientific research and industrial development, experiments and observational studies based on empirical data and requiring appropriate statistical analysis are very useful. In many cases a problem can be solved simply by careful planning of the study and in-depth modeling of the investigated phenomena. Targeted and more demanding methods designed to answer specific problems can be used in many areas of application. In addition to the skilful use of general and specific methods, creative adaptations to given situations and the further development of available procedures may be required.

**c. Biostatistics.** Sophisticated methods are used to deal with the issues that typically arise in medicine and the pharmaceutical industry, and studying these methods can provide a pathway into such work. The job prospects in this sector in Switzerland are very good, particularly in the development and clinical testing of new drugs and treatments.

The courses associated with this area of application are chiefly offered by the Department of Biostatistics of the Institute for Social and Preventive Medicine at the

University of Zurich. Suitable Master theses involve the evaluation of medical data and/or statistical methods that are particularly important in this area.

## 2. Admission

Prospective students wishing to take any program at ETH Zurich have to register via the *Rector's Office*, from where further general information can be obtained.

Students who have successfully completed a Bachelor-level program of study that includes a sufficient number of credit points in mathematics and, in particular, an introduction to probability and statistics, are eligible for unconditional admission to this program. The programs of study at ETH Zurich that satisfy these requirements are listed in the Appendix to the Regulations for the Master Program in Statistics, which also specify the precise preconditions for admission.

Students may apply even before they have obtained the required university degree. The Admissions Committee assesses applicants in respect of their knowledge of the relevant studies and their basic suitability for the Master program and then submits a corresponding application to the Rector's Office, which takes the final decision. If certain conditions are not yet fully satisfied, additional demands may also be imposed.

## 3. General information about the program

**Overview of the program.** The Master program in Statistics offered by D-MATH/D-PHYS lasts one and a half academic years<sup>1</sup> (2 semesters, followed by five months for the Master thesis). The 90 credit points required for the Master degree<sup>4</sup> are acquired in compulsory core courses and freely chosen elective courses, together with a seminar presentation or term paper and a Master thesis. The following table shows the detailed requirements.

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<sup>1</sup> up to a maximum of two and a half years in the case of admission-related conditions involving up to a maximum of 60 credit points

a. Core courses	min. 20 CP
b. Statistical and mathematical elective courses	min. 15 CP
c. Elective courses in a field of application	min. 10 CP
d. Seminar or term paper	min. 4 CP
e. GESS compulsory elective	2 CP
f. Master thesis	30 CP

The minimum number of credit points adds up to 81, which means that a further 9 credit points would be required from categories a to c to obtain the Master degree.

**Maximum study period, part-time study.** Applications for the granting of the degree must be submitted within three years of the start of the Master program. If compelling reasons exist, the Rector may, in response to a written request, extend the study period. This restriction means that students cannot actually complete the program while working full-time. The Master thesis must be completed within five months, and the number of credit points allocated to it means that students must work full-time on their thesis. It is conceivable, therefore, that students could work part-time up to a maximum level of 50% and extend the duration accordingly, followed by minimal other duties while preparing their Master thesis.

**Credits from the Advanced Studies course.** An advanced studies course in Applied Statistics is offered at ETH Zurich. Credits obtained from this program within the previous five years will be counted towards the Master degree.

**Study advice.** Students requiring advice and support in organizing their program of study can contact the Student Studies and Exchange Advisor. All students will submit a study plan to the advisor during the first semester of the program. The study plan must be approved by the Studies Delegate for Statistics.

## 4. Courses and coursework

### 4.1 Core courses

The *core courses* are crucially important since they teach students about fundamental statistical concepts and methods. As a rule, lectures are provided in 5 subject areas, either with a more mathematical slant (every 2 years) or an application-oriented approach (every year or every 2 years). An extended application-oriented course takes place every other year as part of the Advanced Studies program.

The choice of which type of lecture to attend will depend on the student's previous education and interests. Only one of these types per subject can count towards the Master degree. If a course has already been credited during a Bachelor pro-

gram, a type associated with more credit points must be selected for the Master program. If this is not possible, the Studies Delegate for Statistics will specify a compensatory option.

*The core courses<sup>2</sup>*

<i>Lectures</i>	<i>SHW</i>	<i>Per.</i>	<i>Sem</i>	<i>Dept.</i>	<i>CP</i>
<b>Regression</b>					
Applied Statistical Regression	2M	1 yr	Fa	E-SCI	4
--- with extension	4M	2 yr	Fa	ESC	6
Regression	3L 1E	2 yr	Sp	MATH	8
<b>Analysis of Variance and Test Planning</b>					
Applied Analysis of Variance and Test Planning	2M	1 yr	Fa	E-SCI	4
--- with extension	4M	2 yr	Fa	ESC	6
<b>Multivariate Statistics</b>					
Applied Multivariate Statistics	2M	1 yr	Sp	E-SCI	4
--- with extension	4M	2 yr	Sp	ESC	6
Multivariate Statistics	2M	2 yr		MATH	4
<b>Time Series</b>					
Applied Time Series Analysis	4M	2 yr	Sp	ESC	6
Time Series Analysis	2M	2 yr	Sp	MATH	4
<b>Mathematical Statistics</b>					
Applied Mathematical Statistics	2M	1 yr	Sp		4
Mathematical Principles of Statistics	4L 1E	1 yr	Fa	MATH	10

- The information in this table may no longer be up to date. The syllabus information published on the ETH website is binding ([www.vorlesungsverzeichnis.ethz.ch](http://www.vorlesungsverzeichnis.ethz.ch)).

<sup>2</sup> Key to abbreviations used in the tables in this guide:

SHW Number of hours per week during semesters. L: Lecture, E: Exercise classes, M: Mixed, B: Block course  
 Per Period: annually (1 yr) or every two years (2 yr)  
 Sem. Semester in which the course is held.  
 Fa: Fall, Sp: Spring semester  
 Dept. Main department for which the course is offered  
 ESC: Extended Studies Course in Applied Statistics.  
 E-SCI: Environmental Sciences  
 CP Number of credit points

## 4.2 Elective courses in statistics and mathematics

The following elective courses are usually on offer.

<i>Lecture</i>	<i>SHW</i>	<i>Per.</i>	<i>Sem</i>	<i>Dept.</i>	<i>CP</i>
<b>Statistics</b>					
Computational Statistics	5	1 yr	Sp	MATH	10
Advanced Topics in Computational Statistics	2	2 yr	Fa	MATH	4
Stochastic Simulation	3	2 yr	Sp	MATH	6
Empirical Processes and Applications	2	2 yr		MATH	5
Categorical Data	2	2 yr		MATH	5
Bayes Methods	B	2 yr		ESC	2
Non-parametric Methods and Resampling	B	2 yr		ESC	2
Robust Statistics	B	2 yr		ESC	1
Survival Analysis	B	2 yr		ESC	1
Sampling Surveys	B	2 yr		ESC	1
Non-linear Regression	B	2 yr		ESC	1
Non-parametric Regression	B	2 yr		ESC	1
Spatial Statistics	B	2 yr		ESC	1
<b>Biostatistics</b>					
Biostatistical Methods	3	1 yr		Uni	5
Statistical Genetics and Genomics	2				4
Analysis of Longitudinal Data	2				4
Lifetime and Event Analysis	2				4
<b>Mathematics for Finance and Insurance</b>					
Applied Stochastic Processes	3L 1E	2 yr	Sp	MATH	8
Credibility	2	2 yr	Sp	MATH	4
Introduction to Mathematical Finance and Derivatives	2L 1E	1 yr	Fa	MATH	4.5
<b>Operations Research</b>					
System Modeling and Optimization	2L 1E	1 yr	Fa	MATH	6
<b>Numerics</b>					
Numerical Mathematics (for engineers)	2L 1E	1 yr	Sp	MATH	4

- The information in this table may no longer be up to date. The syllabus information published on the ETH website is binding ([www.vorlesungsverzeichnis.ethz.ch](http://www.vorlesungsverzeichnis.ethz.ch)).

### **4.3 Elective courses in applied fields**

A list of suitable application-related specialist and elective courses is not currently available, but will be published on the ETH website in due course. Students select one area of application – normally their previous field of study – and look for suitable courses in which quantitative methods and modeling play a role.

### **4.4 Specialist courses**

Certain elective subjects are compulsory for the individual specialties, particularly for the Major in biostatistics. These then become specialist courses. The list of specialist courses has not yet been drawn up.

### **4.5 Seminar and term paper**

Supplementary subjects are explored or examined in greater detail in a seminar. The students prepare part of the teaching content and present it in class.

Alternatively, if a suitable seminar with sufficient places is not available, or if the student prefers, a term paper can be prepared. The purpose of this exercise is to learn about a specific statistical methodology or undertake a statistical data analysis. The term paper is supervised by a lecturer, who can award 4 or 6 credit points for the paper depending on its scope.

In their study plan, the students inform the Studies Delegate whether they prefer to take part in a seminar or write a term paper.

### **4.6 GESS compulsory elective**

Students must attend courses of a general educational nature from the humanities, social sciences and political sciences (GESS). Attendance sufficient for 2 CP is required. For more detailed information see [www.gess.ethz.ch](http://www.gess.ethz.ch)

#### **4.7 Master thesis**

The Master thesis concludes the curriculum. In their Master thesis, students should demonstrate their ability to carry out independent, structured scientific work. The Master thesis concludes with a written report and is graded. A successful Master thesis is worth 30 CP.

Only those students who have obtained a Bachelor degree, satisfied the relevant admission requirements and have already attended a substantial proportion of the core courses can be admitted to the Master thesis.

The Master thesis lasts five months and is supervised by a professor, who defines the subject and specifies the submission date. The Head of Student Studies approves the subject and the supervision if the supervisor is not a member of D-MATH.

- The students can ask a particular professor to supervise their Master thesis. If the professor agrees, the student informs the Student Studies Advisor and gets, if necessary, the consent of the Head of Student Studies. Finally, s/he informs the Student Administration Office by the appropriate form.

#### **4.8 Outcome and repetition of performance controls**

Students have passed a performance control if their grade is at least 4.0 (on the scale from 1 for very unsatisfactory to 6 for excellent) or their performance is assessed as "passed". A performance control which is not passed can be repeated once. If a seminar presentation or term paper is not passed or if the Master thesis is unsatisfactory, a new subject must be chosen for the second attempt.

### **5. Graduation and certificates**

Once the requirements listed in Section 3 have been fulfilled, students may apply to D-MATH/D-PHYS to graduate within the maximum permitted duration of study. The application to graduate must list the performance achieved in the specified categories which the student wishes to have included in the graduation certificate. The sum of CP in each category must be at least equivalent to the minimum requirement. A maximum of 100 CP will be credited for the Master degree.

The following are listed on the graduation certificate:

- a. The grades and other assessments carried out in performance controls and the grade average determined on the basis of these grades;
- b. On a separate sheet attached to the graduation certificate, a record of any core courses that were not passed as well as of any other evaluations of performance that were carried out.

The grade average is calculated as the average of the grades for the individual subjects weighted with the credit points. Ungraded subjects are ignored.

Once the Master degree has been conferred, graduates receive a *Degree Certificate* and a *Diploma Supplement*. The Diploma Supplement is a document that is intended to facilitate and improve the evaluation and classification of the academic degree for both study and career purposes. It contains a description of the curriculum that has been studied and successfully concluded and a Qualification Profile of the curriculum.

The attainment of the Master degree is published by the Rector's Office.

**Interim grade certificates.** Interim grade certificates are issued at the end of each exam session and document the performance that has been achieved and evaluated since the last interim grade certificate was issued. On request, a certificate listing all previously studied curriculum subjects can be issued.

## 6. Doctoral studies

ETH offers the opportunity to undertake doctoral studies following the completion of the Master Program. Doctoral studies and the doctoral thesis introduce students to current research. Students require a Master degree from ETH or an equivalent degree from another university in order to gain *admission to doctoral studies*. In special cases students must sit an admission exam, the conditions of which are determined on an individual basis. The most important requirement is that a professor at ETH Zurich must be willing to supervise the doctoral thesis. For students with a Master in Statistics, the topic will likely be related to the science studied during the Bachelor program.

Further information can be obtained from the Rules on doctoral studies and the corresponding regulations of the departments concerned.

## 7. Addresses, links and relevant documents

### 7.1 Addresses

#### *Student Studies Advisor for Statistics*

Prof. Werner Stahel  
Seminar for Statistics  
ETH Zentrum, LEO D 8  
CH-8092 Zürich  
Tel.: (044 63) 2 34 30  
E-mail: [stahel@stat.math.ethz.ch](mailto:stahel@stat.math.ethz.ch)

#### *Administration Office*

Christina Künzli  
Seminar for Statistics  
ETH Zentrum, LEO D 11  
CH-8092 Zürich  
Tel.: (044 63) 2 34 38  
E-mail: [kuenzli@stat.math.ethz.ch](mailto:kuenzli@stat.math.ethz.ch)

#### *Student Administration Office*

Ms. Gelawej Assef / Ms. Doris Amstad  
Student Administration Office D-MATH/D-PHYS  
ETH Zentrum, HG G 33.1 / 33.2  
CH-8092 Zürich  
Tel.: (044 63) 2 43 83 / 2 34 78  
E- mail: [gelawej.assef@math.ethz.ch](mailto:gelawej.assef@math.ethz.ch) / [doris.amstad@math.ethz.ch](mailto:doris.amstad@math.ethz.ch)

#### *Rector's Office*

ETH Zentrum, HG F63.1-3  
Tel.: (044 63) 2 30 00  
E-mail: [kanzlei@rektorat.ethz.ch](mailto:kanzlei@rektorat.ethz.ch)  
[www.rektorat.ethz.ch](http://www.rektorat.ethz.ch)

#### *Student Exchange Office*

ETH Zentrum, HG F23  
Tel.: (044 63) 2 61 61  
[www.mobilitaet.ethz.ch](http://www.mobilitaet.ethz.ch)

ETH Zurich Admissions Office: [master@ethz.ch](mailto:master@ethz.ch)

### 7.2 Internet

Information on the Master in Statistics can be found at [stat.ethz.ch/teaching/master](http://stat.ethz.ch/teaching/master) and [www.biostat.uzh.ch/teaching/master.html](http://www.biostat.uzh.ch/teaching/master.html)

The documents listed below can be viewed on the website and downloaded as PDF files.

The home page of ETH ([www.ethz.ch](http://www.ethz.ch)) provides general information about studying at ETH, in particular the documents listed under 7.3 a) below. The course syllabus for the Master Program in Statistics (*Vorlesungsverzeichnis*) can be found at: [www.vorlesungsverzeichnis.ethz.ch](http://www.vorlesungsverzeichnis.ethz.ch)

### *Other important websites*

Important links for students: [www.student.ethz.ch](http://www.student.ethz.ch)

ETH Zurich Rector's Office: [www.rektorat.ethz.ch](http://www.rektorat.ethz.ch)

Enrolment: [www.admission.ethz.ch/master](http://www.admission.ethz.ch/master)

Admissions Office: [master@ethz.ch](mailto:master@ethz.ch)

ETH Zurich Student Exchange Office: [www.mobilitaet.ethz.ch](http://www.mobilitaet.ethz.ch)

International Student Information: [www.study.ethz.ch](http://www.study.ethz.ch)

### **7.3 Documents**

The following can be obtained from the Rector's Office:

a) Applicable to ETH Zurich in general

Guide to academic studies (*Akademischer Führer*)

Rules on admission to studies at ETH Zurich

(*Zulassungsverordnung ETHZ*)<sup>3</sup>

General rules on performance controls at ETH Zurich

(*AVL ETHZ*)<sup>3</sup>

Rules on doctoral studies at ETH Zurich

(*Doktoratsverordnung ETHZ*)<sup>3</sup>

b) for the Statistics program <sup>4</sup>

Departments of Mathematics and Physics: Study Regulations 2007 for the Master Program in Statistics<sup>3</sup>

Departments of Mathematics and Physics: Regulations for the Joint Bodies<sup>3</sup>

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<sup>3</sup> Can also be downloaded as PDF files from [www.rechtssammlung.ethz.ch](http://www.rechtssammlung.ethz.ch) under 'Lehre'.

<sup>4</sup> Also available from the Student Administration Office.