Course Description for Multivariate Analysis,
Advanced level, 7.5 ECTS credits

COURSE OUTLINE

The course provides knowledge within multivariate statistics: theory, calculation technique and applications. The course will also provide some deeper studies of the inference theory in multivariate analysis. The concepts that are more thoroughly treated are:


The course is taught at an intermediate statistical level. The emphasis is on both the theory of multivariate statistics and its applications in multivariate analysis. The course assumes familiarity with basic concepts in probability and inference theory. Computer literacy is essential, as we make extensive use of the computer using statistical software SAS.

The course consists of two course modules:
1. Multivariate analysis (6 ECTS credits)
2. Compulsory exercise in multivariate analysis (1.5 ECTS credits)

LEARNING OUTCOMES

To pass the course the student should be able to:

- account for important theorems and concepts in multivariate analysis,
- account for the most common multivariate methods,
- use multivariate methods to analyse data with statistical software.

COURSE FORMAT

The teaching consists of lectures and exercises including computer labs. During the lectures, new topics on multivariate analysis will be introduced and relevant numerical examples will be presented. During computer labs students will gain practical skills on conducting a multivariate analysis using statistical software SAS. Detailed instructions will be given in connection with the lecture/computer lab.

The compulsory exercise is a hand-in assignment which should be done individually. The emphasis of this hand-in assignment will be on the application of multivariate techniques and the interpretation of results. The hand-in assignment should be reported in written format and presented orally (5 minutes per student).

EXAMINATION

a. Examination will be done by assessing the learning outcomes. Examination will be in the form of a written test and a written report of a compulsory exercise.

b. Grading is done according to a seven-point scale related to the specified learning outcomes:

A = Excellent
B = Very Good
C = Good
D = Satisfactory
E = Adequate
Fx = Inadequate
F = Totally Inadequate
c. The assessment criteria for the course will be distributed at the beginning of the course.

d. In order to pass the course, the grade E or higher is required on course unit 1 and Pass on course unit 2.

e. Students who have received the grade Fx or F on an examination are entitled to at least four additional examinations to achieve the lowest grade E as long as the course is given.

If a student has received the grade Fx on the written reports but is close to passing the assignment, there may be a possibility to hand in an additional assignment. The assignment should be handed in within the given time frame and after the examiner having advised on the need to revise the assignment.

Students who have received the grade E on an examination may not retake this examination in order to attempt to achieve a higher grade.

Students who have received the grade Fx or F on an examination on two occasions by the same examiner have the right to request that a different examiner be appointed to set the grade of the examination. The request must be in writing and sent to the head of the department. The examination denotes all compulsory elements of the course.

Every time the course is given, there should be two examination opportunities during the current semester.

The first module, Multivariate Analysis (6 ECTS credits) is examined through a written individual test. When obtaining grades F or Fx in the written test, no extra exercises or extra assignments will be given to obtain a passing grade.

The second module, Compulsory Exercise in Multivariate Analysis (1.5 ECTS credits) is examined through a hand-in assignment. The hand-in assignment comprises written report and the oral presentation of the obtained results, and should be completed individually. The compulsory exercise (Module 2) is graded as Pass (G) or Fail (U). If a compulsory exercise is graded as Fail (U), the student will have only one chance to re-submit the hand-in assignment and this has to be done within a time period specified by teacher (usually a week).

CRITERIA FOR ASSESSMENT

The following seven criteria-referenced grades are used in Module 1, Multivariate Analysis, 6 ECTS credits:

A: Excellent; B: Very good; C: Good; D: Satisfactory; E: Adequate; Fx: Inadequate; F: Totally Inadequate.

A (Excellent): The student can a well-structured way describe and correctly use the theory of the multivariate statistics which has been considered in the course. Moreover, the student can apply this theory to practical problems in multivariate analysis that not necessarily have been discussed in the course. The student can clearly present all correct problem solutions and use a correct statistical language. Corresponds to 90-100% of the total examination score.

B (Very good): The student can in a well-structured way describe and correctly use the theory of the multivariate statistics which has been considered in the course. The student can apply this theory to practical problems in multivariate analysis that have been partly discussed in the course. The student can clearly present all correct problem solutions and use a correct statistical language. Corresponds to 80-89% of the total examination score.

C (Good): The student can in a well-structured way describe and correctly use the theory of the multivariate statistics which has been considered in the course. Moreover, the student can apply this theory to majority of practical problems in multivariate analysis that have been discussed in the course. The student can present correct solutions for the most problems and use a correct statistical language. Corresponds to 70-79% of the total examination score.

D (Satisfactory): The student can correctly describe and in a satisfactory way use the theory of the multivariate statistics which has been considered in the course. The student can apply this theory to the majority of practical problems in multivariate analysis that have been directly addressed in the course. The student can present in the majority of cases correct problem solutions and use a satisfactory statistical language. Corresponds to 60-69% of the total examination score.

E (Adequate): The student can in a largely correct way describe and use the theory of the multivariate statistics which has been considered in the course. The student can in a largely correct way apply this theory to the majority of practical problems in multivariate analysis that have been directly addressed in the course. The student can present satisfactory problem solutions and use a satisfactory statistical language. Corresponds to 50-59% of the total examination score.

Fx (Inadequate): The student can not correctly describe and use the theory of the multivariate statistics which has been considered in the course. The student fails to present satisfactory problem solutions and use a satisfactory statistical language. Corresponds to 40-49% of the total examination score.
F (Totally Inadequate): The student can not describe and adequately use the theory of the multivariate statistics which has been considered in the course. The student can not satisfactory solve problems in multivariate analysis which are directly based on the course material and fails to correctly use a statistical language. Corresponds to 0-39% of the total examination score.

The following two criteria-referenced grades are used in Module 2, Compulsory Exercise in Multivariate Analysis, 1.5 ECTS credits:

Pass: The student can apply appropriate multivariate methods to correctly complete the compulsory exercise. The student should be able in a satisfactory way to present and interpret his/her findings using proper graphics, descriptive statistics, significance test etc., explain important concepts of multivariate statistics relevant to the compulsory exercise. The student can correctly use statistical software SAS and summarize his/her work in a well-written report using a correct statistical language.

Fail: The student cannot identify and apply appropriate multivariate methods to correctly complete the compulsory exercise or/and the student is not able in a satisfactory way to present and interpret his/her findings using proper graphics, descriptive statistics, significance test etc. or/and the student cannot explain important concepts of multivariate statistics relevant to the compulsory exercise or/and the student cannot correctly use statistical software SAS or/and the student cannot summarize his/her work in a well-written report using a correct statistical language.

LITERATURE

Course participants are responsible for making their own notes during the lectures. Complementary list of important concepts and recommended exercises will be provided via Mondo.

SOFTWARE
SAS should be used during computer labs and for completing the compulsory exercise (Module 2).

TEACHING
The course comprises 14 lectures (L1-L14) and 6 computer sessions (D1-D6). One lecture is reserved for a compulsory seminar (L13). During this lecture-seminar the course participants will orally present their compulsory hand-in exercises.

TEACHERS
Course coordinator and lecturer: Tatjana von Rosen, B771, tel. 08-16 29 57, Tatjana.vonRosen@stat.su.se
Teaching assistant: Karin Stål, B786, tel. 08-16 29 85, Karin.Stal@stat.su.se

COMMUNICATION & COURSE HOMEPAGE
Most of the students’ engagement in the course will happen through the Stockholm university’s learning platform Mondo. All the necessary information concerning the administration of the course, examination, computer labs, compulsory exercise will be published on the course website in Mondo. You can also interact with the teachers and other students in Mondo via discussion boards (forum) and chats.
OBS! In order to use Mondo you need to be registered for the course and activate your University Mail Account.
## Preliminary Teaching Plan

With reservation for changes, the following is a tentative list of the topics to be covered in the lectures scheduled for Autumn 2014.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Content</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Monday, 01/09</td>
<td>09-11 Introduction and overview of the course. Some principles of multivariate statistical modelling.</td>
<td>Chapter 1, 3</td>
</tr>
<tr>
<td>L2</td>
<td>Thursday, 04/09</td>
<td>10-12 Matrix Algebra</td>
<td>Chapter 2</td>
</tr>
<tr>
<td>L3</td>
<td>Wednesday, 10/09</td>
<td>10-12 Multivariate Normal Distribution</td>
<td>Chapter 4</td>
</tr>
<tr>
<td>L4</td>
<td>Thursday, 11/09</td>
<td>10-12 Inference about a mean vector.</td>
<td>Chapter 5</td>
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<tr>
<td>D1</td>
<td>Monday, 15/09</td>
<td>10-12</td>
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</tr>
<tr>
<td>L5</td>
<td>Thursday, 18/09</td>
<td>10-12 Multivariate Analysis of Variance.</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>L6</td>
<td>Friday, 19/09</td>
<td>08-10 Multivariate Analysis of Variance, cont. Repeated measurements.</td>
<td>Chapter 6</td>
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<tr>
<td>D2</td>
<td>Monday, 22/09</td>
<td>10-12</td>
<td></td>
</tr>
<tr>
<td>L7</td>
<td>Tuesday, 23/09</td>
<td>08-10 Multivariate Linear Regression.</td>
<td>Chapter 7</td>
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<tr>
<td>L8</td>
<td>Thursday, 25/09</td>
<td>10-12 Multivariate Linear Regression, cont.</td>
<td>Chapter 7</td>
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<tr>
<td>D3</td>
<td>Monday, 29/09</td>
<td>10-12</td>
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<tr>
<td>L9</td>
<td>Wednesday, 01/10</td>
<td>10-12 Confirmatory Factor Analysis.</td>
<td>Chapter 9</td>
</tr>
<tr>
<td>L10</td>
<td>Thursday, 02/10</td>
<td>10-12 Canonical Correlation Analysis. Compulsory Hand-in Assignment is distributed.</td>
<td>Chapter 10</td>
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<tr>
<td>D4</td>
<td>Monday, 06/10</td>
<td>10-12</td>
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<tr>
<td>L11</td>
<td>Thursday, 09/10</td>
<td>10-12 Discriminant Analysis.</td>
<td>Chapter 11</td>
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<td></td>
<td>Wednesday, 15/10</td>
<td>14.00 Deadline for delivering Compulsory Hand-in Assignment.</td>
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<tr>
<td>D5</td>
<td>Thursday, 16/10</td>
<td>10-12</td>
<td></td>
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<tr>
<td>L12</td>
<td>Friday, 17/10</td>
<td>10-12 Structured Equation Modelling.</td>
<td>Supplementary material</td>
</tr>
<tr>
<td>D6</td>
<td>Monday, 20/10</td>
<td>10-12</td>
<td></td>
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<tr>
<td>L13</td>
<td>Wednesday, 22/10</td>
<td>10-12 Seminar. Oral presentation of students’ compulsory exercises.</td>
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<tr>
<td>L14</td>
<td>Monday, 27/10</td>
<td>10-12 Repetition. Summary of the course.</td>
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<td></td>
<td>Friday, 31/10</td>
<td>15-20 EXAM</td>
<td>Brunsvikssalen</td>
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<td></td>
<td>Wednesday, 03/12</td>
<td>15-20 EXAM</td>
<td>Laduvikssalen</td>
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- Note that it is required to sign up for the examination, as well as for the re-examination, at least one week in advance.
- The following facilities are permitted on the written examination: pocket calculator without stored formulas and text.
- All necessary statistical tables will be distributed at the examination.