STOCKHOLM UNIVERSITY
Department of Statistics
Spring 2019

Ellinor Fackle Fornius
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Course Description
Multivariate Methods, 7.5 ECTS credits, ST304G

COURSE CONTENTS

This course provides an introduction to several important multivariate methods. Among others, the following key concepts will be explained: principal components, exploratory and confirmatory factor analysis, discriminant analysis, logistic regression, and cluster analysis. Basics of matrix algebra required for the course are introduced. The statistical software R will be used in laboratory sessions to exemplify and complement lecture material.

LEARNING GOALS

To pass the course the student should be able to:

- Give an account of the most common multivariate methods;
- Apply statistical software to analyze data modelled by some of the multivariate methods as well as be able to interpret relevant outputs

COURSE LITERATURE AND ADDITIONAL MATERIAL

The course book:

- Sharma, S. (1996). Applied Multivariate Techniques. Wiley, New York.

Other recommended books:

- Johnson, R.A., Wichern, D.W. (1988). Applied Multivariate Statistical Analysis
- Afifi, A.A., Virginia, C. (2003). Computer-Aided Multivariate Analysis

Additional material distributed during the course, e.g. lecture notes, exercises, previous exams, etc., will be posted on Athena https://itslearning.com/se/.

GENERAL INFORMATION, TEACHERS

The Department of Statistics is located on the 7th floor in the B-building (Södra Husen). General information about the department (office hours, phone numbers, schedules etc.) is posted on the department website, www.statistics.su.se.

Course coordinator and examiner: Ellinor Fackle-Fornius, room B798
E-mail: ellinor.fackle-fornius@stat.su.se
Reception hours: Mondays 1-2 PM or by appointment

Teaching assistant: To be announced

TEACHING

The course covers the course book sections that are listed in the table below. There are 14 scheduled lectures (L) and 7 computer labs (C). Each lecture will typically address specified chapters and sections in the course literature including some exercises. During the teacher-led computer labs students solve computer-based exercises related to the various topics of the course. A preliminary outline of the course is provided in the following tables. You should always check the current schedule (accessible via link) for correct information and updates about the schedule.

Lecture	Content	Course book section
L1	Information about the course, introduction	Ch. 1-2
L2	Introduction to matrix algebra	Extra material posted on Athena
L3	Data manipulation, distance measures	Ch. 3
L4	Principal Components Analysis (PCA)	Ch. 4
L5	PCA contd, Exploratory factor analysis (EFA)	Ch. 4, Ch. 5
L6	EFA contd	Ch. 5
L7	Confirmatory Factor Analysis (CFA)	Ch. 6
L8	Cluster Analysis (CA)	Ch. 7
L9	CA contd, Discriminant analysis (DA)	Ch. 7, Ch. 8
L10	DA contd	Ch. 8
L11	Logistic regression (LR)	Ch. 10
L12	LR contd, Assumptions	Ch. 10, Ch. 12
L13	Reserve/Repetition	
L14	Previous exam	

Lecture	Content
C1	Introduction, information about home assignment
C2	PCA
C3	EFA
C4	CFA
C5	CA
C6	DA
C7	LR

MANDATORY ATTENDANCE

Attendance is entirely voluntary but strongly recommended in order to better achieve the learning goals.

COURSE EVALUATION

In connection with each course offering an evaluation of the course is made. The course evaluation is used as a basis for the departments quality work on the course, and as part of student influence. After the course is completed a questionnaire is sent via e-mail to all registered students. Students' responses to the questionnaire will be compiled and added together with the course coordinators' assessment to a final report, which will be posted on Athena.

EXAMINATION

Students are assessed by examination of the expected learning outcomes. The examination consists of a portfolio of two separate examination parts:

(1) Part I : an individual written exam with a selection of theoretical problems, and
(2) Part II: an individual home assignment with practical data analysis to be handed in as a written report.

A more detailed description, the grading criteria and weighting of the two components are provided below.

The final grade on the course is based on the total count of points received for both parts taken together. Grading of the course is on a criterion-referenced seven-grade scale.

A	Excellent
B	Very Good
C	Good
D	Satisfactory
E	Sufficient
Fx	Insufficient
F	Totally insufficient

NOTE! To pass the course (grades A – E) the student must pass both part I and part II. Both parts must be completed and passed during the continuation of the course. Partial exam or home assignment credits cannot be transferred to later semesters.

- Students who receive the grade E or higher on an examination may not re-do any part of the examination for a higher grade.
- Fx as well as F are both insufficient grades and require re-examination.
- Students who receive the grade Fx or F are entitled to at least four additional examination opportunities to achieve at least the grade E as long as the course is still given.
- Students who receive the grade Fx or F on an examination twice by the same examiner are entitled to request that a different examiner be appointed to set the grade of the next examination. Such a request must be in writing and sent to the head of the department

Note that the term 'examination' denotes all examination parts of the course.

EXAMINATION DATES AND RULES

Written exam	**Monday 17 February, 14.00-19.00** Results will be announced no later than 2 March
Written re-exam	**Wednesday 25 March, 14.00–19.00** Results will be announced no later than 8 April

- When the results of the written exam are announced the exams will be available at the Student Office and may be collected during office hours (se website). Suggested solutions will also be posted on Athena no later than the date of announcement.
- The written test is an individual assessment and collaboration of any kind is not allowed. The following aids are allowed for this exam: calculator and a specified list of formulas. Cell phones are not allowed.

NOTE! Registration for examination and re-examination is compulsory. You must sign up **at least one week** before the date of the examination/re-examination through minastudier.su.se or by sending an e-mail to expedition@stat.su.se

Home assignment	**Deadline 1: Wednesday 19 February at 17.00** Assessed by 26 February **Deadline 2: Wednesday 4 March at 17.00** Assessed by 11 March

- The home assignment should be handed in as a written report. Detailed instructions for the assignment will be posted on Athena.
- The home assignment is an individual assessment: collaboration is allowed but the written report is an individual effort. Note that your submission may be run through text matching software to discover plagiarism.
- If the assignment is not passed after the first round of assessment there is a possibility to revise the report, for details see the instructions for the assignment posted on Athena. Revisions should be handed in by deadline 2. Note that it is not possible to revise the report if it is not passed after deadline 2.

ASSESSMENT CRITERIA

The final grade is based on the total count of the scores of the two examination parts:

(1) Part I : written exam with maximum 80 points, to pass a minimum of 40 points is required
(2) Part II: home assignment with maximum 20 points, to pass a minimum of 10 points is required

The maximum total score is thus 100 points. In order to pass the course (grades A-E) the student must pass both examination parts; score at least 40 points on the written exam and at least 10 points on the home assignment. Grading of the course is on a criterion-referenced seven-grade scale:

A	**Excellent.** The student should in a proper and well-structured way be able to apply multivariate methods and associated statistical inference that are not necessarily directly addressed in the course material. The student is also able to clearly present and interpret his/her results; explain concepts, methods and theories used in the implementation of multivariate analysis.	Total: 90-100 points Written exam: ≥40 points Home assignment: ≥10 points
B	**Very good.** The student will correctly and in a well-structured way be able to apply the multivariate methods and associated statistical inference that are directly addressed in the course material. The student is also able to clearly present and interpret his/her findings; explain the concepts, methods and theories used in the implementation of multivariate analysis.	Total: 80-89 points Written exam: ≥40 points Home assignment: ≥10 points
C	**Good.** The student will correctly and in a well-structured way be able to apply the multivariate methods and associated statistical inference that are directly addressed in the course material. The student should also in a good way be able to present and interpret his/her findings; explain concepts, methods and theories used in the implementation of multivariate analysis	Total: 70-79 points Written exam: ≥40 points Home assignment: ≥10 points
D	**Satisfying.** The student will be able to apply multivariate methods with related statistical inference that are directly addressed in the course material. The student will forward in a satisfactory way to present and interpret his/her findings; explain concepts, methods and theories used in the implementation of multivariate analysis.	Total: 60-69 points Written exam: ≥40 points Home assignment: ≥10 points
E	**Sufficient:** The student will be able to apply multivariate practices directly addressed in the course material. The student will, in a satisfactory way, present and interpret his/her findings; explain the concepts, methods and theory used in the implementation of multivariate analysis.	Total: 50-59 points Written exam: ≥40 points Home assignment: ≥10 points
Fx	**Insufficient.** The student's achievements with respect to at least one of the criteria in E have serious shortcomings. .	Total: ≥30 points Written exam: <40 points and/or Home assignment: <10 points
F	**Totally insufficent.** The learning outcomes have not been achieved.	Total: 0-29 points Written exam: <40 points and/or Home assignment: <10 points