Course Description for Experimental Design,
Advanced level, 7.5 ECTS credits

CONTENTS
This is an advanced course in designing experiments. Well-designed experiments allow us to obtain reliable and
valid results with fewer resources comparing to poorly-designed experiments. In this course, both experimental
design and statistical analysis issues are discussed. Opportunities to use the principles taught in this course
arise in all phases of scientific work (e.g. in engineering: technology development, new product design and
development, and manufacturing process improvement). A special focus will be given to analysis of variance,
randomized block designs, Latin square designs and factorial designs. Computer literacy is essential for this
course, students are expected to utilize statistical software SAS for computational purposes.

COURSE STRUCTURE
The course consists of one course module:
1. Experimental Design

LEARNING OUTCOMES
To pass the course the student should be able to:
• give an account of methods used for experimental design,
• choose adequate experimental designs for different types of problems and situations,
• analyse data generated by factorial experiments by using analysis of variance.

COURSE FORMAT
The teaching consists of lectures and exercises including computer labs. During computer labs students will
gain practical skills regarding planning the experiments and analyzing data from experiments using statistical
software SAS. Detailed instructions will be given in connection with the computer lab.

EXAMINATION
a. Examination will be done by measuring the knowledge of the learning outcomes. Examination will comprise
a written test and a written and/or oral report of a compulsory exercise.
The compulsory exercise comprises hand-in assignments which should be done individually. The hand-in as-
signments should be reported in a written format. Detailed instructions will be given later during the course.
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.
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.

f. 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.

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

CRITERIA FOR ASSESSMENT

The examination and the assignments are individual. The written examination comprises a number of problems
that can give a total of at most 75 points, and the assignments comprise at most 25 points that will be added
to the result of the written examination.

The following seven criteria-referenced grades are used in Module 1, Design of Experiments, 7.5 ECTS credits:

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

A (Excellent): The student can correctly present the principles of experimental design, use statistical tech-
niques for planning the experiments and analyze data from experiments that have been considered in
the course. Moreover, the student can discuss issues of experimental design and apply the statistical
techniques correctly to problems that not necessarily have been discussed in the course. The student can
present well-structured problem solutions and use a correct statistical language. Corresponds to 91-100%
of the total examination score.

B (Very good): The student can correctly present the principles of experimental design, use statistical
techniques for planning the experiments and analyze data from experiments that have been considered
in the course. The student can present well-structured problem solutions and use a correct statistical
language. Corresponds to 81-90% of the total examination score.

C (Good): The student can in most cases correctly present the principles of experimental design, use sta-
tistical techniques for planning the experiments and analyzing data from experiments that have been
considered in the course. The student can in most cases present correct problem solutions and use a
correct statistical language. Corresponds to 71-80% of the total examination score.

D (Satisfactory): The student can in most cases correctly present the principles of experimental design,
use statistical techniques for planning the experiments and analyze data from experiments that have
been considered in the course. The student can present satisfactory problem solutions and use a correct
statistical language. Corresponds to 61-70% of the total examination score.

E (Adequate): The student can in a largely correct way present the principles of experimental design,
use statistical techniques for planning the experiments and analyze data from experiments that have
been considered in the course. The student can in a largely correct way present satisfactory problem solutions
and adequately use a statistical language. Corresponds to 51-60% of the total examination score.

Fx (Inadequate): In most cases, the student cannot adequately present the principles of experimental design
nor use statistical techniques for planning the experiments nor analyze data from experiments that have
been considered in the course. The student cannot present satisfactory problem solutions and adequately
use statistical language. Corresponds to 41-50% of the total examination score.

F (Totally Inadequate): Corresponds to 0-40% of the total examination score.

LITTERATURE


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 assignment(s).

TEACHING
The course comprises 14 lectures (L1-L14) and 4 computer sessions (D1-D4).

TEACHERS
Course coordinator and lecturer: Tatjana von Rosen, B771, tel. 08-16 29 57, Tatjana.vonRosen@stat.su.se
Teaching assistant: Chengcheng Hao, B 750, Chengcheng.Hao@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: Fall 2014

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

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Content</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>10-12</td>
<td>Overview of the course. Basic Principles. Simple Designs and Analysis of Variance.</td>
<td>Chapter 1-3</td>
</tr>
<tr>
<td>L2</td>
<td>10-12</td>
<td>Analysis of Variance, cont.</td>
<td>Chapter 3</td>
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<tr>
<td>L3</td>
<td>13-15</td>
<td>Blocking Factors. Block Designs, Latin Squares and Related Designs.</td>
<td>Chapter 4</td>
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<tr>
<td>L4</td>
<td>10-12</td>
<td>Factorial Designs.</td>
<td>Chapter 5</td>
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<tr>
<td>D1</td>
<td>15-17</td>
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</tr>
<tr>
<td>L5</td>
<td>10-12</td>
<td>Factorial Designs, cont.</td>
<td>Chapter 5</td>
</tr>
<tr>
<td>D2</td>
<td>10-12</td>
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</tr>
<tr>
<td>L6</td>
<td>10-12</td>
<td>$2^k$ Designs.</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>L7</td>
<td>10-12</td>
<td>$2^k$ Designs, cont.</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>L8</td>
<td>13-15</td>
<td>Blocking and Confounding in $2^k$ Designs.</td>
<td>Chapter 7</td>
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<tr>
<td>L9</td>
<td>10-12</td>
<td>$2^k$ Fractional Factorial Designs.</td>
<td>Chapter 8</td>
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<td>D3</td>
<td>13-15</td>
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<tr>
<td>L10</td>
<td>10-12</td>
<td>$3^k$ Factorial Designs.</td>
<td>Chapter 9</td>
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<tr>
<td>D4</td>
<td>10-12</td>
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<tr>
<td>L11</td>
<td>10-12</td>
<td>$3^k$ Factorial Designs, cont.</td>
<td>Chapter 9</td>
</tr>
<tr>
<td>L12</td>
<td>10-12</td>
<td>Random Effects Models.</td>
<td>Chapter 13</td>
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<tr>
<td>L13</td>
<td>10-12</td>
<td>Experiments with Nested Factors.</td>
<td>Chapter 14</td>
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<tr>
<td>L14</td>
<td>10-12</td>
<td>Repetition. Summary of the course.</td>
<td></td>
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<tr>
<td>L15</td>
<td>10-12</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.

**Academic Integrity:** Students are encouraged to share ideas and skills and to discuss freely the principles and applications of course materials. However, graded work (exercises) must be the product of independent individual effort unless instructed otherwise.