Course Description for R Programming, Advanced level course, 7.5 HEC, ST4101/ST4102

COURSE CONTENTS
The course treats programming in the language R with focus on both basic as well as more advanced statistical analysis. Special emphasis is placed on data structures, functions and objects, strings, conditional statements, iterations, code optimization, debugging, numerical linear algebra and creation of R packages. Also included is an introduction to object-oriented programming and parallel programming.

The course consists of two modules:

1. R Programming - Exam, 4.5 ECTS credits
2. Hand-in assignment in R Programming, 3 ECTS credits

LEARNING GOALS
After completing the course, the student should be able to

- Write and organize R-programs with different programming techniques such as handling different data structures, function creation, iteration, conditional statements and string management and numerical computations for the purpose of performing statistical analysis.
- Perform statistical computations and simulations using R packages.
- Improve R program code through optimization measures.
- Test and debugging R programs.
- Organize his/her own code in the form of an R package.
- Describe the principles of object-oriented programming in R.
- Describe how parallel programming can be implemented in R.

COURSE LITERATURE
Matloff, N, *The art of R programming*. 2011. No Starch Press.

Additional material distributed during the course, e.g. lecture notes, exercises, etc.,
will be posted on the course site at the learning platform Athena.

EXAMINER AND TEACHERS
Lecturer and Examiner: Parfait Munezero
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Reception hours: On agreement

Teaching assistant: Ralf Xhaferi
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Reception hours: On agreement

The Department of Statistics is located on Campus Albano, House 4, floor 6. General information about the department (office hours, phone numbers, schedules etc.) is posted on statistics.su.se. Information about the course is posted on the course site at Athena.

COURSE EVALUATION
A course evaluation is made after the course is completed. The course evaluation is used as a basis for course quality work and as part of the student influence process. The evaluation is carried out by a questionnaire sent out via e-mail to all registered course participants. The course participants' responses to the questionnaire are compiled and posted at Athena together with the course examiner´s final course evaluation.

TEACHING FORMAT
Teaching consists of 8 lectures (L1-L8) and 8 computer sessions (C1-C8) according to schedule, see link to Time edit on the course home page. A description of the course contents and reading instructions are given in the teaching plan, see below.

MANDATORY ATTENDANCE
There is no mandatory attendance at the course, however it is strongly recommended to participate in all lectures and computer sessions.

EXAMINATION AND GRADES
Students are assessed by examination of the expected learning outcomes through two written examinations:

- Module 1 - Individual exam, is graded according to a criterion-referenced seven-grade scale.

- Module 2 – Hand-in assignment, is graded according to a two-grade scale with the grades Pass (G) and Fail (U)

Grading of Module 1 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

To pass the course, the grade E or higher is required on Module 1 and the grade Pass on course Module 2. Grading for the whole course is then equivalent with the grading of Module 1.

- When obtaining a failing grade F or Fx in Module 1, no extra exercises or extra assignments are given to obtain a passing grade.
- Students who have received the grade Fx or F on Module 1 are entitled to at least four additional examinations to achieve at least grade E if the course is given.
- Students who have received the grade E on Module 1 may not retake this examination to attempt to achieve a higher grade.
- Students who have received the grade Fx or F on Module 1 on two occasions by the same examiner have the right to request that a different examiner be appointed to set the grade of the next examination. The request must be in writing and sent to the head of the department.
- Every time the course is given, there should be two examination opportunities for each Module during the current semester.
- When the course syllabus has been withdrawn, the student has the right to request examination once per semester during a period of three semesters in accordance with this syllabus. The request must be in writing and sent to the head of department.

MODULE 1 – R Programming - Exam, 4.5 ECTS credits

- Module 1 is examined through a written computer-based exam. The writing time is 5 hours.
- The written exam is an individual exam and during the exam, collaboration is prohibited, as are other aids than those allowed by the examiner.
- Special support, if required, may be allowed after request at the department's student counsellor and upon permission of the examiner. Contact the student counsellor well in advance before the exam, preferably no later than three weeks.
- Applicable rules for examinations at Stockholm University can be found at:

  https://www.su.se/medarbetare/organisation-styrning/styrdokument-regelboken/utbildning/regler-för-tentamensskrivningar-vid-stockholms-universitet-1.26334

> **Note! You must register for the exam no later than 10 days before the exam date**. You register for the exam via Ladok. If you have problems with the registration, contact expedition@stat.su.se. If you have not registered correctly, you cannot take the exam.

Exam dates:
- **Exam: October 25**, 14-19
- **Re-exam: December 5**, 8-13

MODULE 2 – Hand-in Assignment in R Programming, 3 ECTS credits

- Module 2 is examined through three hand-in assignments and should be completed in groups of 2 students. The three hand-in assignments must be presented in the form of three written reports. Instructions for the hand-in assignments can be found at Athena.
- Module 2 is graded as Pass (all four hand-in assignments are approved) or Fail (at least one hand-in assignments is not approved). If one or more hand-in assignments are graded as Fail, the students will have a chance to re-submit the incorrect hand-in assignment(s).
- Collaboration within the group is of course allowed, however individual testing and grading within the group may occur. Please note that all group members are responsible for and should be able to answer to all parts of the report. Cooperation between groups is allowed, but each group must submit its unique report.
- The use of AI tools is permitted as an aid during the learning process but not to produce material for the reports. Any type of plagiarism is prohibited which includes AI-generated text. The use of AI tools for the improvement of an originally self-written text is not permitted. Text matching software and AI-generated text detectors are used by the department.
- **Note!** If you miss the first submission occasion and submit for the first time at the re-submission occasion and then fail, you have no more chances to resubmit during the current semester.
- **Note!** All hand-in assignments must be approved during the current semester in order for the entire Module 2 to be graded as "Pass". Results from hand-in assignments are not saved and cannot be transferred to future semesters.

Submission deadlines:

- **Submission hand-in assignment 1: October 9**, no later than **17.00** via Athena.
- **Submission hand-in assignment 2: October 16**, no later than **17.00** via Athena.
- **Submission hand-in assignment 3: October 23**, no later than **17.00** via Athena.

Re-submission for one or more incorrect hand-in assignments: **November 11**, no later than **17.00** via Athena.

GRADING CRITERIA

Module 1 – R Programming - Exam, 4.5 ECTS credits

Module 1 is an individual written computer-based exam. The written exam covers the course content material. The following grading criteria apply for Module 1:

A: (Excellent): The student can in an excellent way construct R Programs and solve problems that have not necessarily been directly addressed in the course. The student provides exhaustive and clear explanations of the R language structure, its functions, properties, and performance. Corresponds to at least 90% of the total written test score.
B: (Very good): The student can in a very good way construct R Programs and solve all types of problems that have been considered in the course. The student provides clear explanations of the R language, its functions, properties, and performance. Corresponds to 80-89% of the total written test score.
C: (Good): The student can in a well-structured way construct R Programs and solve most types of problems that have been considered in the course. The student provides correct explanations of the R language, its functions, properties, and performance. Corresponds to 70-79% of the total written test score.
D: (Satisfactory): The student can in a satisfactory way construct R Programs and solve most types of problems that have been considered in the course. The student provides satisfactory explanations of the R language, its functions, properties, and performance. Corresponds to 60-69% of the total written test score.
E: (Adequate): The student can in an adequate way construct R Programs and solve most types of problems that have been considered in the course. The student can in an adequate way explain the structure of the R language, its functions, properties, and performance. Corresponds to 50-59% of the total written test score.
Fx: (Inadequate): The student's achievements are inadequate with respect to at least one of the criteria for the grade E. Corresponds to 40-49% of the total written test score.
F: (Totally Inadequate): The student shows significant inadequacies in relation to the assessment criteria. Corresponds to 0-39% of the total written test score.

Module 2 – Hand-in Assignment in R Programming, 3 ECTS credits

Module 2 comprises of four hand-in assignments carried out in a group. Module 2 is graded as Pass or Fail. The following grading criteria apply for Module 2:

Pass: The student can write correct program code and create executable well-documented programs in accordance with the assignment instructions. The student can summarize his/her work in well-written reports using R Markdown.
Fail: The student's achievements are inadequate with respect to at least one of the criteria for the grade Pass.

TEACHING PLAN

Course literature

- Matloff, N, *The art of R programming*. 2011. No Starch Press. – Available as an e-book via [Stockholm University Library](#)

Additional reading

- [R for Data Science](#)
- [Handling and Processing Strings in R](#)

Reading instructions

Lecture	Content	Chapter
L1	Introduction, Reading data, Introduction to functions, Logical operators, Preview of data structures, Vectors, Matrices, R Markdown	1-3
L2	Lists, Data frames, Factors and tables, Strings, Input/Output (I/O)	4-6, 10, 11
L3	More on functions, Scope hierarchy, Programming control - conditional statements and loops.	7
L4	Apply functions, Base R Graphics, ggplot2	7, 12
L5	Statistics in R, Linear algebra, Random numbers and simulations, Linear regression.	8
L6	API, Debugging, Code optimization, Introduction to parallel programming	13, 14, 16
L7	Creation of R packages, Introduction to object-oriented programming	9
L8	Tidyverse including Dplyr, Lubridate	