GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2025-2026

Statistics II: Project (C003559)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 165 h**

Course offerings and teaching methods in academic year 2025-2026

A (semester 2)	English	Gent	lecture
			seminar
			group work
			peer teaching

Lecturers in academic year 2025-2026

Dukes, Oliver	WE02	lecturer-in-charge

Offered in the following programmes in 2025-2026	**crdts**	**offering**
Bachelor of Science in Mathematics	6	A

Teaching languages

English

Keywords

Data analysis, Probability theory, mathematical statistics

Position of the course

Taking the step from theoretical, axiomatic knowledge to relevant, correct and efficient data analysis via the software package R, and reporting. As a mathematician, learn to participate in a team and in a multi-disciplinary context as encountered in society and in many research settings. Learn to communicate correctly and understandably assumptions and conclusions to both the more and the less specialized partners. Getting acquainted with the professional field.

Contents

All along the course, three interconnected projects are proposed. The third project concerning a real-life problem is the exam project and tools to develop it are studied in the two first projects. As an introduction, the students learn to investigate confidence intervals and simple tests of hypotheses through data analysis in the software package R; the one-sample t-test, paired and unpaired t-tests, the Pearson chi-square test and the Fisher exact test can be involved.

Subsequently and according to the content of the third project, the students are introduced to:

- Simulation experiments for the evaluation of the properties of estimators,
- Principles and techniques of descriptive data analysis. This may include: principal component analysis, cluster analysis, recommender systems,
- Nonparametric statistical techniques,
- Scientific integrity and data confidentiality,
- Oral and written scientific reporting (in LaTeX):
  - The logical structure of the text: global and in detail, substantive and formal
  - Citation of the source (acknowledgments, copyright and plagiarism).
  - Reference styles (BibTeX).
  - Structure of a slide, story structure and timing.

During the subsequent lessons, the students as a team bring in a piece of theory that is necessary for the elaboration of the exam project. These lessons are developed by the students under supervision and in team and presented to the

class after feedback from the lecturer. The content of these lessons depends on the exam project. Leading the way are basic techniques for data analysis, such as principles and techniques for descriptive data analysis, principal component analysis, cluster analysis, one-way anova, the multiplicity problem, non-parametric testing, study design, bootstrap and jackknife. These lessons are enriched with a brief report in which a data analysis, using these techniques in the software package R, is illustrated. During the tutorials, these techniques are practiced under supervision using the software R.

During the semester, the second project will be worked out sequentially by different teams. In preparation for the exam project, this project aims to introduce students to and participate in the research process:

- in which an applied problem formulation from empirical research is translated into a mathematical / statistical problem;
- proposing various solution strategies and comparing their quality through analytical work and simulation experiments;
- whereby the strategy that has been found to be optimal is used to analyze the available data and thus provide an answer to the research question posed;
- whereby the results are reported in writing and orally to the fellow students.

There is a weekly discussion around the present problem, after which 1 team gets to work to solve part of the present question. The findings are then reported orally, discussed in the entire student group, after which the next team sets to work on solving another part of the problem. Leading the way is the analysis of classification and regression problems,
where the students compare and evaluate various possible statistical analyses. Gradually the students are made clear that various analyses are often possible, but the quality often differs. The importance of statistical design and protocol of a study is discussed in that light.

In the third project, students develop interesting / original solutions to the proposed real-life problem; they write a full report and defend it during the oral exam. Mathematically, the third project only hinges on the knowledge developed in the two first projects. However, the students should comply with the characteristics of the domain which the third project is applied to.

Initial competences

Final competences of the courses Statistics I and Analysis I.

Final competences

1 The student must recognize the relevance of simple statistical methods for practical problems and be able to work out the solution.
2 The student can report results, both orally and written, in a transparent and correct manner.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Group work, Seminar, Lecture, Peer teaching

Extra information on the teaching methods

Theory: lectures. Exercises, including computer practicals, under guidance in class; visits to the (digital) library; project work in team with reporting and feedback; exchanges through the electronic learning environment.

Study material

Type: Handbook

Name: Elements from textbooks'
Indicative price: Free or paid by faculty
Optional: no
Additional information: Learning material is further supported by elements from textbooks (online available).

Type: Slides

Name: Slides'
Indicative price: Free or paid by faculty
Optional: no
Additional information: Slides are available on Ufora.

References

T. Hastie, R. Tibshirani and J. Friedman. 'The elements of Statistical Learning' (2nd edition); Springer, 2009.
G. James, D. Witten, T. Hastie and R. Tibshirani. 'An Introduction to Statistical Learning with Applications in R'; Springer, 2013.
W. Mendenhall. 'Mathematical Statistics with Applications' (6th edition); Duxbury Press, 2001.
D. Nolan and T. Speed. 'Stat Labs: Mathematical Statistics through applications'; Springer, 2000.

Course content-related study coaching

Lectures and computer practicals, independent work with reporting and feedback, exchanges through the electronic learning environment.

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment open-book

Examination methods in case of periodic assessment during the second examination period

Written assessment open-book

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible in modified form

Extra information on the examination methods

The knowledge and problem solving skills of the students are tested by means of written and oral reporting of project work.

Calculation of the examination mark

Permanent evaluation (oral and written reporting):
- 1 group work (developing a lecture under supervision) with oral report (25%)
- 1 group work (developed during the semester under supervision) with written and oral reporting (20%)
- 1 group work (worked out individually as an exam project) with written report and individual oral defense (25%)

Periodic evaluation: open book exam (30%)