

## Statistical Consulting (C004414)

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

**Credits 5.0**

**Study time 150 h**

### Course offerings and teaching methods in academic year 2024-2025

A (semester 2)

English

Gent

lecture

seminar

### Lecturers in academic year 2024-2025

Goetghebeur, Els

WE02

lecturer-in-charge

### Offered in the following programmes in 2024-2025

[Master of Science in Statistical Data Analysis](#)

**crdts**

**offering**

5

A

### Teaching languages

English

### Keywords

Statistical consulting, applied data analysis, client oriented problem solving, reproducible research, communication skills, capita selecta in statistics

### Position of the course

Consulting is an important aspect of today's statisticians and data scientists' activities. It requires

- broad mastery of the statistical data analysis methods
- the ability to recognize relevant structure in applied research questions and available data bases
- decisions about a data analytic approach that will deliver useful results for the most important questions with respect for the (e.g. time) constraints
- interaction with clients to understand the setting and what really matters in context
- performing the analysis in a reproducible manner
- writing a sufficiently clear and critical report on the process, the results and their interpretation in light of the original question
- ethical conduct throughout

Skills and knowledge have so far entered the basic training of our data analysts in a more segmented way, organized in topics around specific data analytic methods and techniques. This course builds on such knowledge and skills obtained through several compulsory courses. With this background, and added targeted instruction from this new course, the student will digest the questions of a researcher (real client) who seeks statistical help for a new research project, having obtained a dataset that can be analyzed for this purpose.

### Contents

- Introduction to statistical consulting and the client intake meeting
- Scientific reporting and presentation (e.g. visualization techniques)
- Methodological quality: good statistical practice, transparency and reproducible research, ...
- Initial data analysis: protocol writing, data screening, ...
- Overview of statistical methods and their applications
- Common encounters in data analysis (*Capita selecta*) (4 topics chosen in function of the client projects presented with 4 times 1.15 hour lecture -> could be a POS seminar).
- Missing data

- Ethics
- Hypothesis tests versus confidence intervals, statistical significance & effect sizes
- Multiple testing
- Sample size calculations & experimental design
- Dependent samples -> mixed models, GEEs, time series, ...
- Overfitting
- Misuses in statistics
- Protocol writing
- Data cleaning / error/fault detection
- ...

A study of the literature with possibly specialized methods in context of the specific client project may follow.

### Initial competences

Having successfully completed the following courses: Principles of Statistics, Statistical Programming, Analysis of Continuous Data and Analysis of Categorical Analysis (or Statistical Modelling), or having acquired otherwise the corresponding competences.

### Final competences

- 1 Able to structure a client project in logically ordered identified components: the primary and secondary research question(s) in context, the database with it sampling design and possible limitations, simple and/or complex analysis methods that may answer the formalized question(s), priorities and constraints of the project (client), existing literature on the topic the audience to report results to, the decisions that may be based on the statistical analysis results. and recognize statistical issues in different situations, e.g. research question, study design, sampling procedure, etc.
- 2 Identify and motivate an appropriate data analysis technique to answer the client's research question in available time.
- 3 Perform initial data analysis on a transferred database to detect any possible errors (missing data and outliers, suspected measurement error, ...), discover the scope of the study population (structural composition, specific constraints, dependencies, ...), and have reasonable basis for model fitting, analysis choice and preprocessing of data.
- 4 Execute the proposed analysis plan in an agreed amount of time and a reproducible manner (involving a data management plan, appropriate software and archiving).
- 5 Interpret the obtained results and draw conclusions on the research question, along with a critical evaluation and suggestion for further analysis/research.
- 6 Report initial results and final results in writing for an appropriate audience and discuss with client.
- 7 Orally present results for an audience of statisticians.
- 8 Respect ethical guidelines, as well as GDPR and privacy protection rules.

### 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

Seminar, Lecture

### Extra information on the teaching methods

This statistical consulting course consists of nine plenary sessions and nine practical sessions.

The **plenary sessions** involve compulsory lectures on high level topics like how to communicate effectively, on practical processes and specific statistical topics, less dealt with in the MaStat. These lectures also include instruction on how to conduct the client meetings, write reports and deliver oral presentations. The course instructors are experienced statistical consultants.

The **practical sessions** involve meetings between the students (acting as

(Approved)

statistical consultants, henceforth called 'the consultants') and the actual client(s). Teams of three students will each carry out a statistical consultation project for one of the actual clients. The clients are applied researchers with a research question and available data. The consultants will analyze the data and solve the client's research problem as well as possible. During the process, they have access to a statistical coach (a tutor) for support.

Our typical statistical consultancy project consists of three phases: intake, analysis, and final advice. Every project starts with an intake meeting to learn about the client's problem and its context. When an advice can be given immediately, the consulting process consists of only one meeting. In this course, however, one focusses on the above-mentioned three client meetings.

The students will contact the statistical coach twice: before the second client meeting (the progress report meeting) and before the third client meeting (the final results meeting). Typical topics to discuss are the choice of the analysis approach, how to check assumptions and perform the analysis.

### **Concept of client meetings**

The goal of the client meetings is twofold here: to come to a well adapted correct result for the research project and to improve the statistical consulting skills. The students not only act as statistical consultants for their own project, but also watch other groups of students who are consulting. During these stages they will not be graded on their performance, but will be provided with (and give themselves) constructive feedback: the meetings are considered as training sessions.

For the client meetings, each student is assigned to a working group of  $4 \times 3 = 12$  students, hence covering around 4 clients.

The third meeting will be followed by the writing of the final report to be submitted to the client. This report + an oral presentation of the team (3x5 minutes) followed by Q&A will form an important component of the grade.

In between client-meetings, the team of 3 will collaborate on the planning, analysis and reporting of the project.

### **Study material**

Type: Slides

Name: Statistical Consulting

Indicative price: € 5

Optional: no

Language : English

Available on Ufora : Yes

Online Available : Yes

Available in the Library : No

Available through Student Association : No

Additional information: The slides are free of charge. The indicated cost is for the printing of these slides.

### **References**

- Kenett, R., & Thyregod, P. (2006). Aspects of statistical consulting not taught by academia. *Statistica Neerlandica*, 60(3), 396-411.
- Chapter 1 "Giving advice on research methods" by David J. Hand in *Advising on research methods: A consultant's companion*, Part I. E-book published in 2019 by Johannes Van Kessel. ISBN nr 9789079418756
- Huebner, A., le Cessie, S., Schmidt, C. O., & Vach, W. (2018). A contemporary conceptual framework for initial data analysis. *Observational Studies*, 4, 171-92
- The ASA's statement on p-values: context, process, and purpose. *The American Statistician*, 70(2), 129-133.
- Guidelines for data science (2019) + additional information on these guidelines (2019) and Gelman, A. (2018). Ethics in statistical practice and communication: Five recommendations. *Significance*, 15(5), 40-43.
- Annesley, T. M. (2010). The discussion section: your closing argument. *Clinical Chemistry*, 56(11), 1671-1674.

### **Course content-related study coaching**

### **Assessment moments**

end-of-term and continuous assessment

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

Oral assessment, Assignment

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

Oral assessment, Assignment

**Examination methods in case of permanent assessment**

Participation

**Possibilities of retake in case of permanent assessment**

examination during the second examination period is not possible

**Extra information on the examination methods**

- (Scientific) report, written in phases following the client meetings. Evaluated by the tutor and feedback is given
- Oral presentation and defense of study results
- Reflection report: individual report on the process of the statistical consulting project. The aim is to inform the instructors about the process (with both client and partner-students) and about your participation in the written report.

**Calculation of the examination mark**

Final written report including reflection report (50%); final oral presentation (25%); active participation during the meetings (25%). Attending the lectures and client meetings is compulsory during the whole course.