



Course syllabus for

# **Biostatistics 2: Methods and applications, 7.5 credits**

Biostatistik 2: Metoder och tillämpningar, 7.5 hp

This course syllabus is valid from autumn 2025.

Course code	5BD002
Course name	Biostatistics 2: Methods and applications
Credits	7.5 credits
Form of Education	Higher Education, study regulation 2007
Main field of study	Biostatistics and Data Science
Level	AV - Second cycle
Grading scale	Pass with distinction, Pass, Fail
Department	Department of Medical Epidemiology and Biostatistics
Decided by	Programme committee for study programmes in biomedicine
Decision date	2023-10-11
Course syllabus valid from	Autumn 2025

## **Specific entry requirements**

At least grade G (Pass) for the course Biostatistics 1: Introduction to biostatistics.

## **Objectives**

The course aims to equip the student with knowledge and understanding of a number of statistical methods that are commonly applied in biomedical research and which complement or extend methods covered in other compulsory courses in the programme. The course also aims to equip the student with the competence, skills, and judgement to apply statistical methods in biomedical research. In addition, the course aims to equip the student with the competence, skills, and judgement to face the practical challenges faced by collaborative or consulting biostatisticians in biomedical research.

Upon completion of the course, the student should be able to:

Regarding knowledge and understanding

- Demonstrate an understanding of why clustering (non-independence) of observations must be taken into account for valid inference.
- Describe how mechanisms for missing data are defined/classified and demonstrate an understanding of how the analytic approach and missingness mechanism impacts the validity of inference when analysing incomplete data in biomedical research.

- Demonstrate an understanding of the fundamental problem of causal inference and knowledge of suitable approaches to the statistical analysis of cause and effect based on observational data in biomedical research.

#### Regarding competence and skills

- Apply appropriate methods in the field of causal inference to investigate relationships and draw valid causal conclusions from observational data in biomedical research.
- Demonstrate competence in analysing complex data within biomedical research, including but not limited to incomplete (missing) data, correlated data, and genetic data.
- Communicate the results of biomedical research studies effectively, both in written and oral forms, to diverse audiences, including fellow researchers, clinicians, and stakeholders.

#### Regarding judgement and approach

- Show insight into the role of science and technology in society and people's responsibility for how it is used for sustainable development.
- Recognize and mitigate issues related to questionable research practices, such as p-hacking, data dredging, HARKing, and cherry-picking, to uphold the integrity of biomedical research.

## Content

Both theoretical and practical (hands-on data analysis) components will be included. The course will provide an introduction to the following statistical concepts and methods:

- Methods for incomplete/missing data
- Methods for causal inference from observational data, including directed acyclic graphs, inverse probability weighting, propensity scores, regression standardization, and semi-parametric theory
- Methods for correlated/clustered data, including repeated measures
- Methods for genetic epidemiology, including methods for multiple comparisons, and an introduction to statistical methods for twin and family studies
- Methods for analysis of high-throughput ('omics') data

The course will also introduce students to some of the practical challenges faced by collaborative or consulting biostatisticians in biomedical research: these include efficient communication with collaborators in order to understand and formulate research questions, thorough problem formulation prior to statistical analysis, organization and management of data flows, interpretation and communication of results to non-statisticians, the legal frameworks for biomedical research, and some of the ethical dilemmas faced by practicing biostatisticians. The course will provide opportunities for discussion and reflection as well as practical skills training, exposing the students to a set of conceptual and technical tools for meeting these challenges. Specific topics include the following:

- Reproducible research and the role of statistical analysis plans
- The problems of p-hacking, data dredging, HARKing, cherry-picking, and other questionable research practices
- Scientific communication, including practical skills in formulating and structuring content, as well as knowledge of rhetoric, writing and presentation techniques.
- Gender equality and diversity; sustainable development

## Teaching methods

The primary teaching methods will be lecture-based learning, technology-enhanced learning (primarily computer-based data analysis), individual learning, and group learning. The course focuses on active learning, i.e., putting knowledge into practice and critically reflecting upon the knowledge.

## **Examination**

The examination consists of assignments (with written and/or oral presentation) and an individual written examination. The deliverable elements of the assignments (e.g., holding an oral presentation or submitting a written report) are to be completed before the end of the course according to the times specified in the schedule.

If there are special grounds, or a need for adaptation for a student with a disability, the examiner may decide to deviate from the syllabus' regulations on the examination form or the possibility of supplementation or exemptions from compulsory sections of the course. Content and learning outcomes as well as the level of expected skills, knowledge and abilities may not be changed, removed, or reduced.

### **Compulsory participation**

It is compulsory to attend the introduction to the course and the sessions in which the assignments are presented/discussed. The examiner assesses if and, in that case, how absence from compulsory components can be compensated. Before the student has participated in all compulsory parts or compensated absence in accordance with the examiner's instructions, the student's results will not be registered in LADOK. Absence from a compulsory activity may result in that the student cannot compensate the absence until the next time the course is given.

### **Limit to the number of examinations**

A student who does not pass the first examination is entitled to participate in five more examinations. If the student does not pass after four examinations, he/she is recommended to retake the course at the next regular course date, and may, after that, participate in two more examinations. If the student has failed six examinations, no additional examination or new admission is provided.

The number of times that the student has participated in one and the same examination is regarded as an examination session. Submission of a blank examination is regarded as an examination. An examination, for which the student registered but not participated in, is not counted as an examination.

## **Other directives**

The course language is English.

## **Literature and other teaching aids**

Study material and reference articles will be provided during the course.