UNIVERSITY
OF SKÖVDE

COURSE SYLLABUS

Statistical Analysis and Data Visualization, Post-graduate level
6 credits

Course code: IT0945F
Version number: 3.3
Valid from: 1 January 2025
Ratified by: Curriculum Committee for Third-cycle Studies
Date of ratification: 18 November 2024

1. General information about the course

The course is provided by the University of Skövde and is named Statistical Analysis and Data Visualization, Post-graduate level (Statistisk analys och datavisualisering, Forskarnivå). It comprises 6 credits.

The course is a part of the third-cycle subject areas of Informatics and Health Science.

2. Entry requirements

The prerequisites for this course are general entry requirements for third-cycle courses and study programmes, i.e. a second-cycle qualification or satisfied requirements for courses comprising at least 240 credits of which at least 60 credits were awarded in the second cycle (or the equivalent).

In order to fulfil the specific entry requirements, the applicant must have completed course requirements of at least 60 credits, including an independent project of at least 15 credits at the second cycle, within the subject Informatics, applicable areas of a similar kind or other fields assessed as directly relevant for thesis work in the subject Informatics.

An additional requirement is proof of skills in English equivalent of studies at upper secondary level in Sweden, known as the Swedish course English 6. This is normally demonstrated by means of an internationally recognized language test, e.g. IELTS or TOEFL or the equivalent.

3. Course content

The course covers essential statistical methods within descriptive statistics and inferential statistics, and exploratory analysis through multivariate data visualization. The course starts with an introduction to statistical measures and commonly used probability distributions and their applications. Classical univariate and bivariate visualization methods are described next, followed by machine learning based multivariate visualization methods, which include clustering, dimensionality reduction based projections and two-dimensional mapping.

The inferential statistics part adopts the frequentist approach, but a brief overview of the Bayesian framework is also provided. The fundamentals of statistical hypothesis testing and its basis in the scientific method are discussed. Under this topic, commonly used experimental designs and sampling methods are explained. A wide variety of statistical hypothesis tests, which include Goodness-of-fit tests, location tests and dispersion tests, are covered for one-sample, two-sample and multiple-sample scenarios. Statistical regression methods are also described within inferential statistics.

The course ends with a critical analysis of statistical procedures adopted in research articles from different domains, and discussions on how improper experimental design, misinterpretation of statistical tests and unethical statistical reporting can negatively influence debate in the scientific community and society.

The course employs statistical toolboxes and libraries in one or more scientific computing software and programming environments. Real-world publicly available datasets are used in the labs, some of which are chosen to promote discussions on societal issues like climate change, economic inequality, gender inequality and discrimination.

4. Objectives

After completed course the doctoral student should be able to:

Knowledge and understanding

- describe and differentiate between various methods within descriptive and inferential statistics,
- demonstrate the use of multivariate visualization methods for exploratory data analysis,

Competence and skills

- formulate statistical hypotheses and use statistical software to test them,
- evaluate and justify the use of specific statistical and visualization methods for certain data analysis tasks,

Judgement and approach

- analyze and assess statistical procedures adopted in research articles from different domains, and
- argue how experimental design and statistical reporting can influence debate in the scientific community and society.

5. Examination

The course is graded G (Pass) or U (Fail).

To receive the grade Pass on the course, all examination parts have to be graded Pass.

The examinations of the course consist of the following modes of assessment:

- **Laboratory Assignments**
  2 credits, grades: G/U

- **Seminar**
  1 credit, grades: G/U

- **Project Report**
  3 credits, grades: G/U (determines the final grade)

Doctoral students with a permanent disability who have been approved for directed educational support may be offered adapted or alternative modes of assessment.

6. Types of instruction and language of instruction

The teaching is comprised of lectures, laboratory sessions, seminars and project work.

The teaching is conducted in English.

7. Course literature and other educational materials

Reference Literature

Chen, C., Härdle, W. K., Unwin, A. (2008). *Handbook of Data Visualization*. Berlin Heidelberg: Springer-Verlag. ISBN 9783662500743.

Efron, B., & Hastie, T. (2016). *Computer Age Statistical Inference: Algorithms, Evidence, and Data Science*. Cambridge, UK: Cambridge University Press..

Field, A. (2017). *Discovering statistics using IBM SPSS Statistics* (5th ed.). London: SAGE. ISBN 9781526419521.

Nussbaumer Knaflic, C. (2015). *Storytelling with Data: A Data Visualization Guide for Business Professionals*. Hoboken, New Jersey: John Wiley & Sons. ISBN 978-1-119-00225-3.

Peck, R., Olsen, C. & Devore, J. (2019). *Introduction to Statistics and Data Analysis* (6th ed.). Cengage Learning. ISBN 9781337793612.

Wasserman, L. (2004). *All of Statistics*. New York, NY: Springer. ISBN 9781441923226.

Weiss, N. A. (2016). *Introductory Statistics*. Pearson. ISBN 9780321989178.

Scientific articles according to the teacher's instructions.

8. Doctoral student influence

Doctoral student influence in the course is ensured by means of course evaluation. The students are informed about the results of the evaluation and potential measures that have been taken or are planned, based on the course evaluation.

9. Additional information

Further information about the course, as well as national and local governing documents for higher education, is available on the website of the University of Skövde.