Probability Theory and Statistics (I700272)

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

Credits 6.0   **Study time** 180 h

Course offerings and teaching methods in academic year 2024-2025

A (semester 2)	Dutch	Gent	lecture	0.0h
			seminar	0.0h

Lecturers in academic year 2024-2025

Meys, Joris	LA26	staff member
Van de Walle, Elien	LA26	staff member
Luca, Stijn	LA26	lecturer-in-charge
De Baets, Bernard	LA26	co-lecturer

Offered in the following programmes in 2024-2025	crdts	offering
Bachelor of Science in Bioscience Engineering Technology	6	A
Linking Course Master of Science in Bioscience Engineering Technology: Agriculture and Horticulture (main subject Horticulture)	6	A
Linking Course Master of Science in Bioscience Engineering Technology: Agriculture and Horticulture (main subject Plant and Animal Production)	6	A
Linking Course Master of Science in Biochemical Engineering Technology	6	A
Linking Course Master of Science in Bioscience Engineering Technology: Food Industry	6	A

Teaching languages

Dutch

Keywords

Probability, probabilistic model, random variables and vectors, distributions, central limit theorem, statistical data-analysis, parameter inference, t-test, linear model, non-parametric tests

Position of the course

The course is a modern introduction to the theory of probability & statistics and its application in the analysis of experimental data. A central concept is the use of probabilistic models and random vectors to model uncertain outcomes of experiments. This will provide the student with the necessary tools to solve various types of issues related to uncertainty. Subsequently, the course provides an introduction to the principles of statistics, in particular point estimators and confidence intervals. With the help of these insights, the main methods of statistical data analysis are discussed (t-tests, linear regression and non-parametric tests). The theoretical concepts are extensively illustrated by means of examples, with an emphasis on problem-solving skills and engineering thinking. The emphasis is on the application of the methods while treating the necessary mathematical background as well. Realistic examples and excercises are given so that students learn to analyze with the aid of a statistical software package.

Contents

Part 1 (probability theory): (1) Introduction to probability theory (probabilistic model, probabilistic events, independence, conditional probability, Bayes' rule). (2) Discrete and continuous random variables (PMF/PDF and CDF; functions of a random variable; conditioning; characteristics). (3) Important discrete and continuous distributions. (4) Discrete and continuous random vectors (PMF/PDF and CDF; functions of a random vector; covariance and correlation coefficient; important distributions). (5) The central limit theorem.
Part 2 (statistics): (1) An introduction to statistical inference: estimators, confidence intervals, evaluating probabilistic models. (2) Tests for normally distributed variables: t-tests, F-tests for comparing variances, P-values, decision errors. (3) The general linear model: categorical and

continuous predictors, t-tests, analysis of variance, post-hoc analyses, model selection. (4) Nonparametric statistics.

Initial competences

This course builds on certain final competences of calculus and linear algebra, which may have been acquired in a different way.

Final competences

1 Master basic rules from probability theory.
2 Basic intuition and insight in discrete and continuous random variables and vectors, (in) dependence and conditioning.
3 Propagate input uncertainty through a model.
4 Solve problems on probabilistic models easily.
5 Apply the basic concepts of statistical inference and the general lineair model in the context of an applied data analysis.
6 Select an appropriate statistical technique for a data analysis given a research question.
7 Perform a statistical data analysis supported by statistical software.
8 Correctly interpret and evaluate the numerical results of a statistical data analysis.
9 Formulate correct conclusions based on the output of a statistical test.

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

During the lectures, the theoretical concepts are introduced intuitively and illustrated by means of examples. For part 1 (probability theory): students prepare basic and more advanced exercises at home. Afterwards, in the plenary exercise session, background and interpretation is given to the more advanced exercises. For part 2 (statistics): the statistical principles from the lectures are applied to practical examples (datasets and research questions) during the PC class exercises. Furthermore, it is shown how to correctly and efficiently use a common software package for data analysis.

Study material

Type: Syllabus

Name: Probability and statistics
Indicative price: Free or paid by faculty
Optional: no
Language : Dutch
Available on Ufora : Yes
Online Available : No
Available in the Library : No
Available through Student Association : No

References

DeGroot, M. and Schervish, M. (2014). Probability and Statistics, Pearson.
Gelman, A., Hill, J. and Vehtari, A. (2021). Regression and other stories. Cambridge University Press.

Course content-related study coaching

The teacher answers questions related to the exercises during the exercise sessions. Support can also be provided through Ufora's discussion forums.

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

Skills test

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

Written exam with open questions, open book exam and some continous assessment provided through UFORA-tests.

Calculation of the examination mark

The final score is a weighted average of the parts probability (40%) and statistics (60%). For part 2 (statistics), the permanent evaluation (UFORA tests) counts for 1/10. In the second examination period, all marks for part 2 (statistics) are on the written exam (points for UFORA tests are therefore not transferred to the second examination period).