



# Exchange programme Vrije Universiteit

Vrije Universiteit Amsterdam - Exchange programme Vrije Universiteit - 2022-2023

## Exchange

Vrije Universiteit Amsterdam offers many English-taught courses in a variety of subjects, ranging from arts & culture and social sciences, neurosciences and computer science, to economics and business administration.

The International Office is responsible for course approval and course registration for exchange students. For details about course registration, requirements, credits, semesters and so on, please [visit the exchange programmes webpages](#).

# Probability Theory

Course Code	X_400622
Credits	6.00
Period	P4+5
Course Level	200
Language Of Tuition	English
Faculty	Faculty of Science
Course Coordinator	dr. A. Zocca
Examiner	dr. A. Zocca
Teaching Staff	dr. A. Zocca
Teaching method(s)	Partial Exam, Seminar, Lecture

## Course Objective

After this course:

1. Students know the three axioms of probability and associated basic propositions and are able to use these to compute probabilities of events.  
They understand the concept of independence and can compute conditional probabilities (directly or with Bayes' rule).
2. Students can compute probability mass functions and density functions, cumulative distributions, expectations and variances of discrete and continuous random variables. They also know important discrete and continuous probability distributions (Bernoulli, binomial, Poisson, geometric, hyper geometric, uniform, normal and exponential distribution) and their properties and know in which context these distributions occur.
3. Students can work with jointly distributed random variables. They can compute probabilities, use the concept of independence in this context, compute marginal distributions, conditional distributions, (conditional) expectations, covariances and correlations.
4. Students can compute the probability distribution of a function of a random variable or a random vector.
5. Students know and can apply the central limit theorem.

## Course Content

We study experiments in which randomness plays a role. We first consider discrete probability experiments: experiments with a countable number of possible outcomes. You can think of tossing dice, shuffling a deck of cards, flipping coins etc. The possible outcomes form a set, the so called sample space. Every subset of this sample space is an event. We assign reasonable probabilities to events, such that the three axioms of probability are satisfied. We compute probabilities in these situations and consider associated concepts such as independence, conditional probabilities, random variables and important discrete probability distributions e.g. the Bernoulli, Binomial, geometric, hypergeometric and Poisson distribution.

We then consider experiments with an uncountable number of possible outcomes and continuous random variables. We consider a number of well-known continuous distributions: the uniform, exponential and normal distributions. We study joint distributions of several (discrete or continuous) random variables. In this context we deal with independence, conditional distributions and expectations, distributions and expectations of functions of random vectors and covariance. We study the Central limit theorem and normal approximations to Binomial distributions.

## Additional Information Teaching Methods

lectures (4 hours per week) and tutorials (2 hours per week). There will be 4 short tests during the tutorials.

## Method of Assessment

Midterm exam (40%), final exam (40%) and short tests (20%), see Canvas for the details.

## Literature

Anderson, D.F, Seppäläinen, T, and Valkó, B, Introduction to Probability, Cambridge University Press, 2018.

## Additional Information Target Audience

Mathematics and BA, year 1 and premaster Mathematics

## Recommended background knowledge

-First year calculus courses for BA or Mathematics. Mathematics students have their second Calculus course simultaneously with Probability Theory.

-Sets and Combinatorics (BA) or Basic Concepts in Mathematics (Mathematics). If you were unable to take the course Basic Concepts in Mathematics or Sets and Combinatorics, e.g. because you are a part time student, it is recommended that you study Appendix B and C of the book before the start of the course.