Exchange programme Vrije Universiteit Amsterdam

Vrije Universiteit Amsterdam - Exchange programme Vrije Universiteit Amsterdam - 2024-2025

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.

Stochastic Modelling

Course Code	X_400646
Credits	6
Period	P1+2
Course Level	200
Language Of Tuition	English
Faculty	Faculty of Science
Course Coordinator	dr. R. Bekker
Examiner	dr. R. Bekker
Teaching Staff	dr. R. Bekker
Teaching method(s)	Lecture, Seminar, Written partial exam

Course Objective

In this course you will become acquainted with stochastic processes and models for waiting lines (queueing models). The learning objectives are:

1. to be able to determine the stability condition for a discrete/continuous-time Markov Chain and find its limit and occupancy distributions;
2. to be able to calculate the distribution and expectation of a hitting time, or a hitting probability; in particular, to master the technique of conditioning on the 1st step/jump;
3. to know the structure of a Poisson process and use its properties to calculate probabilities;
4. to become familiar with classical queuing models, including M/M/1, M/M/c/c, etc.;
5. to be able to determine multiple performance measures for a queuing model, e.g. the average waiting time or proportion of lost customers; in particular, to master such techniques as PASTA, Little's law, arrival relation, Mean Value Analysis;
6. to be able to model a practical situation as a discrete/continuous-time Markov chain, a standard queueing model, or a variation of a standard queuing model;
7. to be able to interpret the results and understand the practical implications, e.g. economies of scale or impact of variability.

Course Content

Stochastic processes and queueing models are often applied to model practical situations where uncertainty is involved. This course mainly focuses on Markov chains and queueing models. A key element is the theoretical development of such models with the emphasis on modeling and its analysis. In addition, the models are motivated by applications.
More specifically, the fundamental stochastic processes and queueing models that we study are: Markov chains in discrete and continuous time, the Poisson process, the M/M/1 queue, the Erlang delay and loss model, the M/G/1 queue and the waiting-time paradox.

Additional Information Teaching Methods

Lectures and tutorials.

Method of Assessment

4 in-class short tests (pass/fail), a written midterm exam at the end of period 1 (50% of the grade), and a written final exam at the end of period 2 (50% of the grade). There is no separate resits for the short tests or midterm and final exams. There is a single resit that covers the entire course material. A student passes the course in the following scenarios:

- 3 out of 4 short tests are a pass and the average of the two exams is at least 5.5 (there are no minimum requirements on the partial grades);
- the resit grade is at least 5.5.

Literature

The lecture slides are self-contained. For additional reading, the following are recommended:

- Kulkarni, V.G., Introduction to Modeling and Analysis of Stochastic Systems, Springer Texts in Statistics (also available as e-book via UBVU).
- Adan, I.J.B.F., and Resing, J.A.C., Queueing Theory, lecture notes (available online)

Additional Information Target Audience

2BA

Recommended background knowledge

Probability Theory (in particular, the concepts of independence, distribution, expectation, variance; Bernoulli, binomial, Poisson, exponential, uniform, normal distributions; the law of total probability, or conditioning), Calculus 1 and 2 (in particular, integration techniques, power series and Taylor series), Linear Algebra (in particular, being able to solve systems of linear equations). The course assumes fluency in the mentioned topics, these are not simply recommended but *required* prerequisites.