

Finance and risk	
Offered by	Department of Mathematics and Computer Science
Language	English
Primarily interesting for	All students, but most relevant for students with background in Applied Mathematics and Industrial Engineering
Prerequisites	Introductory courses in calculus and probability theory
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Content and composition

This coherent package gives a realistic view on the important role played by mathematical models in the world of finance. For many engineers the financial world presents great career opportunities.

Course code	Course name	Level classification
2DF20	Stochastics and simulation for finance	2. Intermediate
or 2WB50 (math.)	Stochastic simulation	2. Intermediate
2DF30	Insurance and credit risk	3. Advanced
2DF40	Financial mathematics	3. Advanced

Precedence relationships within the package

In order to follow 2DF30 and 2DF40, it is strongly recommended to first follow 2DF20. Mathematics students do the course Stochastic Simulation (2WB50) instead of Stochastics and Simulation for Finance (2DF20). In the financial world, mathematics in general, and probability theory in particular, are of crucial importance. Think for instance of insurance companies that face claims that occur at unexpected moments, or the stock market with its highly unpredictable behaviour, or pension funds investing in risky assets. It is therefore that probabilistic models and stochastic processes provide a crucial foundation needed for the financial markets to operate properly. An emerging topic in finance is credit risk, which deals with mathematical models that can predict the risk that a person, a company, or even a country runs of going into default. Since several years we know that even banks can go bankrupt. Some of the most important mathematical models are discussed, including several famous financial models of Nobel laureates. A special feature of all three courses is that, next to theory, there is considerable attention for practice through:

- Active use of real data
- Actual implementation of all models
- Crash course on programming in R
- Real-life assignments, to be made in pairs

Course description

Stochastics and Simulation for Finance

In the world of finance, randomness plays a major role. Mathematical models for insurance risk, credit risk, stock markets, and investment strategies therefore typically require probabilistic concepts. This introductory course covers the most relevant basic concepts from probability theory and simulation for finance. Amongst others the following topics will be discussed: random variables and transform methods (generating functions and Laplace transforms), (random) sums of random variables, law of large numbers and central limit theorem, (compound) Poisson processes. Students will also acquire the skills to simulate a financial or insurance model in the programming language R.

Insurance and Credit Risk

Insurance claim amounts and claim times are usually assumed to be random, hence probability theory is needed to determine key performance measures like the probability that an insurance company gets ruined or the deficit of the company at ruin. In this course, we discuss several models and methods which are relevant for the probabilistic analysis of insurance models. We also discuss some of the emerging models that are used to predict credit risk, which is the risk of facing bankruptcy.

Financial Mathematics

This course covers fundamental theories from the world of finance, including classical ideas about the trade-off between risk and return, optimal investments, derivative pricing, and the famous models of the Nobel laureates Markowitz, Black and Scholes. We also consider practical examples, and realistic financial data.