

Module Description

MA5715: Financial Engineering with Copulas

TUM Department of Mathematics

Module level: Master	Language: English	Module duration: one semester	Occurrence: one-time
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Credits*: 6	Total number of hours: 180	Self-study hours: 120	Contact hours: 60
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* The number of credits can vary depending on the corresponding SPO version. The valid number is always indicated on the Transcript of Records or the Performance Record.

Description of achievement and assessment methods:

The module examination is based on a written exam (60 minutes). By answering questions in text form, students have to show their understanding of the concepts of financial engineering with copulas and their capability to apply these concepts. They have to analyze mathematical models of dependence structures in financial markets and solve given problems. This includes, among others, questions on dependence measures, copula families, stochastic models and simulation, estimation, and the implementation of specific problems as algorithm.

The questions may include mathematical proofs, calculations, and algorithms.

Exam type: not specified	Exam duration (min.): not specified	Possibility of re-taking: In the next semester: No At the end of the semester: Yes	Homework: No
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Lecture: No	Conversation: No	Written paper: No
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(Recommended) requirements:

MA2402 - Basic Statistics

Contents:

Motivating examples (e.g. dependence in asset returns and default times), definition of copulas and Sklar's Theorem, dependence measures and their properties, computation rules for multivariate probability distributions, families of copulas and general construction principles, parameter estimation, stochastic simulation, applications (e.g. to portfolio credit-risk modelling), uncertainty concerning dependence.

Study goals:

After successful completion of the module, students have a sound understanding of the dependence structure behind multivariate stochastic problems, which is one of the key challenges for modern financial engineering. They understand the relevant tools and intuition behind copulas and are able to successfully apply them in applications. They are able to measure and model dependence, select a problem-adequate dependence structure, and fit the constructed model to empirical data. This includes the use of statistical software (e.g. R) to estimate copula models, visualize multivariate data, and perform efficient high-dimensional simulations.

Teaching and learning methods:

The module consists of lectures supplemented by exercise sessions (including computer exercises). The lecture material is presented with slide presentations and mathematical proofs are presented on the blackboard. The students are encouraged to study course references and course subjects. The exercise session consists of

theoretical and computer-oriented exercises. In the theoretical exercises students will work under instructor assistance on assignments, sometimes in teamwork.

In computer-oriented exercises students implement and estimate dependence measures and copulas and work with real data. The exercises contribute to a better understanding of the lecture materials.

Media formats:

blackboard, beamer slides, R (statistic programme), exercise sheets

Literature:

1. H. Joe, Multivariate Models and Dependence Concepts, Chapman and Hall/CRC, London (1997).
2. J.-F. Mai, M. Scherer, Simulating copulas: Stochastic models, simulation algorithms, and applications, Imperial College Press (2012).
3. J.-F. Mai, M. Scherer, Financial Engineering with Copulas explained, Palgrave (2014).
4. A.J. McNeil, R. Frey, P. Embrechts, Quantitative Risk Management, Princeton University Press, Princeton, New Jersey (2005).
5. R.B. Nelsen, An Introduction to Copulas, second edition, Springer, New York (2006).

Responsible for the module:

Scherer, Matthias; Prof. Dr. rer. nat.: scherer@tum.de

Courses (Type, SH) Lecturer:

0000003342 Financial Engineering with Copulas (Exercise Session) (1SWS P, WS 2016/17) [BF]
Scherer M, Fernandez L, Hüttner A

0000003348 Financial Engineering with Copulas (2SWS L, WS 2016/17) [BF]
Fernandez L [L], Scherer M (Hüttner A)

0000003366 Financial Engineering with Copulas (Programming Exercise) (1SWS P, WS 2016/17) [BF]
Scherer M, Fernandez L, Hüttner A

0000003369 Additional material, historical background, and review discussions on copulas (1SWS L, WS 2016/17) [BF]
Fernandez L, Hüttner A, Scherer M

For further information about this module and its allocation to the curriculum see:
<https://campus.tum.de/tumonline/wbModHb.wbShowMHBReadOnly?pKnotenNr=1016511>

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