Module Description 24-M-PT-STA Stochastic Analysis

Faculty of Mathematics

Version dated Feb 9, 2026

This module guide reflects the current state and is subject to change. Up-to-date information and the latest version of this document can be found online via the page

https://ekvv.uni-bielefeld.de/sinfo/publ/modul/533549134

The current and valid provisions in the module guide are binding and further specify the subject-related regulations (German "FsB") published in the Official Announcements of Bielefeld University.

24-M-PT-STA Stochastic Analysis

Faculty

Faculty of Mathematics

Person responsible for module

Prof. Dr. Barbara Gentz

Regular cycle (beginning)

Every winter semester

Credit points

10 Credit points

Competencies

Non-official translation of the module descriptions. Only the German version is legally binding.

Students master advanced content and methods of stochastic analysis, in particular they are able to independently carry out very complex proofs in this area requiring a high level of mathematical expertise. They are able to model complex relationships using probabilistic structures as a basis for applications and to analyse these probabilistic structures mathematically, i.e. concretely:

- Students can construct the stochastic integral for Brownian motion and apply it to various application contexts.
- Students can solve stochastic differential equations.
- Students can model and analyse various application situations using stochastic analysis (stochastic integral, stochastic differential equations).

Students will be introduced to current research questions in the area of Probability Theory. They are able to recognise and assess further development opportunities and research goals.
Furthermore, students recognise further-reaching connections to mathematical issues that have already been worked out. They can transfer and apply the knowledge and methods they have learnt so far to deeper mathematical problem areas. Students also expand their mathematical intuition as a result of more intensive study.
In combination with other in-depth modules, they will be able to write their own research papers, e.g. a master's thesis in the field of Probability Theory.
In the tutorials, students develop their ability to discuss mathematical topics and thus further prepare themselves for the requirements of the Master's module, in particular for the scientific discussion within the Master's seminar presentation and the defence of their Master's thesis.

Content of teaching

The following advanced content of teaching is compulsory:

- Construction and properties of the stochastic integral for Brownian motion
- Ito calculus

- Girsanov transformation
- Stochastic differential equations and applications

In addition, the following content of teaching can be covered, for example:

- Basic features of the construction and properties of the stochastic integral for general martingales
- Ito representation theorem

This module prepares the content of a master's thesis.

Recommended previous knowledge

Solid knowledge of the basics of Stochastic Dynamics (theory of continuous-time martingales, Brownian motion) as in 24-M-PT-STP

Necessary requirements

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Explanation regarding the elements of the module

Module structure: 1 SL, 1 bPr [1]

Courses

Title	Type	Regular cycle	Workload [5]	LP[2]
Lecture Stochastic Analysis	lecture	WiSe	60 h (60 + 0)	2 [Pr]
Tutorials Stochastic Analysis	exercise	WiSe	90 h (30 + 60)	3 [SL]

Study requirements

Allocated examiner	Workload	LP[2]
Teaching staff of the course **Tutorials Stochastic Analysis (exercise)** *Regular completion of the exercises, each with a recognisable solution approach, as well as participation in the exercise groups for the module's lecture. As a rule, participation in the exercise group includes presenting solutions to exercises twice after being asked to do so as well as regular contributions to the scientific discussion in the exercise group, for example in the form of comments and questions on the proposed solutions presented. The organiser may replace some of the exercises with face-to-face exercises.*	see above	see above

Examinations

Allocated examiner	Type	Weighting	Workload	LP[2]
Teaching staff of the course **Lecture Stochastic Analysis (lecture)** *(electronic) written examination in presence of usually 120 minutes, oral examination in presence or remote of usually 40 minutes, A remote electronic written examination is not permitted.*	e-Klausur o. Klausur o. mündliche e-Prüfung o. mündliche Prüfung	1	150h	5

Legend

1	The module structure displays the required number of study requirements and examinations.
2	LP is the short form for credit points.
3	The figures in this column are the specialist semesters in which it is recommended to start the module. Depending on the individual study schedule, entirely different courses of study are possible and advisable.
4	Explanations on mandatory option: "Obligation" means: This module is mandatory for the course of the studies; "Optional obligation" means: This module belongs to a number of modules available for selection under certain circumstances. This is more precisely regulated by the "Subject-related regulations" (see navigation).
5	Workload (contact time + self-study)
SoSe	Summer semester
WiSe	Winter semester
SL	study requirement
Pr	Examination
bPr	Number of examinations with grades
uPr	Number of examinations without grades