Module Description 24-M-PT-STP Stochastic Processes

Faculty of Mathematics

Version dated Jun 3, 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/533550751

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.

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

24-M-PT-STP Stochastic Processes

Faculty

Faculty of Mathematics

Person responsible for module

Prof. Dr. Vitali Wachtel

Regular cycle (beginning)

Every summer semester

Credit points

10 Credit points

Competencies

Students master the basic contents and methods of the theory of Stochastic Processes, in particular they can independently carry out complex proofs in this area requiring a high level of mathematical expertise. Students 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 are able to construct conditional expectations in general and apply them to various application contexts.
- Students are able to prove the existence of discrete and continuous-time stochastic processes, in particular discrete-time Markov chains and martingales.
- Students are able to construct Brownian motion in various ways and prove essential properties of Brownian evaluation.
- Students are able to analyse stochastic processes, in particular the Brownian motion using martingale theory.

Furthermore, the students recognise further-reaching connections to mathematical facts already acquired. 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 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 basic content of teaching from the field of probability theory is mandatory:

- Construction of conditional expectation and applications
- Markov chains and processes
- Discrete-time martingale theory
- Time-continuous stochastic processes

- Brownian motion: various constructions, path properties and finite dimensional distributions,

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

- Poisson processes
- Ergodic theory
- Time-Continuous martingales

Recommended previous knowledge

Basic knowledge of probability theory (such as in module 24-B-EW)

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 Processes	lecture	SoSe	60 h (60 + 0)	2 [Pr]
Tutorials Stochastic Processes	exercise	SoSe	90 h (30 + 60)	3 [SL]

Study requirements

Allocated examiner	Workload	LP[2]
Teaching staff of the course **Tutorials Stochastic Processes (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 Processes (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