Probability Theory 2

Type of Module	**Module Code**
Advanced Module	AM-WT2

Identification Number	**Workload**	**Credit Points**	**Term**	**Offered Every**	**Start**	**Duration**
MSc-M-WT2	270 Hours	9 CP	1. – 3. Semester	WiSe	Winter semester	1 Semester

1	**Course Types**	**Contact Time**	**Private Study**	**Planned Group Size**
	a) Lecture	56 h	112 h	b) 30 Students
	b) Exercise	28 h	56 h	
	Exam Preparation		18 h	

2 Module Objectives and Skills to be Acquired

In-depth knowledge of the concepts and methods of probability theory and the fundamentals of stochastic processes, preparation for advanced stochastics modules.

Conveying technical and methodological skills. Ability to develop and apply stochastic work techniques independently. Understanding of relevant specialist literature.

In addition to in-depth knowledge, lectures and exercises also provide advanced skills for classifying, recognizing, formulating and solving problems and training in conceptual, analytical and logical thinking. In addition to deepening the lecture material, the exercises also serve to acquire communication and presentation skills.

3	**Module Content** 1. Martingale theory - Martingales, Submartingales, Supermartingales, Semimartingales - Stop times, optional stopping (sampling) theorem - Martingale convergence and their application - Equally integrable and square integrable martingales - Doob-Meyer decomposition 2. Markov chains and branching processes - Types of states, irreducible chains, aperiodic chains - Criteria for recurrence and transience - Markov chains in continuous time 3. Stationary consequences - Ergodic sentences - applications 4. Special distributions - Unlimited divisible distributions, canonical representation - Regular variation, Karamata - Theory stable distributions, sub - exponential distributions 5. Brownian movement (Wiener process), Gaussian processes - Stop times, strong Markov property, mirroring principle - Principles of invariance and their applications - Central limit value sets for dependent random variables - Quadratic variation and stochastic integrals - Extreme value theory literature e.g. Chow, Y.S., Teicher, H. (1997) Probability Theory. Springer, New York (3rd Edition) For further literature see the current annotated course catalog
4	**Teaching Methods** Lecture and Exercise
5	**Prerequisites (for the Module)** Formally: None Regarding the Contents: Contents of Probability Theory I (Bachelor)
6	**Type of Examination** Written or Oral Examination

7	**Credits Awarded** The module is passed and credit points are awarded if the 180-minute final exam is passed or the 30-45-minute oral final exam is passed. The prerequisite for admission to the exam is regular successful completion of the exercises. The respective lecturer announces the exact requirements at the beginning of the event. Registration is required to take the final exam; A resit examination is offered at the beginning of the following semester. Repeated participation in the lecture and the exercises to prepare for a repetition of the final examination is possible. The module is graded.
8	**Compatibility with other Curricula** The module is usable in the master courses “Mathematik” and “Wirtschaftsmathematik”
9	**Proportion of Final Grade** 9/114
10	**Module Coordinator** A. Drewitz, P. Mörters, H. Schmidli
11	**Further Information**