M121	**Stochastic Processes II**	L	P	S	ECTS
		2	2	0	6

Course objectives. Adoption of theoretical concepts related to basic types of continuous-time stochastic processes, understanding of analytical techniques for solving problems in theory and practice, and identifying possible applications of stochastic processes in practice.

Prerequisites. Probability, Stochastic Processes I.

Course content.

1. Wide and strict sense stationarity of a stochastic process. Stochastic processes with stationary and independent increments. Important examples.
2. Continuous-time martingales. Examples from applications.
3. Continuous-time Markov chains. An important class of examples - birth and death processes. Transition probabilities. Kolmogorov's differential equations. Limiting distribution. Ergodicity.
4. Diffusions. Ito's integral. Ito's formula. Concept and interpretation of stochastic differential equation (SDE). Numerical solutions of SDEs. Important examples from applications.

No.	LEARNING OUTCOMES
1.	Explaining the notion of stationarity of a stochastic process.
2.	Explaining the concept of stationarity and independence of increments of a stochastic process.
3.	Recognizing practical phenomena suitable for modelling by stationary processes or processes with stationary and/or independent increments.
4.	Identifying processes in practice suitable for modelling by continuous-time martingales and Markov chains.
5.	Explaining the concept of diffusion and the related concept of stochastic differential equation.
6.	Argumentation of numerical approximation of diffusions by a specifically constructed set of random variables.
7.	Interpreting the stochastic differential equation that serves as a model in a specific practical problem.
8.	Solving problems related to the application of continuous- time stochastic processes in practice and interpreting their solutions.
9.	Combining concepts and methods from course content for solving more complex problems.

RELATING THE LEARNING OUTCOMES, ORGANIZATION OF THE EDUCATIONAL PROCESS AND ASSESSMENT OF THE LEARNING OUTCOMES

TEACHING ACTIVITY	ECTS	LEARNING OUTCOME **	STUDENT ACTIVITY*	EVALUATION METHOD	POINTS	
					min	max
Attending lectures and exercises	1.5	1-9	Lecture attendance, discussion, team work, independent work on given tasks and short examination	Attendance lists, tracking activities	0	5
Homework	0.5	3, 4, 8, 9	Solving theoretical and practical problems	Evaluation	0	5

Written exam (Mid-terms)	2	1-9	Preparing for written exam	Evaluation	30	60
Final exam	2	1-9	Revision	Oral exam	20	30
TOTAL	6				50	100

Teaching methods and student assessment. Lectures and exercises are obligatory. The final exam is oral, taken after the completed lectures and exercises and achieved minimum number of credits at the midterm exams. Students can influence the grade by writing homework during the semester.

Can the course be taught in English: Yes

Basic literature:

1. G. Grimmett, D. Stirzaker, Probability and Random Processes, Clarendon Press, Oxford, 2004.
2. T. Mikosch, Elementary Stochastic Calculus with Finance in View, World Scientific, 2000.

Recommended literature:

1. P. Baldi, L. Mazliak, P. Priouret, Martingales and Markov Chains: Solved Exercises and Elements of Theory, Chapman and Hall, New York, 2002.
2. N. Elezović, Statistika i procesi, Element, Zagreb, 2007.
3. S. Karlin, H. M. Taylor, A First Course in Stochastic Processes, Academic press, New York-London, 1975.
4. S. Karlin, H. M. Taylor, A Second Course in Stochastic Processes, Academic press, New York-London, 1981.
5. J. R. Norris, Markov Chains, Cambridge University Press, 1997.
6. S. I. Resnick, Adventures in Stochastic Processes, Birkhauser, Boston, 2002.
7. S. M. Ross, Introduction to Probability Models, Academic Press, 2014.
8. Z. Vondraček, Financial modelling (web material in croatian), Faculty of Natural Sciences - Department of Mathematics, University of Zagreb, 2018.
9. Z. Vondraček, Markov Chains (web material in croatian), Faculty of Natural Sciences - Department of Mathematics, University of Zagreb, 2013.
10. Z. Vondraček, Stochastic Processes (web material in croatian), Faculty of Natural Sciences - Department of Mathematics, University of Zagreb, 2018.
11. D. Williams, Probability with Martingales, Cambridge University Press, 2001.