UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Verjetnost 2
Course title:	Probability 2

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **Semester**
Magistrski študijski program Finančna matematika	ni smeri	1	prvi
Master's study programme Financial Mathematics	none	1	first

Vrsta predmeta / Course type	obvezni
Univerzitetna koda predmeta / University course code:	M2514

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Klinične vaje** **work**	**Druge oblike študija**	**Samost. delo** **Individ. work**	**ECTS**
45		**30**			**105**	**6**

Nosilec predmeta / Lecturer:	prof. Mihael Perman

Jeziki / Languages:	**Predavanja / Lectures:**	slovenski/Slovene, angleški/English
	Vaje / Tutorial:	slovenski/Slovene, angleški/English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Vsebina:	**Content (Syllabus outline):**

Markovske verige v diskretnem času: Slučajni procesi in markovska lastnost. Teorija markovskih verig. Povezava s teorijo grafov in linearno algebro. Osnovna struktura verig. Časi prvih prehodov in vrnitev. Povrnljiva in minljiva stanja. Poljubno mnogo obiskov stanja. Ergodično obnašanje verige. Limitni izreki. Posebnosti v končnem. Markovske verige v zveznem času: Poissonov tok in Poissonov proces. Rojstni procesi: reševanje enačb Kolmogorova. Zvezna markovska lastnost. Naprejšnje in nazajšnje enačbe Kolmogorova in njihove rešitve. Stacionarna porazdelitev. Obratna pot do markovskih verig. Stabilnost in eksplozije. Diferencialne enačbe in generator polgrupe. Uporaba markovskih verig: Čakalni sistemi (rojstno smrtni čakalni sistem, čakalni sistem M/M/1, osnovni pojmi teorije strežnih sistemov, nekateri pomembni primeri čakalnih sistemov). Metoda Monte Carlo markovskih verig (Bayesova statistika in Monte Carlo simulacije, algoritma Gibbsov vzorčevalnik in Metropolis-Hastings, konvergenca algoritmov, aplikacije v finančni matematiki).	Discrete time markov chains: Random processes and Markov property. Markov chain theory. Connections to graph theory and linear algebra. Basic structure of a chain. Times of first passage ant first return. Recurrent and transient states. Infinitely many visits of a state. Ergodic behaviour of a chain. Limit theorems. Specific results for the case of finite number of states. Continuous time markov chains: Poisson flow and Poisson process. Birth processes: solving Kolmogorov equations. Continuous time Markov property. Forward and backward Kolmogorov equations and their solutions. Stacionary distribution. Reverse approach. Stability and explosions. Diferential equations and generator of a one-parameter semigroup. Applications of markov chains: Waiting queue systems (birth&;death system, M/M/1, introduction into the general theory,some important cases of waiting queue systems). Monte Carlo markov chains (Bayesian statistics and Monte Carlo simulations, Gibbs sampler and Metropolis-Hastings algorithm, convergence of MCMC algorithms, applications in Financial Mathematics).

Temeljni literatura in viri / Readings:

G. Grimmett, D. Stirzaker: Probability and Random Processes, 3rd edition, Oxford Univ. Press, Oxford, 2001.

D. Williams: Probability with Martingales, Cambridge Univ. Press, Cambridge, 1995.

L. C. G. Rogers, D. Williams: Diffusions, Markov Processes, and Martingales I : Foundations, 2nd edition, Cambridge Univ. Press, Cambridge, 2000.

J. R. Norris: Markov Chains, Cambridge Univ. Press, Cambridge, 1999.

S. I. Resnick: Adventures in Stochastic Processes, Birkhäuser, Boston, 1992.

Cilji in kompetence:	**Objectives and competences:**

Pri predmetu obravnavamo vrsto posebnih verjetnostnih vsebin, pri katerih ni potrebno globoko teoretično predznanje, so pa pomembne za uporabo. Poudarek je predvsem na ergodični teoriji, tako v diskretnem kot zveznem času. Uporabe vključujejo teorijo čakalnih sistemov ter MCMC metode.	The course provides a certain number of probability themes that do not need deep theoretical knowledge. However they are important in view of applications. The emphasys is on ergodic theory, both in discrete and continuous time. Appliacations include waiting queue systems and MCMC methods.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Spoznavanje nekaterih najpomembnejših aplikacij verjetnosti.	Knowledge and understanding: The knoledge of some of the most important applications of probability is acquired.

Metode poučevanja in učenja:	**Learning and teaching methods:**
predavanja, vaje, domače naloge, konzultacije	Lectures, exercises, homeworks, consultations

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): izpit iz vaj, ki ga je možno nadomestiti z 2 kolokvijema izpit iz teorije, ki ga je možno delno nadomestiti s teoretičnimi testi ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)	50% 50%	Type (examination, oral, coursework, project): written exam or 2 midterm type exams oral exam that can be partially replaced by theoretical tests grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)

Reference nosilca / Lecturer's references:

Mihael Perman:

– PERMAN, Mihael, WELLNER, Jon A. On the distribution of Brownian areas. Annals of applied

probability, ISSN 1050-5164, 1996, let. 6, št. 4, str. 1091-1111 [COBISS.SI-ID 7101017]

– PERMAN, Mihael. An excursion approach to Ray-Knight theorems for perturbed Brownian motion. Stochastic Processes and their Applications, ISSN 0304-4149. [Print ed.], 1996, let. 63, str. 67-74 [COBISS.SI-ID 7621465]

– PERMAN, Mihael, PITMAN, Jim, YOR, Marc. Size-biased sampling of Poisson processes and excursions. Probability theory and related fields, ISSN 0178-8051, 1992, 92, no. 1, str. 21-39 [COBISS.SI-ID 12236377]