UČNI NAČRT PREDMETA / COURSE SYLLABUS (leto / year 2017/18)

Predmet:	Slučajni procesi 1
Course title:	Stochastic processes 1

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Univerzitetni študijski program Finančna matematika	ni smeri	3	drugi
First cycle academic study programme Financial Mathematics	none	3	second

Vrsta predmeta / Course type	obvezni / compulsory

Univerzitetna koda predmeta / University course code:	M0320

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30		30			90	5

Nosilec predmeta / Lecturer:	prof. dr. Janez Bernik, prof. dr. Mihael Perman

Jeziki / Languages:	Predavanja / Lectures:	slovenski / Slovene
	Vaje / Tutorial:	slovenski / Slovene

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Vpis v letnik študija. Opravljen predmet Verjetnost 1.	Enrolment in the programme. Completed course Probability 1.

Vsebina:	Content (Syllabus outline):

Slučajni procesi v diskretnem in zveznem času.	Stochasic processes in discrete and continuous time.
Procesi štetja: homogeni Poissonovi procesi (definicija, lastnost medprihodnih časov, lastnost vrstilnih statistik), nehomogeni Poissonovi procesi (karakterizacija, konstrukcija), prenovitveni procesi (definicija, osnovni prenovitveni izrek, prenovitvene enačbe).	Counting processes: homogeneous Poisson processes (definition, interarrival times property, ordered statistics property), inhomogeneous Poisson processes (characterization, construction), renewal processes (definition, elementary renewal theorem, renewal equations).
Brownovo gibanje: konstrukcija Brownovega gibanja, lastnosti trajektorij, krepka lastnost Markova, princip zrcaljenja.	Brownian motion: construction, path properties, strong Markov property, reflection principle.
Markovske verige v diskretnem času: klasifikacija stanj, klasifikacija verig, lastnost Markova, ergodijske lastnosti.	Discrete time Markov chains: classification of states, classification of chains, Markov properties, ergodic properties.
Markovske verige v zveznem času: definicija, krepka lastnost Markova, začetne in končne enačbe Kolmogorova, rojstno-smrtni procesi, procesi razvejanja, ergodijske lastnosti.	Continuous time Markov chains: strong Markov property, forward and backward Kolmogorov equations, birth-death processes, branching processes, ergodic properties.

Temeljni literatura in viri / Readings:

S. Resnick: Adventures in Stochastic Processes, Birkhäuser Boston, 2002.

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

J. F. C Kingman: Poisson Processes, Oxford Science Publications, 1993.

Z. Brzeźniak, T. Zastawniak: Basic Stochastic Processes, Springer, 1999.

D. Williams: Probabilty with Martingales, Cambridge University Press, 1995.

B. Øksendal: Stochastic Differential Equations: An Introduction with Applications, 6th Edition, Springer, 2005.

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

Predmet je uvod v teorijo slučajnih procesov v zveznem času in predstavlja osnovne gradnike teorije slučajnih procesov kot so Poissonovi procesi, prenovitveni procesi, markovske verige v diskretnem in zveznem času ter Brownovo gibanje.	Introduction to the theory of stochastic processes in continuous time and the

basic examples of stochastic processes such as

Poisson processes, renewal processes, Markov chains and Brownian motion. |

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Razumevanje soigre naključnosti in časa in usvojitev za to potrebnih matematičnih orodij.

Uporaba: Osnova za modeliranje v mnogih vejah matematike in njene uporabe, še posebej na področju zavarovalništva in financ.

Refleksija: Vsebina predmeta pomaga za nazaj poglobiti razumevanje konceptov verjetnosti in koncepta odvisnosti.

Prenosljive spretnosti – niso vezane le na en predmet: Spretnosti so prenosljive na druga področja matematičnega modeliranja, še najbolj pa je predmet pomemben zaradi svoje neposredne uporabnosti pri finančnem modeliranju | Knowledge and understanding: Understanding of the interplay between randomness and time evolution and development of the necessary mathematical concepts and tools.

Application: Stochastic processes form a foundation for various kinds of modelling, particulary in insurance and finance.

Reflection: The nature of the course implies that the basic concepts of probability, which were introduced in earlier courses, are now

used, thus broadening and deepening their understanding.

Transferable skills: The skills acquired are directly transferable not only to other branches of mathematics, but to direct modelling of real world phenomena, especially in finance. |

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

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
2 kolokvija namesto izpita iz vaj, izpit iz vaj,		2 midterm exams instead of written exam, written exam
izpit iz teorije		oral exam
ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)	50% 50%	grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)

Reference nosilca / Lecturer's references:

Mihael Perman:

AHČAN, Aleš, MASTEN, Igor, POLANEC, Sašo, PERMAN, Mihael. Quantile approximations in auto-regressive portfolio models. Journal of Computational and Applied Mathematics, ISSN 0377-0427. [Print ed.], Feb 2011, vol. 235, iss. 8, str. 1976-1983. [COBISS.SI-ID 19878630]

KOMELJ, Janez, PERMAN, Mihael. Joint characteristic functions construction via copulas. Insurance. Mathematics & economics, ISSN 0167-6687, 2010, vol. 47, iss. 2, str. 137-143. [COBISS.SI-ID 16242777]

HUZAK, Miljenko, PERMAN, Mihael, ŠIKIĆ, Hrvoje, VONDRAČEK, Zoran. Ruin probabilities and decompositions for general perturbed risk processes. Annals of applied probability, ISSN 1050-5164, 2004, vol. 14, no. 3, str. 1378-1397. [COBISS.SI-ID 13168985]

Janez Bernik:

BERNIK, Janez, MASTNAK, Mitja. Lie algebras acting semitransitively. Linear Algebra and its Applications, ISSN 0024-3795. [Print ed.], 2013, vol. 438, iss. 6, str. 2777-2792. [COBISS.SI-ID 16553561]

BERNIK, Janez, MARCOUX, Laurent W., RADJAVI, Heydar. Spectral conditions and band reducibility of operators. Journal of the London Mathematical Society, ISSN 0024-6107, 2012, vol. 86, no. 1, str. 214-234. [COBISS.SI-ID 16357721]

BERNIK, Janez, MASTNAK, Mitja, RADJAVI, Heydar. Positivity and matrix semigroups. Linear Algebra and its Applications, ISSN 0024-3795. [Print ed.], 2011, vol. 434, iss. 3, str. 801-812. [COBISS.SI-ID 15745625]