

UČNI NAČRT PREDMETA / COURSE SYLLABUS (leto / year 2017/18)						
<b>Predmet:</b>		Slučajni procesi 1				
<b>Course title:</b>		Stochastic processes 1				
<b>Študijski program in stopnja</b> Study programme and level		<b>Študijska smer</b> Study field		<b>Letnik</b> Academic year		<b>Semester</b> Semester
Univerzitetni študijski program Matematika		ni smeri		3		drugi
First cycle academic study programme Mathematics		none		3		second
<b>Vrsta predmeta / Course type</b>				izbirni / elective		
<b>Univerzitetna koda predmeta / University course code:</b>				M0249		
<b>Predavanja</b> Lectures	<b>Seminar</b> Seminar	<b>Vaje</b> Tutorial	<b>Klinične vaje</b> work	<b>Druge oblike</b> študija	<b>Samost. delo</b> Individ. work	<b>ECTS</b>
30		30			90	5
<b>Nosilec predmeta / Lecturer:</b>		prof. dr. Janez Bernik, prof. dr. Mihael Perman				
<b>Jeziki / Languages:</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene				
	<b>Vaje / Tutorial:</b>	slovenski / Slovene				
<b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b>			<b>Prerequisites:</b>			
Vpis v letnik študija.			Enrolment in the programme.			
Opravljen predmet Verjetnost.			Completed course Probability.			
<b>Vsebina:</b>			<b>Content (Syllabus outline):</b>			

<p>Slučajni procesi v diskretnem in zveznem času.</p> <p>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).</p> <p>Brownovo gibanje: konstrukcija Brownovega gibanja, lastnosti trajektorij, krepka lastnost Markova, princip zrcaljenja.</p> <p>Markovske verige v diskretnem času: klasifikacija stanj, klasifikacija verig, lastnost Markova, ergodijske lastnosti.</p> <p>Markovske verige v zveznem času: definicija, krepka lastnost Markova, začetne in končne enačbe Kolmogorova, rojstno-smrtni procesi, procesi razvejanja, ergodijske lastnosti.</p>	<p>Stochastic processes in discrete and continuous time.</p> <p>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).</p> <p>Brownian motion: construction, path properties, strong Markov property, reflection principle.</p> <p>Discrete time Markov chains: classification of states, classification of chains, Markov properties, ergodic properties.</p> <p>Continuous time Markov chains: strong Markov property, forward and backward Kolmogorov equations, birth-death processes, branching processes, ergodic properties.</p>
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#### **Temeljni literatura in viri / Readings:**

<p>S. Resnick: Adventures in Stochastic Processes, Birkhäuser Boston, 2002.</p> <p>J. R. Norris: Markov Chains, Cambridge University Press, 1999.</p> <p>J. F. C Kingman: Poisson Processes, Oxford Science Publications, 1993.</p> <p>Z. Brzeźniak, T. Zastawniak: Basic Stochastic Processes, Springer, 1999.</p> <p>D. Williams: Probability with Martingales, Cambridge University Press, 1995.</p> <p>B. Øksendal: Stochastic Differential Equations: An Introduction with Applications, 6th Edition, Springer, 2005.</p>
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#### **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:**

Znanje in razumevanje: Razumevanje soigre naključnosti in časa in usvojitve 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

**Intended learning outcomes:**

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, particularly 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:**

Predavanja, vaje, domače naloge, konzultacije

**Learning and teaching methods:**

Lectures, exercises, homework, consultations

**Načini ocenjevanja:**

Delež (v %) /

Weight (in %) /

**Assessment:**

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

Mihael Perman:

AHČAN, Aleš, MASTEN, Igor, POLANEC, Sašo, PERMAN, Mihael. Quantile approximations in autoregressive 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]

