

UČNI NAČRT PREDMETA / COURSE SYLLABUS						
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 Matematika		ni smeri		3	drugi	
First cycle academic study programme Mathematics		none		3	second	
Vrsta predmeta / Course type				izbirni		
Univerzitetna koda predmeta / University course code:				M0249		
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. Janez Bernik, prof. Mihael Perman				
Jeziki / Languages:		Predavanja / Lectures: slovenski/Slovene				
		Vaje / Tutorial: slovenski/Slovene				
Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:				Prerequisites:		
Opravljen predmet Verjetnost.				Completed course Probability.		
Vsebina:				Content (Syllabus outline):		

<p>Slučajni procesi v diskretnem in zveznem času.</p> <p>Procesi štetja: homogeni Poissonovi procesi (definicija, lastnost medprijhodnih 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:

<p>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.</p>
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Objectives and competences:

<p>Introduction to the theory of stochastic processes in continuous time and the basic examples of stochastic processes such as Poisson processes, renewal processes, Markov</p>
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chains and Brownian motion.

Predvideni študijski rezultati:

<p>Znanje in razumevanje: Razumevanje soigre naključnosti in časa in usvojitve za to potrebnih matematičnih orodij.</p> <p>Uporaba: Osnova za modeliranje v mnogih vejah matematike in njene uporabe, še posebej na področju zavarovalništva in financ.</p> <p>Refleksija: Vsebina predmeta pomaga za nazaj poglobiti razumevanje konceptov verjetnosti in koncepta odvisnosti.</p> <p>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</p>
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Intended learning outcomes:

<p>Knowledge and understanding: Understanding of the interplay between randomness and time evolution and development of the necessary mathematical concepts and tools.</p> <p>Application: Stochastic processes form a foundation for various kinds of modelling, particularly in insurance and finance.</p> <p>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.</p> <p>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.</p>
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Metode poučevanja in učenja:

<p>Predavanja, vaje, domače naloge, konzultacije</p>
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Learning and teaching methods:

<p>Lectures, exercises, homework, consultations</p>

Načini ocenjevanja:

Delež (v %) /

Weight (in %)

Assessment:

<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt): 2 kolokvija namesto izpita iz vaj, izpit iz vaj, izpit iz teorije</p> <p>ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)</p>	<p>50% 50%</p>	<p>Type (examination, oral, coursework, project): 2 midterm exams instead of written exam, written exam 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:

Janez Bernik:

- 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]
- 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. 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]

Mihael Perman:

- HUŽAK, 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]
- 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]
- 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]