

UČNI NAČRT PREDMETA / COURSE SYLLABUS						
<b>Predmet:</b>		Slučajni procesi 2				
<b>Course title:</b>		Stochastic processes 2				
<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	
Magistrski študijski program Finančna matematika		ni smeri		1 ali 2	prvi ali drugi	
Master's study programme Financial Mathematics		none		1 or 2	first or second	
<b>Vrsta predmeta / Course type</b>				izbirni		
<b>Univerzitetna koda predmeta / University course code:</b>				M2520		
<b>Predavanja</b> Lectures	<b>Seminar</b> Seminar	<b>Vaje</b> Tutorial	<b>Klinične vaje</b> work	<b>Druge oblike študija</b>	<b>Samost. delo</b> Individ. work	<b>ECTS</b>
30	15	30			105	6
<b>Nosilec predmeta / Lecturer:</b>		prof. Janez Bernik, prof. Mihael Perman				
<b>Jeziki / Languages:</b>		<b>Predavanja / Lectures:</b> slovenski/Slovene, angleški/English				
		<b>Vaje / Tutorial:</b> slovenski/Slovene, angleški/English				
<b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b>				<b>Prerequisites:</b>		
<b>Vsebina:</b>				<b>Content (Syllabus outline):</b>		

<p><b>Brownovo gibanje:</b></p> <p>Osnovne lastnosti, obstoj, lastnosti trajektorij, naravna filtracija, čas prvega dotika, markovske lastnosti, krepka lastnost Markova, princip zrcaljenja, pridruženi procesi (proces tekočega supremuma, Brownov most itd.), kvadratična variacija.</p> <p>Martingali v zveznem času:</p> <p>Filtracije, časi ustavljanja, martingali, izreki o ostavljanju, enakomerna integrabilnost, maksimalne neenakosti, konvergenca martingalov.</p> <p>Stohastični integral:</p> <p>Stohastični integral glede na Brownovo gibanje, Itova izometrija, zvezni polmartingali, zvezni lokalni martingali, kvadratična variacija in kovariacija, stohastični integral glede na zvezne polmartingale, Itova formula, izrek Girsanova, izrek o reprezentaciji martingalov.</p>	<p><b>Brownian motion:</b></p> <p>Basic properties, existence, path properties, natural filtration, first hitting time, Markov properties, strong Markov property, reflection principle, associated processes (running supremum process, Brownian bridge etc.), quadratic variation.</p> <p>Continuous time martingales:</p> <p>Filtrations, stopping times, stopping theorems, uniform integrability, maximal inequalities, convergence of martingales.</p> <p>Stochastic integral:</p> <p>Stochastic integral wrt Brownian motion, Itô isometry, continuous semimartingales, local martingales, quadratic variation and covariation, stochastic integral wrt continuous semimartingales, Itô's formula, Girsanov Theorem, representation of martingales.</p>
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**Temeljni literatura in viri / Readings:**

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

I. Karatzas, S. E. Shreve: Brownian Motion and Stochastic Calculus, 2nd Edition, Springer, 2005.

M. Yor, D. Revuz: Continuous Martingales and Stochastic Calculus, 2nd Edition, Springer, 2004

J. M. Steele: Stochastic Calculus and Financial Applications, Springer, New York, 2001.

**Cilji in kompetence:**

Predmet predstavlja uvod v teorijo slučajnih procesov v zveznem času z zveznimi trajektorijami. Rigorozno obravnava Brownovo gibanje kot osnovni primer in gradnik, vpelje martingale v zveznem času, Itôv stohastični račun in Itovo formulo.

**Objectives and competences:**

This course is an introduction to the theory of stochastic processes in continuous time with continuous sample paths. It rigorously treats Brownian motion as a basic example and building block, introduces martingales in continuous time, stochastic calculus and Ito's

formula.

**Predvideni študijski rezultati:**

Znanje in razumevanje: Matematična orodja za strogo obravnavo in uporabo slučajnih procesov.  
Uporaba:

Osnova za modeliranje v mnogih vejah matematike in njene uporabe.

Refleksija:

Vsebina predmeta pomaga za nazaj poglobiti razumevanje konceptov verjetnosti, koncepta odvisnosti in časa.

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:  
Mathematical tools for rigorous treatment and applications of stochastic processes.

Application:

Basic tools for modelling in many branches of Mathematics and its applications.

Reflection:

The contents of the course help in retrospect to deepen the understanding of the concepts of probability, dependence and time.

Transferable skills:

The skills acquired are transferable to other areas of mathematical modelling, in particular it is immediately applicable to financial models.

**Metode poučevanja in učenja:**

predavanja, vaje, domače naloge, konzultacije

**Learning and teaching methods:**

Lectures, exercises, homeworks, consultations

<b>Načini ocenjevanja:</b>	<b>Weight (in %)</b>	<b>Assessment:</b>
<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt): pisni izpit</p> <p>Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)</p>	100%	<p>Type (examination, oral, coursework, project): written exam</p> <p>Grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)</p>

**Reference nosilca / Lecturer's references:**

Janez Bernik:

- BERNIK, Janez, MASTNAK, Mitja, RADJAVI, Heydar. Realizing irreducible semigroups and real algebras of compact operators. *Journal of mathematical analysis and applications*, ISSN 0022-247X. [Print ed.], 2008, vol. 348, no. 2, str. 692-707. [COBISS.SI-ID 14899289]
- 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]

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, 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]