UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Slučajni procesi 2
Course title:	Stochastic processes 2

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **Semester**
Magistrski študijski program Matematika	ni smeri	1 ali 2	prvi ali drugi
Master's study programme Mathematics	none	1 or 2	first or second

Vrsta predmeta / Course type	izbirni
Univerzitetna koda predmeta / University course code:	M2520

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Klinične vaje** **work**	**Druge oblike študija**	**Samost. delo** **Individ. work**	**ECTS**
30	**15**	**30**			**105**	**6**

Nosilec predmeta / Lecturer:	prof. Janez Bernik, 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):**

Brownovo gibanje: 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. Martingali v zveznem času: Filtracije, časi ustavljanja, martingali, izreki o ostavljanju, enakomerna integrabilnost, maksimalne neenakosti, konvergenca martingalov. Stohastični integral: 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.	Brownian motion: 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. Continuous time martingales: Filtrations, stopping times, stopping theorems, uniform integrability, maximal inequalities, convergence of martingales. Stochastic integral: 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.

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:	**Objectives and competences:**
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.	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:	**Intended learning outcomes:**
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.	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:	**Learning and teaching methods:**
predavanja, vaje, domače naloge, konzultacije	Lectures, exercises, homeworks, consultations

Delež (v %) /

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

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]