Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS								
Predmet:	**Verjetnost**							
Course title:	Probability							
Študijski program in stopnja Study programme and level		**Študijska smer Study field**				**Letnik Academic year**		**Semester Semester**
Matematika						**3.**		**5.**
Mathematics						**3rd**		**5th**
Vrsta predmeta / Course type					obvezni/compulsory			
Univerzitetna koda predmeta / University course code:								
Predavanja Lectures	**Seminar Seminar**	**Sem. vaje Tutorial**	**Lab. vaje Laboratory work**	**Teren. vaje Field work**	**Samost. delo Individ. work**			**ECTS**
60		**45**			**135**			**8**
Nosilec predmeta / Lecturer:	Dominik BENKOVIČ							
Jeziki / Languages:	**Predavanja / Lectures:**	SLOVENSKO/SLOVENE						
	Vaje / Tutorial:	SLOVENSKO/SLOVENE						

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Vsaka izmed naštetih obveznosti v načinih ocenjevanja mora biti opravljena s pozitivno oceno. Pozitivna ocena pri pisnem izpitu je pogoj za pristop k ustnemu izpitu.	Each of the mentioned commitments must be assessed with a passing grade. Passing grade of the written exam is required for taking the oral exam.
Vsebina:	**Content (Syllabus outline):**
• Osnovni pojmi verjetnosti: Poskus, dogodek in algebra dogodkov. Klasična, statistična, geometrijska in aksiomatična definicija verjetnosti. Osnovne lastnosti verjetnosti. • Pogojna verjetnost: Neodvisni dogodki. Relejni poskusi, formula za popolno verjetnost in Bayesova formula.	• Basic concepts of probability: experiment, event and sample space. The classical, statistical, geometrical and axiomatic definition of probability. Basic properties of probability. • Conditional probability: Independent events. The formula of total probability and the Bayes' rule.

• Zaporedja neodvisnih poskusov: Bernoullijevo zaporedje poskusov. Binomska porazdelitev. Limitni izreki: Poissonova formula, Laplaceova lokalna in integralska formula. Bernoullijev zakon velikih števil.	• Sequences of independent trials: Bernoulli trials. The binomial distribution. Limit theorems: Poisson's theorem, local and integral Laplace theorems. The Bernoulli's law of large numbers.
• Slučajne spremenljivke: Porazdelitvena funkcija in njene osnovne lastnosti. Diskretne in zvezne porazdelitve. Pomembne porazdelitve. Funkcije slučajnih spremenljivk.	• Random variables: The distribution function and its basic properties. Discrete and continuous distributions. Examples of most important distributions. Functions of random variables.
• Številske karakteristike slučajnih spremenljivk: Matematično upanje in disperzija. Višji momenti in vrstilne karakteristike.	• Numerical characteristics of random variables: Mathematical expectation and variance. Higher moments and order characteristics.
• Slučajni vektorji. Diskretni in zvezni slučajni vektorji. Neodvisnost slučajnih spremenljivk. Funkcije slučajnih vektorjev. Kovarianca in korelacijski koeficient.	• Random vectors: Discrete and continuous random vectors. Independence of random variables. Functions of random vectors. Covariance and correlation coefficient.
• Rodovne in karakteristične funkcije: Definicija in osnovne lastnosti rodovnih in karakterističnih funkcij.	• Generating and characteristic functions: Definition and elementary properties of generating and characteristic functions.
• Limitni izreki teorije verjetnosti: Zakon velikih števil. Centralni limitni izrek.	• Limit theorems of probability theory: Law of large numbers. The central limit theorem.
• Uvod v teorijo slučajnih procesov: Markovske verige. Klasifikacija stanj. Stacionarna porazdelitev. Primeri: slučajni sprehod, proces razvejanja, proces rojevanja, Poissonov proces.	• Introduction to random processes: Markov chains. Classification of states. Stationary distribution. Examples: random walk, branching process, birth process, Poisson process.

Temeljni literatura in viri / Readings:

1. D. Benkovič: Verjetnost, Univerza v Mariboru, Univerzitetna založba, Maribor 2022.
2. R. Jamnik: Verjetnostni račun in statistika, DMFA, Ljubljana 1995.

Dodatna literatura / Additional Readings:

3. R. Drnovšek, T. Košir, E. Kramar, G. Lešnjak: Zbirka rešenih nalog iz verjetnostnega računa, DMFA, Ljubljana 1998.
4. B. V. Gnedenko: The theory of probability, Mir Publishers, Moskva 1988.
5. G. Grimmett, D. Stirzaker: Probability and random processes, Oxford University Press, Oxford 2009.

6. M. Hladnik: Verjetnost in statistika, Fakulteta za računalništvo in informatiko, Ljubljana 2002.
7. J. Pitman: Probability, Springer-Verlag, New York [etc.] 1993.
8. D. Williams: Weighing the odds : a course in probability and statistics, Cambridge University Press, Cambridge 2004.

Cilji in kompetence:

Glavni cilj predmeta je proučiti najpomembnejše koncepte in rezultate teorije verjetnosti.

Objectives and competences:

The main goal of the course is to study the fundamental concepts and results of probability theory.

Predvideni študijski rezultati:

Znanje in razumevanje:

- Razumevanje verjetnosti in različnih pristopov k definiranju le-te ter osvojitev različnih tehnik računanja verjetnosti.
- Osvojiti najpreprostejši primer slučajnega procesa - homogene markovske verige.
- Razumevanje in poznavanje osnovnih rezultatov teorije verjetnosti, ki so povezani s slučajnimi spremenljivkami in vektorji.
- Poznavanje osnovnih rezultatov, ki so povezani z rodovnimi in karakterističnimi funkcijami ter limitnimi izreki.

Prenesljive/ključne spretnosti in drugi atributi:

- Uporaba znanja iz teorije verjetnosti pri statistiki in na drugih področjih uporabne matematike.

Intended learning outcomes:

Knowledge and Understanding:

- Understanding the notion of probability, different approaches to its definition, and techniques of calculating probability.
- Understanding of the simplest example of the random process – Markov chain.
- Understanding and knowledge of basic results of the probability theory which are related to random variables and vectors.
- Knowledge of basic results which are related to generating and characteristic functions and also to limit theorems.

Transferable/Key Skills and other attributes:

- Knowledge transfer of methods of probability theory into statistics and to other fields of applied mathematics.

Metode poučevanja in učenja:

- Predavanja
- Teoretične vaje

Learning and teaching methods:

- Lectures
- Theoretical exercises

Načini ocenjevanja:

Assessment:

	Delež (v %) / Weight (in %)	
Pisni izpit	50%	Written exam
Ustni izpit	50%	Oral exam

Opombe:

Pisni izpit se lahko nadomesti s kolokviji v enakem deležu 50%.

Comments:
Written exam can be replaced by written midterm examination in the weight of 50%.

Reference nosilca / Lecturer's references:

1. BENKOVIČ, Dominik, EREMITA, Daniel. Generalized derivations of current Lie algebras. *Communications in algebra*. 2024, vol. 52, iss. 11, str. 4603-4611. ISSN 0092-7872. https://www.tandfonline.com/doi/full/10.1080/00927872.2024.2354423, DOI: 10.1080/00927872.2024.2354423. [COBISS.SI-ID 200554755]

2. BENKOVIČ, Dominik. A note on generalized Jordan n-derivations of unital rings. *Indian Journal of pure and applied mathematics*. 2024, vol. 55, str. 623-627. ISSN 0019-5588. https://doi.org/10.1007/s13226-023-00394-2, DOI: 10.1007/s13226-023-00394-2. [COBISS.SI-ID 224333827]

3. BENKOVIČ, Dominik. Lie σ-derivations of triangular algebras. *Linear and Multilinear Algebra*. 2022, vol. 70, iss. 15, str. 2966-2983. ISSN 0308-1087. https://www.tandfonline.com/doi/full/10.1080/03081087.2020.1820431, DOI: 10.1080/03081087.2020.1820431. [COBISS.SI-ID 127110659], [JCR]

4. BENKOVIČ, Dominik, GRAŠIČ, Mateja. Jordan {g,h}-derivations of unital algebras. *Operators and matrices*. 2022, vol. 16, no. 2, str. 415-428. ISSN 1846-3886. http://oam.ele-math.com/16-32/Jordan-g,h-derivations-of-unital-algebras, DOI: 10.7153/oam-2022-16-32. [COBISS.SI-ID 114972163], [JCR]

5. BENKOVIČ, Dominik. Generalized Lie n-derivations of triangular algebras. *Communications in algebra*. 2019, vol. 47, iss. 12, str. 5294-5302. ISSN 0092-7872. https://doi.org/10.1080/00927872.2019.1617875, DOI: 10.1080/00927872.2019.1617875. [COBISS.SI-ID 18879833], [JCR]