| UČNI NAČRT PREDMETA / COURSE SYLLABUS | |
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| **Predmet:** | Napredna statistika |
| **Course title:** | Advanced statistics |

| Študijski program in stopnja<br>Study programme and level | Študijska smer<br>Study field | Letnik<br>Academic year | Semester<br>Semester |
|---|---|---|---|
| Računalništvo in spletne tehnologije, magistrski študijski program druge stopnje | - | Prvi | Prvi |
| Computer science and web technologies, second cycle Masters Study Programme | - | First | First |

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| **Vrsta predmeta / Course type** | Obvezni / Obligatory |
| **Univerzitetna koda predmeta / University course code:** | 2-RST-MAG-NS-2024-02-05 |

| Predavanja<br>Lectures | Seminar<br>Seminar | Vaje<br>Tutorial | Klinične vaje<br>work | Druge oblike študija | Samost. delo<br>Individ. work | ECTS |
|---|---|---|---|---|---|---|
| 30 | - | 35 | - | - | 145 | 7 |

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| **Nosilec predmeta / Lecturer:** | doc. dr. Nuša Erman |

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| **Jeziki / Languages:** | **Predavanja / Lectures:** | Slovenski, angleški / Slovene, English |
| | **Vaje / Tutorial:** | Slovenski, angleški / Slovene, English |

| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | **Prerequisits:** |
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| Poznavanje osnov statistike.<br><br>Študent/študentka mora pred pristopom k izpitu pripraviti in zagovarjati seminarsko nalogo. | Knowledge of basic statistics.<br><br>Prior to the exam, the student has to prepare and present seminar work. |

| **Vsebina:** | **Content (Syllabus outline):** |
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| Teorije verjetnosti in klasična statistika:<br>• klasična in statistična definicija verjetnosti,<br>• pravila verjetnosti,<br>• slučajne spremenljivke in njihove verjetnostne porazdelitve (binomska, Poissonova, normalna, multivariatna normalna, *t* in multivariatna *t* porazdelitve). | Probability theory and classical statistics:<br>• classical and statistical definition of probability,<br>• rules of probability,<br>• random variables and their probability distributions (binomial, Poisson, normal, multivariate normal, *t* and multivariate *t* distributions). |

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| Uvod v klasično sklepno statistiko:<br>• vzorčenje,<br>• ocenjevanje parametrov,<br>• preizkušanje statističnih domnev,<br>• metoda največjega verjetja.<br><br>Osnove Baysove statistike:<br>• Bayesov izrek za točkovne verjetnosti,<br>• Bayesov teorem v verjetnostnih porazdelitvah.<br><br>Bayesovsko sklepanje:<br>• posteriorno povprečje,<br>• ostale Bayesove točkovne ocene,<br>• Bayesovi posteriorni intervali,<br>• uporaba posteriornih porazdelitev za testiranje statističnih domnev.<br><br>Statistično modeliranje:<br>• linearni regresijski modeli, posplošeni linearni modeli in hierarhični modeli,<br>• klasično proti Bayesovskemu ocenjevanju parametrov modelov,<br>• ocenjevanje prileganja modelov podatkom.<br><br>Uporaba sodobnih računalniških programov za napredno statistično analizo. | Introduction to classical statistical inference:<br>• sampling,<br>• parameter estimation,<br>• hypothesis testing,<br>• maximum likelihood estimation.<br><br>Basics of Bayesian statistics:<br>• Bayes' theorem for point probabilities,<br>• Bayes' theorem applied to probability distributions.<br><br>Bayesian inference:<br>• the posterior mean,<br>• other Bayesian point estimates,<br>• Bayesian posterior intervals,<br>• using the posterior distribution to test hypotheses.<br><br>Statistical modelling:<br>• linear regression models, generalized linear models and hierarchical models,<br>• classic vs. Bayesian parameter estimation,<br>• evaluating model fit.<br><br>Application of state-of-the-art software for applied statistical analysis. |

**Temeljni literatura in viri / Readings:**


- Johnson, R. A., Wichern, D. W. (2018): *Applied Multivariate Statistical Analysis, 6th edition*. Pearson International Edition.
- Gareth, J., Witten, D., Hastie, R., R. Tibshirani (2021). *An Introduction to Statistical Learning with Applications in R, 2nd edition*. New York: Springer.
- Johnson, A.A., Ott, M.Q., Dogucu, M. (2022). *Bayes Rules!: An Introduction to Applied Bayesian Modeling*. Boca Raton: CRC Press.
- Cowles, M.K. (2013): *Applied Bayesian Statistics*. New York: Springer.


| **Cilji in kompetence:** | **Objectives and competences:** |
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| *Učna enota prispeva k razvoju naslednjih splošnih in predmetno specifičnih kompetenc:*<br><br>• poznavanje pomena kakovosti in prizadevanje za kakovost strokovnega dela skozi avtonomnost, samoiniciativnost, (samo)kritičnost, | *The instructional unit contributes to the development of the following general and subject-specific competences:*<br><br>• familiarity with the importance of quality, striving to maintain the quality of professional work through practicing autonomous behaviour, showing |

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| (samo)refleksivnost in (samo)evalviranje v strokovnem delu<br>• sposobnost fleksibilne uporabe znanja v praksi<br>• sposobnost pridobivanja, selekcije, ocenjevanja in umeščanja novih informacij in zmožnost interpretacije raziskovalnega problema;<br>• uporaba metodoloških orodij – izvajanje, koordiniranje in organiziranje raziskav, uporaba raznih raziskovalnih metod in tehnik<br><br>• poznavanje osnovnih in naprednih metod analize podatkov in poizvedovanja v podatkih<br>• obvladanje raziskovalnih metod, postopkov in procesov<br>• sposobnost izvedbe kvantitativne raziskave in analize podatkov z uporabo ustreznih statističnih metod in modelov s pomočjo primerne programske opreme | initiative, as well as through (self-)criticism, (self-)reflection and (self-)evaluation<br>• ability to use the acquired knowledge in practice in a flexible manner<br>• the ability to obtain, select, evaluate and place new information and the ability to interpret the research problem;<br>• use of methodological tools, i.e. implementation, coordination and organization of research, use of various research methods and techniques<br><br>• familiarity with the basic and applied data analysis and data inquiry methods<br>• competence in research methods, procedures and processes<br>• ability to perform quantitative research and data analysis using appropriate statistical methods and models and suitable software |

| **Predvideni študijski rezultati:** | **Intended learning outcomes:** |
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| Znanje in razumevanje:<br><br>*Sposobnost študenta/študentke bo:*<br>• v povezavi z drugimi predmeti bo poznal in razumel relevantna poglavja iz družboslovnega raziskovanja, podatkovnih baz in podatkovne analitike.<br>• sposoben zavzeti stališče do ključnih etičnih vprašanj v raziskovalnem procesu in kritično vrednotiti konkreten primer<br>• poznal in bil sposoben uporabiti izbrane metode in tehnike kvantitativnega raziskovanja na višjem nivoju<br>• sposoben uporabe osnovne programske opreme za kvantitativno analizo<br>• sposoben pripraviti in izvesti načrt kvantitativne raziskave: raziskovalno vprašanje, hipoteze, načrt zbiranja in obdelave podatkov, zbiranje in obdelava podatkov, diskusija o rezultatih<br>• sposoben refleksije in kritičnega vrednotenja primernosti določene | Knowledge and understanding:<br><br>The ability of the student:<br>• to realise and understand the relevant chapters from the research in social science, data bases and data analytics.<br>• to take a position on key ethical issues in the research process and to be critical in evaluating concrete examples;<br>• to apply methods and techniques of quantitative research on higher level;<br>• to use of basic software for quantitative analysis;<br>• to prepare and implement a quantitative research plan: research questions, hypotheses, data collection and processing plan, collection and processing of data, discussion about the results;<br>• reflection and critical evaluation of the appropriateness of certain research methods for the analysis of concrete problems |

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| raziskovalne metode za analizo konkretnega problema | |

| **Metode poučevanja in učenja:** | **Learning and teaching methods:** |
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| • *predavanja* z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri, reševanje problemov)<br>• *vaje*, kjer študentje na enostavnih primerih ponovijo temeljne koncepte in metode, predstavljene na predavanjih<br>• *laboratorijske vaje*, kjer se študenti seznanijo s programskimi orodji za zbiranje in analiziranje podatkov | • *lectures* with active students participation (explanations, discussion, questions, examples, problem solving);<br>• *tutorials* (students will recall, reinforce, and shed light on the concepts and methods taught on lectures);<br>• *lab work* (students will learn state of the art software for data collection and analysis. |

| **Načini ocenjevanja:** | Delež (v %) / Weight (in %) | **Assessment:** |
|---|---|---|
| Način:<br><br>• pisni izpit<br>• seminarska naloga | <br><br>60 %<br>40 % | Type:<br><br>• written exam<br>• seminar |

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

- ROJKO, Katarina, ERMAN, Nuša. The Impact of the Covid-19 Pandemic on Higher Education Students' Perceptions of Educational Applications and Platforms. International Journal of Cognitive Research in Science, Engineering and Education. 2023, vol. 11, no. 2, str. 267-279,
- ERMAN, Nuša, ROJKO, Katarina, LESJAK, Dušan. Traditional and new ICT spending and its impact on economy. Journal of computer information systems. 2022, vol. 62, iss. 2, str. 384-396,
- ROJKO, Katarina, LESJAK, Dušan, ERMAN, Nuša. The COVID-19 Pandemic Crisis : impact on ICT spending. Journal of computer information systems. 2022, vol. , iss. , str. 1-16,
- ROJKO, Katarina, ERMAN, Nuša, JELOVAC, Dejan. Impacts of the transformation to industry 4.0 in the manufacturing sector : the case of the U.S. Organizacija : revija za management, informatiko in kadre. [Tiskana izd.]. Nov. 2020, vol. 53, no. 4, str. 287-305, ilustr. ISSN 1318-5454. http://organizacija.fov.uni-mb.si/index.php/organizacija/article/view/1387, http://www.dlib.si/details/URN:NBN:SI:doc-OYOUO2A9, DOI: 10.2478/orga-2020-0019.

- ERMAN, Nuša. Prospects for innovation performance on European level. Research in social change. Sep. 2020, vol. 12, iss. 3, str. 100-114,