UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SODOBNE STATISTIČNE METODE V NARAVOSLOVJU
Course title:	MODERN STATISTICAL METHODS IN THE NATURAL SCIENCES

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **Semester**
Varstvo okolja in ekotehnologije, 2. stopnja	/	2.	/
Environmental Protection and Eco-technologies, 2nd level	/	2nd	/

Vrsta predmeta / Course type Obvezni predmet / Obligatory course

Univerzitetna koda predmeta / University course code: SSMN

Predavanja **Lectures**	**Sem. vaje** **Tutorial**	**Lab. vaje** **Laboratory work**	**Teren. vaje** **Field work**	**Samost. delo** **Individ. work**	**ECTS**
30	10	20		120	**6**

Nosilec predmeta / Lecturer: prof. dr. Kristijan Breznik

Jeziki / Languages:	**Predavanja / Lectures:**	Slovenski / Slovenian
	Vaje / Tutorial:	Slovenski / Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Pogojev ni.	No formal prerequisites.

Vsebina:

Predmet obravnava temeljne in naprednejše statistične pristope za analizo podatkov v naravoslovju, s poudarkom na razumevanju statističnih konceptov, pravilni izbiri metod in interpretaciji rezultatov v znanstvenem kontekstu. Študenti se seznanijo z verjetnostnimi modeli, statističnim sklepanjem, regresijskimi in multivariatnimi metodami ter s specifičnimi statističnimi pristopi, ki se pogosto uporabljajo v naravoslovnih in naravovarstvenih raziskavah. Poseben poudarek je namenjen praktični obdelavi, analizi in vizualizaciji realnih podatkov z uporabo sodobnih statističnih orodij.

Poglavitne teme:

- **Statistične spremenljivke**
- **Verjetnostne porazdelitve**
- **Testiranje hipotez in statistični testi**
- **Obdelava podatkov s pomočjo statističnih orodij**
- **Enostavni regresijski modeli**
- **Regresijski modeli več spremenljivk**

Content (Syllabus outline):

The course covers fundamental and advanced statistical approaches for data analysis in the natural sciences, with an emphasis on understanding statistical concepts, the appropriate selection of methods, and the interpretation of results in a scientific context. Students are introduced to probabilistic models, statistical inference, regression and multivariate methods, as well as specific statistical approaches commonly used in natural science and conservation research. Particular emphasis is placed on the practical processing, analysis, and visualization of real-world data using modern statistical tools.

Main topics:

- **Statistical variables**
- **Probability distributions**
- **Hypothesis testing and statistical tests**
- **Data processing using statistical software**
- **Simple regression models**
- **Multiple regression models**
- **Methods of multivariate statistical analysis**

• **Metode multivariatne statistične analize** • **Specifične statistične metode v naravoslovju** • **Vizualizacija podatkov**	• **Specific statistical methods in the natural sciences** • **Data visualization**

Temeljna literatura in viri / Textbooks:

Obvezna / Required:

1. Zar, J.H. (2010) Biostatistical Analysis. 5th Edition, Prentice-Hall/Pearson, Upper Saddle River.
2. Wickham, H., Çetinkaya-Rundel, M., Grolemund, G. (2023). R for Data Science (2e). Spletni vir: https://r4ds.hadley.nz/

Priporočena / Recommended:

1. Diez, D., Cetinkaya-Rundel, M., Barr, C. D. (2019). OpenIntro Statistics. 4th Edition. OpenIntro. https://www.openintro.org/book/os/
2. Košmelj K., (2007). Uporabna statistika. Biotehniška fakulteta UL.
3. Venables, W. N., Smith, D. M. and the R Core Team (2025). An Introduction to R. Spletni vir: https://cran.r-project.org/doc/manuals/R-intro.pdf

Cilji in kompetence:

Predmetno specifični cilji in kompetence:

Namen predmeta je seznaniti študente s temeljnimi statističnimi vsebinami brez poglobljenih teoretičnih poudarkov. Predstavljen bo širok spekter naravoslovnih in naravovarstvenih problemov, ki jih lahko rešujemo s pomočjo ustreznih statističnih metod.

Splošne kompetence:

- sposobnost analitičnega in kritičnega mišljenja pri obravnavi kompleksnih naravoslovnih problemov;
- zmožnost samostojnega zbiranja, obdelave in analize podatkov ter utemeljene izbire ustreznih statističnih metod;
- sposobnost interpretacije in vrednotenja statističnih rezultatov v znanstvenem in strokovnem kontekstu;
- usposobljenost za uporabo sodobnih statističnih in računalniških orodij za analizo in vizualizacijo podatkov;
- sposobnost jasnega pisnega in ustnega komuniciranja kvantitativnih analiz ter rezultatov;
- zmožnost kritičnega branja in presojanja znanstvene literature z vidika pravilne rabe statističnih metod.

Objectives and competences:

Specific competences:

The aim of the course is to introduce students to fundamental statistical concepts without an in-depth theoretical emphasis. A wide range of natural science and conservation-related problems that can be addressed using appropriate statistical methods will be presented.

General competences:

- the ability to apply analytical and critical thinking when addressing complex problems in the natural sciences;
- the ability to independently collect, process, and analyse data and to justify the selection of appropriate statistical methods;
- the ability to interpret and evaluate statistical results in scientific and professional contexts;
- proficiency in the use of modern statistical and computational tools for data analysis and visualisation;
- the ability to communicate quantitative analyses and results clearly in both written and oral form;
- the ability to critically read and assess scientific literature with regard to the appropriate use of statistical methods.

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:

Študent bo ob zaključku predmeta sposoben:

- razumeti temeljne in naprednejše statistične koncepte ter njihovo vlogo pri analizi naravoslovnih podatkov;
- pojasniti lastnosti in uporabo verjetnostnih porazdelitev ter metod statističnega sklepanja;
- razložiti strukturo in predpostavke enostavnih in večspremenljivskih regresijskih modelov ter specifičnih statističnih metod v naravoslovju;
- interpretirati rezultate statističnih analiz v povezavi z naravoslovnimi procesi in omejitvami uporabljenih metod;
- razumeti pomen pravilne vizualizacije podatkov za analizo in predstavitev znanstvenih rezultatov.

Prenosljive/ključne spretnosti in drugi atributi:

- samostojno analiziranje realnih podatkov z uporabo ustreznih statističnih in računalniških orodij;
- kritično ovrednotenje rezultatov statističnih analiz ter njihovo veljavnost in zanesljivost;
- jasno pisno in ustno predstavljanje in interpretiranje statističnih analiz in rezultatov različnim strokovnim ciljnim skupinam;
- uporabljanje statističnih metod v podporo znanstvenemu odločanju in reševanju kompleksnih problemov.

Knowledge and understanding:

At the end of the course, student will be able:

- understand fundamental and advanced statistical concepts and their role in the analysis of natural science data;
- explain the properties and applications of probability distributions and methods of statistical inference;
- explain the structure and assumptions of simple and multiple regression models as well as specific statistical methods used in the natural sciences;
- interpret the results of statistical analyses in relation to natural processes and the limitations of the applied methods;
- understand the importance of appropriate data visualisation for the analysis and presentation of scientific results.

Transferable/key skills and other attributes:

- independently analyse real-world data using appropriate statistical and computational tools;
- critically evaluate the results of statistical analyses, including their validity and reliability;
- clearly present and interpret statistical analyses and results in both written and oral form for different professional audiences;
- apply statistical methods in support of scientific decision-making and the solving of complex problems.

Metode poučevanja in učenja:

Oblike dela:

- predavanja;
- seminarske vaje; z predstavitvijo in obravnavo konkretnih primerov iz naravoslovja;
- računalniške vaje, usmerjene v praktično obdelavo in analizo podatkov z uporabo statističnih orodij;
- samostojno študijsko delo študentov z uporabo priporočene literature in podatkovnih virov;
- sprotne konzultacije z nosilcem predmeta.

Metode dela:

- frontalna/razlagalna metoda z uporabo primerov iz naravoslovnih raziskav;
- problemsko usmerjeno učenje in reševanje praktičnih statističnih problemov;

Learning and teaching methods:

Forms of teaching:

- lectures;
- seminar classes, including the presentation and discussion of concrete examples from the natural sciences;
- computer-based practicals focused on the practical processing and analysis of data using statistical software;
- independent student work based on the use of recommended literature and data sources;
- ongoing consultations with the course instructor.

Teaching methods:

- frontal / expository teaching method supported by examples from natural science research;

• študija primera (case study) na podlagi realnih raziskovalnih podatkov; • uporaba informacijsko-komunikacijskih tehnologij in statistične programske opreme; • diskusija in kritična analiza znanstvenih člankov.	• problem-based learning and the solving of practical statistical problems; • case study method based on real research data; • use of information and communication technologies and statistical software; • discussion and critical analysis of scientific articles.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pogoj za pristop k izpitu: opravljene sprotne obveznosti v obliki oddanih nalog Končna ocena pri predmetu je sestavljena iz ocen sprotnih nalog in pisnega ali ustnega izpita. Ocenjevalna lestvica: ▪ zadostno 6: 60–67 % ▪ dobro 7: 68–75 % ▪ prav dobro 8: 76–83 % ▪ prav dobro 9: 84–90 % ▪ odlično 10: 91–100 %		A prerequisite for access to the exam: … Final evaluation consists of … Grading scale: ▪ Sufficient D (6): 60–67% ▪ Good C (7): 68–75% ▪ Very good B (8): 76–83% ▪ Very good B+ (9): 84–90% ▪ Excellent A (10): 91–100%

Materialni pogoji za izvedbo predmeta :	**Material conditions for subject realization:**
• dostop do ustrezne računalniške opreme; • namestitev in vzdrževanje statistične programske opreme; • dostop do ustreznih podatkovnih zbirk; • dostop do knjižničnih virov in elektronskih baz.	• access to adequate computer equipment; • installation and maintenance of statistical software; • access to appropriate data sets; • access to library resources and electronic databases.

Obveznosti študentov:		**Student's commitments:**	
Sprotne naloge	30 %	Continuous assessment tasks:	30%
Predstavitev nalog na seminarju	20 %	Presentation of assignments in seminar classes:	20%
Pisni ali ustni izpit	50%	Written or oral examination:	50%

Reference nosilca predmeta:	**Lecturer's references:**
Pedagoško delo: • Nosilec in izvajalec predmeta *Advanced research methods in Social Science* na študije tretje stopnje, MFDPŠ, Celje; • Nosilec in izvajalec predmeta *Kvantitativne raziskovalne metode v družboslovju* na študiju druge stopnje, MFDPŠ, Celje; • Nosilec in izvajalec predmeta *Aplikativna statistika in podatkovna analitika* na študiju druge stopnje, FTPO, Slovenj Gradec; • Mentor eni doktorski in preko kot 50 magistrskih nalog;	**Pedagogic activities:** • Course coordinator and instructor of Advanced Research Methods in Social Science at the third-cycle (doctoral) programme, ISSBS, Celje; • Course coordinator and instructor of Quantitative Research Methods in the Social Sciences at the second-cycle (master's) programme, ISSBS, Celje; • Course coordinator and instructor of Applied Statistics and Data Analytics at the second-cycle (master's) programme, FTPO, Slovenj Gradec; • Supervisor of one doctoral dissertation and more than 50 master's theses;

- Vodenje oz. sodelovanje v komisijah za zagovor doktorskih disertacij v Sloveniji in tujini.

Znanstveno-raziskovalno delo:

- Vodenje oz. sodelovanje v številnih znanstveno raziskovalnih projektih;
- Član uredniškega odbora znanstvenih WoS/Scopus indeksiranih revij:
  - International journal of innovation and learning,
  - International journal of management and enterprise development,
  - International journal of management in education,
  - International journal of value chain management,
  - World transactions on engineering and technology education.
- Recenzent v več kot 20 mednarodnih indeksiranih revijah.

Strokovno delo in izbrane strokovne publikacije:

- Vpisan v register strokovnjakov NAKVIS-a;
- Član organizacijskih odborov mednarodnih konferenc;
- V preteklosti predsednik državne komisije za tekmovanje iz matematike;
- Zunanji ocenjevalec matematike na maturi.

Priznanja in nagrade:

- …

- Chairing and/or participation in doctoral dissertation defence committees in Slovenia and abroad.

Scientific and research work:

- Leadership of and/or participation in numerous scientific research projects;
- Member of the editorial boards of WoS/Scopus-indexed scientific journals:
  - International Journal of Innovation and Learning,
  - International Journal of Management and Enterprise Development,
  - International Journal of Management in Education,
  - International Journal of Value Chain Management,
  - World Transactions on Engineering and Technology Education;
- Reviewer for more than 20 international indexed scientific journals.

Professional work and selected professional publications:

- Registered in the NAKVIS register of experts;
- Member of the organising committees of international conferences;
- Former Chair of the national commission for mathematics competitions;
- External evaluator of mathematics in the national secondary school leaving examination (Matura)

Awards:

- …

Izbrani znanstveni članki / Selected scientific papers:

NUORTIMO, Kalle, HÄRKÖNEN, Janne, BREZNIK, Kristijan. Waste management–related trust, acceptance, and reputation : a multidisciplinary big data analysis across knowledge domains. Technological forecasting and social change. [Print ed.]. Apr. 2026, vol. 225, article no. 124553, 24 str., ilustr. ISSN 0040-1625. https://www.sciencedirect.com/science/article/pii/S0040162526000302, DOI: 10.1016/j.techfore.2026.124553. [COBISS.SI-ID 267088643]

AL SAYEGH PETKOVŠEK, Samar, KOTNIK, Klemen, BREZNIK, Kristijan, POKORNY, Boštjan. Wildlife mortality on the Slovenian highways: monthly patterns, identification of hotspots and effectiveness of acoustic deterrents. Urban ecosystems. 2025, vol. 28, iss. 1, [article no.] 57, 12 str., ilustr. ISSN 1083-8155. https://link.springer.com/article/10.1007/s11252-024-01616-z, DOI: 10.1007/s11252-024-01616-z . [COBISS.SI-ID 214762755]

NUORTIMO, Kalle, BREZNIK, Kristijan, HÄRKÖNEN, Janne. Global, regional, and local acceptance of solar power. Renewable and sustainable energy reviews. [Online ed.]. Apr. 2024, vol. 193, [article no.] 114296, str. 1-12, ilustr. ISSN 1879-0690. https://www.sciencedirect.com/science/article/pii/S1364032124000194?fr=RR-2&ref=pdf_download&rr=849979bb3eefc21e, DOI: 10.1016/j.rser.2024.114296. [COBISS.SI-ID 186000131]

BREZNIK, Kristijan, RESTAINO, Marialuisa, VITALE, Maria Prosperina, RAGOZINI, Giancarlo. Analyzing countries' performances within the international student mobility program over time. Annals of operations research. 17. Jun 2023, str. 1-19, ilustr. ISSN 0254-5330. https://link.springer.com/article/10.1007/s10479-023-05436-w#article-info, DOI: 10.1007/s10479-023-05436-w. [COBISS.SI-ID 158743299]

ŠPEH, Natalija, LONČARIĆ, Robert, BREZNIK, Kristijan, SURIĆ, Maša. Burden of the Coastal Area with Solid Waste in Kornati National Park (Croatia). V: KREVS, Marko (ur.). Hidden geographies. Cham: Springer Nature, cop. 2021. Str. 153-170, ilustr., zvd. Key challenges in geography. ISBN 978-3-030-74589-9. ISSN 2522-8420. DOI: 10.1007/978-3-030-74590-5_7. [COBISS.SI-ID 85836803]