UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Izbrana poglavja znanstvene metodologije
Course title:	Selected topics from Scientific Methodology

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Informacijska družba, doktorski študijski program tretje stopnje	-	Prvi	Prvi
Information Society, third cycle Doctoral Study Programme	-	First	First

Vrsta predmeta / Course type	Obvezni/ Compulsory
Univerzitetna koda predmeta / University course code:	1-ID-DR-IPZM-2021-01-20

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30	0	0	/	/	420	15

Nosilec predmeta / Lecturer:	prof. dr. Borut Rončević, prof. dr. Matej Makarovič, izr. prof. dr. Zoran Levnajić, izr. prof. dr. Biljana Mileva Boshkoska, izr. prof. dr. Blaž Rodič

Jeziki / Languages:	**Predavanja / Lectures:**	Slovenski / Slovenian, Angleški / English
	Vaje / Tutorial:	Slovenski / Slovenian, Angleški / English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Vpis v prvi letnik študija.	Enrolment in the first year of studies.

Vsebina:	**Content (Syllabus outline):**
Cilj predmeta je dati študentom metodološke osnove za izdelavo doktorske naloge. V sklopu predmeta bodo študentje spoznali nabor kvantitativnih in kvalitativnih raziskovalnih metod, s katerimi bodo suvereno začeli z doktorsko raziskavo. **KVALITATIVNA IN PRIMERJALNA METODOLOGIJA** • Uporaba kvalitativne in primerjalne metodologije pri proučevanju informacijske družbe in za potrebe	The aim of the course is to endow the students with the methodological basis for preparation of their doctoral thesis. Within the course students will learn a number of quantitative and qualitative research methods, which will enable them to confidently start their doctoral research. **QUALITATIVE AND COMPARATIVE RESEARCH METHODS** • Using qualitative and comparative methodology in research on information society and in the computer science (specific

računalniških znanosti (konkretni primeri in pogovor s študenti)
- Pregled izbranih kvalitativnih metod: terensko raziskovanje, kvalitativni intervjuji, fokusne skupine, analiza dokumentov
- Primerjalno raziskovanje: študije primerov, primerjalne študije primerov, analiza mehkih množic (fuzzy-set analiza), metodološki problemi v mednarodnem primerjalnem raziskovanju
- Metode triangulacije: interpretativna in pozitivistična paradigma, post-pozitivizem kot nova epistemološka sinteza, kombiniranje kvalitativnih in kvantitativnih metod
- Programska oprema za kvalitativno analizo

OSNOVNI STATISTIČNI KONCEPTI IN DESKRIPTIVNE STATISTIKE
- Izbrane teme iz inferenčne in bivariatne statistike (t test, bivariatna analiza variance, hi-kvadrat, Kenallov tao-b in gamma, korelacija intervalnih spremenljivk)
- Uvod v izbrane multivariatne metode (faktorska analiza, hierarhična klaster analiza, regresija)

UVOD V ANALIZO OMREŽIJ
- Omrežja in zakaj in preučujemo, prednosti omrežne predstavitve podatkov
- Družbena, informacijska, tehnološka in biološka omrežja
- Osnovni koncepti teorije grafov, pojam analize omrežij, standardna orodje analize omrežij
- Modeliranje realnih omrežij, osnovni modeli omrežij
- Sktruktura skupnosti, dinamični procesi
- Odprti problemi v sodobni znanosti omrežij

SODOBNE METODE ANALIZE PODATKOV

examples and discussion with students)
- Overview of selected qualitative methods: field research, qualitative interviews, focus groups, documentary analysis
- Comparative research: case studies, comparative case studies, fuzzy-set analysis, methodological problems in international comparative research
- Triangulation: interpretive and positivist paradigm, post-positivism as a new epistemological synthesis, combining qualitative and quantitative methods
- Software for qualitative analysis

BASIC STATISTICAL CONCEPTS AND DESCRIPTIVE STATISTICS
- Selected topics from inferential and bivariate statistics (t test, bivariate analysis of variance, chi-square test, Kendall tao-b and gamma, correlation of interval variables)
- Introduction to selected multivariate methods (factor analysis, hierarchical cluster analysis, regression)

INTRODUCTION TO NETWORK ANALYSIS
- Networks and why we study them, benefits of representing data as networks
- Social, information, technological and biological networks
- Basic graph theory concepts, idea of analyzing a network, standard tools for network analysis
- Modeling real networks, fundamental network models
- Community structure, dynamical processes
- Open problems in modern network science

MODERN METHODS OF DATA ANALYSIS
- Data mining and other methods for data analysis
- A standardized data mining procedure
- Tasks of data mining

- Podatkovno rudarjenje in druge metode za analizo podatkov
- Standardiziran proces prodatkovnega rudarjenja
- Vrste problemov in nalog primernih za reševanje s podatkovnim rudarjenjem
- Pregled najpomembnejših metod za podatkovno rudarjenje: odločitvena in regresijska drevesa, metoda podpornih vektorjev, Bayesovske metode, nevronske mreže
- Odločanje in modeli

OSNOVE AGENTNEGA MODELIRANJA

- Uvod v modeliranje z agenti (MA), kdaj in zakaj uporabljati MA
- Pregled MA orodij, Izbira teme MA projekta, Arhitekture agentnih modelov, izbira arhitekture za izbrani MA projekt
- Delavnica z izbranimi MA orodji, implementacija enostavnega modela
- Verifikacija in validacija modela
- Analiza in predstavitev rezultatov, izvajanje simulacije in analiza modela in rezultatov simulacije

- An overview of data mining methods: decision and regression trees, support vector machines, Bayesian methods, neural networks
- Decision making and decision support methods and modeling

BASICS OF AGENET BASED MODELLING

- Introduction to agent based modelling (ABM), when and why to use ABM
- Overview of ABM tools, Choosing the ABM project theme, Architectures of agent-based models, selection of architecture for the selected ABM project
- Workshop with selected tools,implementation of a simple model
- Verification and validation of the model
- Analysis and presentation of results, implementation of simulation and analysis of the model and simulation results

Temeljni literatura in viri / Readings:

- RAJARAMAN, ANAND in ULLMAN, JEFFREY DAVID (2012) *Mining of massive datasets*. New York: Cambridge university press.
- HÄRDLE, WOLFGANG KARL in SIMAR, LÉOPOLD (2015) *Applied Multivariate Statistical Analysis. Fourth Edition*. Heidelberg: Springer.
- HASTIE TREVOR, TIBSHIRANI ROBERT IN FRIEDMAN JEROME (2009) *The elements of statistical learning: Data Mining, Inference, and Prediction*. New York: Springer.
- PATTON MICHAEL QUINN (2015) *Qualitative Research & Evaluation Methods: Integrating Theory and Practice.* London: SAGE.
- RAGIN C. CHARLES (2008): *Redesigning Social Inquiry: Fuzzy-sets and Beyond.* Chicago: Chicago University Press.
- TASHAKKORI ABBAS IN TEDDLIE CHARLES (1998) *Mixed Methodology, Combining Qualitative and Quantitative Approaches*. Sage Publications, 1998.
- CRESWELL JOHN W. (2014) *A Concise Introduction to Mixed Methods Research*. SAGE, 2014.
- Railsback, S.F., Grimm V. (2011) Agent-Based and Individual-Based Modeling: A Practical Introduction, Princeton University Press.
- Gilbert, N. (2007), Agent-Based Models (Quantitative Applications in the Social Sciences), SAGE Publications.

- Grigoryev, I. (2014) AnyLogic 7 in Three Days: A Quick Course in Simulation Modeling, AnyLogic North America.
- Newman, M. (2010) Networks: An Introduction, Oxford University Press

Cilji in kompetence:

Učna enota prispeva k razvoju naslednjih splošnih in predmetno-specifičnih kompetenc:

- sposobnost identificiranja danega raziskovalnega problema, njegove analize ter možnih rešitev
- ustvarjanje novega znanja in prispevek k razvoju znanosti
- sposobnost obvladanja standardnih metod, postopkov in procesov raziskovalnega dela na različnih znanstvenih področjih
- sposobnost samostojnega raziskovalno-razvojnega dela in vodenje raziskovalne skupine
- sposobnost za reševanje konkretnih raziskovalnih problemov na posameznih področjih družbenih in ostalih ved
- razvoj veščin in spretnosti v uporabi znanja na raziskovalnem področju doktorske disertacije
- sposobnost inovativne uporabe in kombiniranja raznih raziskovalnih metod

Objectives and competences:

Learning unit contributes to the development of the following general and subject-specific competences:

- the ability to identify, analyze and construct solution a given research problem
- creation of new knowledge and contribution to the development of science
- mastery of standard methods and approaches in the process of scientific research in various scientific fields
- ability of independent research and development work and management of research group
- skills and abilities for solving concrete research problems in various fields of social and other sciences
- development of skills and abilities in usage of knowledge in doctoral research
- ability of innovative combined usage of various research methodologies

Predvideni študijski rezultati:

Znanje in razumevanje:

Študent/študentka:

- obvlada ključne raziskovalne metode, ki so potrebne za izdelavo doktorske naloge,
- pozna naravo velikih količin podatkov in je sposoben uporabiti visokozmogljive računalniške sisteme za analizo velikih količin podatkov,
- je sposoben kombinirati metode kvalitativne in kvantitativne analize,
- je sposoben samostojnega raziskovalnega dela z uporabo kvalitativnih in kvantitatvnih metod,

Intended learning outcomes:

Knowledge and understanding:

The student:

- masters key research methods that are necessary to conduct the doctoral research work,
- knows the nature of big data and is able to use high-performance computers for simple analysis of big data,
- is able to combine the methods of qualitative and quantitative analysis,
- is capable of independent research using qualitative and quantitative methods,

• je sposoben kombinirati različne pristope družboslovnega in naravoslovnega raziskovanja, • je sposoben predstavitve svojih raziskovalnih rezultatov v znanstvenih publikacijah. • poznavanje metod modeliranja in simulacije z agenti.	• is able to combine different approaches from social and natural sciences, • is able to present his/her research results in scientific publications. • knowledge of modelling and simulation methods using agents.

Metode poučevanja in učenja:	**Learning and teaching methods:**
• *Predavanja* z aktivno udeležbo študentov; kratka razlaga, diskusija, razprava na primerih, reševanje problematike. • *Seminarsko delo* v obliki priprave in zagovora projektne naloge. • *Individualno delo* študentov: samostojni študij znanstvene in strokovne literature in rezultatov raziskav. Izdelava domačih nalog in projektne naloge.	• *Lectures* with active participation of students; a brief explanation, discussion, debate on cases dealing with the problems. • *Seminar* in the form of preparation and presentation of project assignment. • *Individual work* of students; independent study of scientific and professional literature and research results. Work on home and project assignments.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Študent izbere enega nosilca, ki določi potrebne naloge.	100	Type (examination, oral, coursework, project): Student chooses one of the lecturers who sets the entire course requirements.

Reference nosilca / Lecturer's references:

- FRIC, Urška, RONČEVIĆ, Borut, DŽAJIĆ URŠIČ, Erika. Role of computer software tools in industrial symbiotic networks and the examination of sociocultural factors. Environmental progress & sustainable energy. 2020, vol. 39, no. 2, 7 str.
- RONČEVIĆ, Borut, BESEDNJAK VALIČ, Tamara. How to think about regional development agencies as a sociologist. The social sciences. [Online ed.]. 2019, vol. 14, iss. 9, str. 326-334
- M. Bohanec, P. Boškoski, Đ. Juričić, B. Mileva-Boshkoska, Copula-based decision support system for quality ranking in the manufacturing of electronically commutated motors, Journal of intelligent manufacturing 26(2) (2015), 281-293.
- P. Boškoski, A. Debenjak, Đ. Juričić, B. Mileva-Boshkoska, Dependence among complex random variables as a fuel cell condition indicator, Journal of power sources 284 (2015) 566-573.
- Zorko, M. Frühwirth, N. Goswami, M. Moser, Z. Levnajić, Heart Rhythm Analyzed via Shapelets Distinguishes Sleep From Awake, Frontiers in Physiology 10, 1554, 2020.
- M. Faggian, F. Ginelli, F. Rosas, Z. Levnajić, Synchronization in time-varying random networks with vanishing connectivity, Scientific Reports 9, 10207, 2019.
- MAJETIĆ, Filip, MAKAROVIČ, Matej, ŠIMLEŠA, Dražen, GOLOB, Tea. Performance of work integration social enterprises in Croatia, Slovenia, and Italian regions of Lombardy and Trentino. Economics & sociology. 2019, vol. 12, no. 1, str. 286-301.
- GOLOB, Tea, MAKAROVIČ, Matej. Reflexivity and structural positions : the effects of generation, gender and education. Social sciences. 2019, vol. 8, no. 9, str. 1-23.

- T. Kanduč, B. Rodič, Optimisation of machine layout using a force generated graph algorithm and simulated annealing, Int Jour Sim Modelling 15(2) (2016), 1726-4529.
- B. Rodič, T. Kanduč, Optimisation of a complex manufacturing process using discrete event simulation and a novel heuristic algorithm, Intl Jour Math Mod Meth Appl Sci 9 (2015), 320-329.