

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Matematično modeliranje v naravoslovju in družbenih vedah
Course title:	Mathematical modeling in life and social sciences

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
drugostopenjski magistrski študijski program Poučevanje	Predmetno poučevanje	1. letnik	zimski
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Vrsta predmeta / Course type C - Strokovni izbirni predmet

Univerzitetna koda predmeta / University course code: /

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individ. Work	ECTS
15	15	0	0	0	60	3

Nosilec predmeta / Lecturer:

izr. prof. dr. Marko Slapar
doc. dr. Boštjan Kuzman

Jeziki / Languages **Predavanja / Lectures:** slovenščina, angleščina
Vaje / Tutorial: slovenščina, angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Ni posebnih pogojev.

Prerequisites:

No special requisites.

Vsebina:

Deterministični modeli: - modeliranje ene ali več populacij (diskretni modeli, eksponentna rast, logistična rast, Latka-Volterra, simbioza, tekmovalje za vire); - modeliranje tumorjev (von Bertalanffyjev model, Gompertzov model); - modeliranje oboroževalne tekme (Richardsonov model); - modeliranje epidemij in opravljanja (diskretni modeli, SIR model in posplošitve); - epidemiološki modeli za modeliranje opravljanja, širjenja mitov, problema pijančevanja, zombies. Aksiomatski modeli: - volitve (Arrowov izrek nezmožnosti, Gibbard-Satterthwaitejev izrek, liberalni paradox,...); - teorija pričakovane koristnosti; - menjalne ekonomije (2 ali več oseb), Nash-Debreujev pristop, Paretova učinkovitost, ravnovesne točke. Verjetnostni modeli (Markovski procesi): - kulturna stabilnost (sistem Gadda); - Bowerjev PAL model za učenje; - Stohastični modeli v epidemiologiji. Vse teme ne bodo obravnavane. Obravnavane teme bodo izbrane glede na zanimanje študentov.

Content (Syllabus outline):

Deterministic models: - modeling on or many populations (discrete models, exponential growth, logistic growth, Latka-Volterra, symbiosis, competition for natural resources); - modeling tumors (von Bertalanffyjev model, Gompertzov model); - arms race model (Richardsonov model); - modeling epidemics (discrete models, SIR model and generalisations); - epidemiological models in modeling gossips, myth propagations, problem drinking, zombies. Axiomatic models: - votings (Arrow's impossibility theorem, Gibbard-Satterthwaite's theorem of gloomy alternatives, the liberal paradox,...); - utility theory; - exchange economies (2 or more persons), Nash-Debreu approach, Pareto utility, equilibrium points. Probabilistic models (Markov processes): - cultural stability (the Gadda system); - Bowers Paired Associate Learning model; - stochastic models in epidemiology. All topics will not be covered. The topics covered will be selected depending on students interests.

Temeljni literatura in viri / Readings:

- Olinick, M., Mathematical Modeling in the Social and Life Sciences, Wiley, 2014, 574 str. - Edelstein-Keshet, L., Mathematical Models in Biology, The Random House/Birkhäuser Mathematics Series. Random House, Inc., New York, 1988. xviii+586 str - Smith?, R., ed., Mathematical Modelling of Zombies, University of Ottawa Press, 468 str.

Cilji in kompetence:

- Zmožnost raziskovanja in prenašanja spoznanj v prakso. - Razvijanje novega znanja in razumevanja področja. - Razvijanje višjih kognitivnih veščin, povezanih z ustvarjanjem novega znanja. - Poznavanje, razumevanje in apliciranje zahtevnejših vsebin elementarne matematike. - Uveljavljanje pomena matematike v kulturi in v interdisciplinarnem pedagoškem delovanju. - Obvladovanje splošnih in za matematiko specifičnih informacijsko-komunikacijskih tehnologij.

Objectives and competences:

- Ability to conduct research and to transfer knowledge into practice. - Developing new knowledge and understanding of the field. - Development of higher cognitive skills related to the creation of new knowledge. - Knowledge, understanding and applying of advanced contents of elementary mathematics - Enforcement of the importance of mathematics in culture in interdisciplinary pedagogical activities. - Mastering general information and mathematics-specific information and communication technologies.

Predvideni študijski rezultati:

Znanje in razumevanje: - Poznavanje temeljnih pojmov in konceptov s področij, ki so navedena pri vsebini. - Razumevanje temeljnih principov matematičnega modeliranja. Uporaba: - Uporaba temeljnih znanj in konceptov matematike na konkretnem področju raziskovanja. - Načrtovanje novih oblik reševanja problemov pri raziskovalnem delu. Refleksija: - Reflektiranje obstoječih modelov za modeliranje naravnih in družbenih pojavov. Prenosljive spretnosti: - Zmožnost modeliranja v novih okoljih.

Intended learning outcomes:

Knowledge and understanding: - Knowledge of fundamental terms and concepts in the areas mentioned in the course contents. - Understanding of basic principles of mathematical modelling. Application: - Application of fundamental skills and concepts in mathematics to the specific field of research. - Design new forms of problem solving in research. Reflection: - Reflection of existing models used to model certain natural and social phenomena. Transferable skills: - Ability to make predictive models in new settings.

Metode poučevanja in učenja:

1. Frontalna pri predavanjih.

Learning and teaching methods:

1. Frontal at lectures.

Načini ocenjevanja:

**Delež (v %) /
Weight (in %)**

Assessment:

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Pisni izpit.	100	Written exam.

Za pozitivno oceno pri predmetu mora biti študent/-ka pozitivno ocenjen/-a pri vsakem posameznem deležu, ki sestavlja končno oceno. Ocenjevalna lestvica je v skladu s Statutom UL.

To pass the course, the student must have successfully completed (with the passing grade) all the course parts. The grading scale is prescribed by the University of Ljubljana Statute.

Reference nosilca / Lecturer's references:

1. RUBERMAN, Daniel, SLAPAR, Marko, STRLE, Sašo. On the thom conjecture in CP3. International mathematics research notices. 2021, vol. 2022, no. 1 2. DRINOVEC-DRNOVŠEK, Barbara, SLAPAR, Marko. Proper holomorphic curves attached to domains. Complex variables and elliptic equations. 2020, vol. 65, no. 3, str. 489-497. 3. SLAPAR, Marko; Torres, Rafael Existence results of totally real immersions and embeddings into CN. Proc. Amer. Math. Soc. 146 (2018), no. 12, 5463-5474 4. KUZMAN, Boštjan. On k-rainbow domination in regular graphs. Discrete applied mathematics. [Print ed.]. Sep. 2020, vol. 284, str. 454-465 5. KUZMAN, Boštjan, MALNIČ, Aleksander, POTOČNIK, Primož. Tetravalent vertex- and edge-transitive graphs over doubled cycles. Journal of combinatorial theory. Series B. July 2018, vol. 131, str. 109-137. 6. KUZMAN, Boštjan. On graphs of prime valency admitting a solvable arc-transitive group. Bulletin of the Australian Mathematical Society, ISSN 0004-9727, 2015, vol. 92, iss. 2, str. 214-227.