UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Ime predmeta:	MATEMATIČNI MODELI IN METODE V POSLOVNIH LOGISTIČNIH SISTEMIH
Course title:	MATHEMATICAL MODELS AND METHODS IN BUSINESS LOGISTIC SYSTEMS

Študijski program in stopnja **Study programme and cycle**	**Študijska smer** **Study option**	**Letnik** **Year of study**	**Semester** **Semester**
LOGISTIKA SISTEMOV 2. stopnja		2.	4.
SYSTEM LOGISTICS 2nd degree		2.	4.

Vrsta predmeta (obvezni ali izbirni) / **Course type (compulsory or elective)**	OBVEZNI COMPULSORY
Univerzitetna koda predmeta / University course code:	MAG

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Klinične vaje** **Clinical training**	**Druge oblike študija** **Other forms of study**	**Samost. delo** **Individual work**	**ECTS**
28 a-P 12 e-P		28 a-V 12 e-V			100	6

Nosilec predmeta / Course coordinator:	**DRAGAN DEJAN**
Jeziki /Languages: **Predavanja / Lectures:**	SLOVENSKI/SLOVENE
Vaje / Tutorial:	SLOVENSKI/SLOVENE

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites for enrolling in the course or for performing study obligations:**
Ni pogojev.	None.

Vsebina (kratek pregled učnega načrta):	**Content (syllabus outline):**
1. Osnove ekonometrije (regresijski modeli, modeli linearnih in nelinearnih časovnih vrst, problematika izbire optimalnih modelov, napovedovanje v poslovnih logističnih sistemih). 2. Trajnostno modeliranje pri optimizaciji mednarodnih blagovnih tokov, zalog in transporta (emisijski modeli za analizo transportnih vplivov na okolje, regresijski statistični modeli za merjenje družbene neodgovornosti podjetij in organizacij). 3. Upravljanje zalog in stroški (deterministični in stohastični modeli za upravljanje zalog, povezava z napovedovanjem povpraševanja). 4. Modeli za potrebe analize učinkovitosti podjetij in organizacij (DEA modeli za ovojnično podatkovno analizo, radialni vhodno in izhodno	1. Fundamentals of econometrics (regression models, linear and nonlinear time series models, optimal model selection problems, forecasting in business logistics systems). 2. Sustainable modeling in optimizing international goods flows, stocks and transport (emission models for the analysis of transport impacts on the environment, regression statistical models for measuring the social irresponsibility of companies and organizations). 3. Inventory control and cost management (deterministic and stochastic models for inventory management and control, link to demand forecasting). 4. Models for the efficiency analysis of companies and organizations (data envelopment analysis (DEA) models, radial input and output oriented models,

orientirani modeli, direkcijski model, aditivni model, super-učinkovit model, alokativni modeli, modeli z nezaželenimi izhodi). 5. Temeljni koncepti finančnega modeliranja, statističnega upravljanja tveganj in odločitvene teorije z negotovostjo v logističnih sistemih (osnovni pojmi in modeli iz teorije financ, model diskontiranega denarnega toka, modeli za vrednotenje realnih opcij, modeliranje tveganj v oskrbovalnih verigah, odločitvena drevesa na osnovi teorije verjetnosti, »utility« funkcije).	directional model, additive model, super-efficient model, allocative models, models with undesirable outputs). 5. Basic principles of financial modeling, statistical risk management and decision theory with uncertainty in logistics systems (basic concepts and models from finance theory, discounted cash-flow model, models for valuation of real options, supply chain risk modeling, decision trees based on probability theory, utility functions).

Temeljni literatura in viri / Reading materials:

E-gradivo predmeta.

DRAGAN, Dejan. Statistika in uvod v regresijske modele v Matlabu pri optimizaciji logističnih procesov : visokošolski učbenik. 1. izd. Celje: Fakulteta za logistiko, 2014. 801 str. http://blend.fl.uni-mb.si/. [COBISS.SI-ID 80939521].

DRAGAN, Dejan. Upravljanje logističnih sistemov : visokošolski učbenik. Celje: Fakulteta za logistiko, 2009. 434 str., ilustr. ISBN 978-961-6562-31-7 . [COBISS.SI-ID 246006272].

DRAGAN, Dejan. Logistična regresija s programskim orodjem Matlab : skripta. Celje: Fakulteta za logistiko, 2014. 124 str., ilustr. https://estudij.um.si/. [COBISS.SI-ID 512785981].

DRAGAN, Dejan. Predstavitev optimalnih strategij za upravljanje zalog pri stohastičnem povpraševanju : interno dodatno gradivo za predmet Upravljanje logističnih sistemov. Celje: Fakulteta za logistiko, 2009. 48 f., graf. prikazi. [COBISS.SI-ID 512203325].

DRAGAN, Dejan. Upravljanje logističnih sistemov : doktorski študij (posodobljeno študijsko gradivo). Celje: Fakulteta za logistiko, 2017. 1053 str. [COBISS.SI-ID 512852285].

DRAGAN, Dejan. Probability theory, stochastic processes, queueing theory, and inventory control : lecture notes (international course - statistics). Celje: Faculty of Logistics, 2020. [535] str., ilustr. http://estudij.um.si/. [COBISS.SI-ID 27127043].

Box, G. E. P., Jenkins, G. M., Reinsel, G. C., et al. 2015. Time Series Analysis: Forecasting and Control: John Wiley & Sons.

Cooper, W. W., Seiford, L. M., Tone, K. 2007. Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software: Springer Science & Business Media.

Copeland, T. E.; Weston, J. F.; Shastri, K. *Financial Theory and Corporate Policy: Pearson New International Edition*; Pearson Education Limited, 2013.

Dougherty, C. 2011. Introduction to Econometrics: OUP Oxford.

McNeil, A. J., Frey, R., Embrechts, P. 2005. Quantitative Risk Management: Concepts, Techniques, and Tools: Princeton University Press.

Neftci, S. N., Hirsa, A., Neftci, S. N. 2000. An Introduction to the Mathematics of Financial Derivatives: Academic Press.

Ross, S. M. 2003. An Elementary Introduction to Mathematical Finance: Options and Other Topics: Cambridge University Press.

Wilmott, P., Howson, S., Howison, S., et al. 1995. The Mathematics of Financial Derivatives: A Student Introduction: Cambridge University Press.

Cilji in kompetence:	**Objectives and competences:**
Cilji predmeta so: • osvojiti in razumeti pojme in znanja s področja matematičnih modelov in metod v poslovnih logističnih sistemih (PLS),	The aims of this course are: • to acquire and understand concepts and knowledge in the field of mathematical models and methods in business logistics systems (BLS),

- pravilno identificirati probleme s tega področja in pridobiti znanja za konstrukcijo modelov in uporabo metod v PLS,
- razumeti mehanizme delovanja metod in modelov PLS, ter jih znati pravilno uporabiti za reševanje problemov,
- pridobiti znanja pravilne klasifikacije različnih problemov in zmožnosti uporabe pravilnih in ustreznih metod in modelov PLS za dani problem,
- pridobiti razumevanje teoretičnih ozadij, nujno potrebnih za pravilno interpretacijo dobljenih rezultatov metod in modelov PLS in ocenitev njihove kakovosti,
- pridobiti razumevanje fizikalnih in matematičnih mehanizmov v ozadju obravnavanih problemov in procesov v okviru PLS,
- se naučiti pravilno ovrednotiti ustreznost in kvaliteto uporabljenih metod in modelov PLS, ter znati pravilno uporabiti ustrezne metrike za testiranje njihove veljavnosti,
- se naučiti pravilno interpretirati rezultate uporabljenih metod in modelov PLS ter pravilno podati sklepe na njihovi osnovi.

Kompetence, ki jih pridobijo študenti:

- osvojijo teoretično znanje na področju matematičnih modelov in metod v PLS,
- poglobljeno razumejo matematične modele in metode v PLS,
- spoznajo in razumejo metrike na področju matematičnih modelov in metod v PLS,
- razumejo fizikalne in matematične mehanizme v ozadju matematičnih modelov in metod v PLS,
- rešujejo kompleksne probleme v logističnih sistemih s pomočjo matematičnih modelov in metod v PLS,
- razumejo delovanje matematičnih modelov in metod v PLS, koristno tako v okviru tega, kot tudi drugih sorodnih predmetov.

- correctly identify problems in this area and gain knowledge for the construction of models and the use of methods in BLS,
- understand the working mechanisms of methods and models in BLS, and be able to use them correctly to solve problems,
- to acquire knowledge of the correct classification of various problems and the ability to use the correct and appropriate methods and models of BLS for a given problem,
- to gain an understanding of the theoretical backgrounds necessary for the correct interpretation of the obtained results of methods and models in BLS and assessment of their quality,
- to gain an understanding of the physical and mathematical mechanisms behind the problems and processes discussed within BLS,
- learn to properly evaluate the adequacy and quality of the conducted methods and models of BLS, and to be able to correctly use the appropriate metrics to test their validity,
- learn to correctly interpret the results of the used methods and models of BLS and to correctly draw conclusions based on these methods and models.

Competences acquired by students:

- acquire theoretical knowledge in the field of mathematical models and methods in BLS,
- have an in-depth understanding of mathematical models and methods in BLS,
- get to know and understand metrics in the field of mathematical models and methods in BLS,
- understand the physical and mathematical mechanisms behind mathematical models and methods in BLS,
- solve complex problems in logistics systems using mathematical models and methods in BLS,
- understand the working principles of mathematical models and methods in BLS, useful both within this and other related subjects.

Predvideni študijski rezultati:

Znanje in razumevanje:
Študent/študentka bo ob zaključku predmeta zmožen:

- obvladati raziskovalne metode, postopke in procese na področju metod in modelov PLS,

Intended learning outcomes:

Knowledge and understanding:
The student will be able to:

- master research methods, procedures, and processes in the field of methods and models of BLS,
- able for independent scientific research work in the field of methods and models of BLS,

• samostojno znanstveno raziskovati na področju metod in modelov PLS, • uporabljati kvantitativne metode in modele PLS, • poglobljeno analizirati probleme in uporabljati pri tem sistemsko razmišljanje na tem področju, • reševati probleme v poslovnih logističnih okoljih, • pridobiti splošna in specifična znanja na področju metod in modelov PLS, • integrirati različne koncepte kvantitativnih metod in modelov PLS, ki vodijo k inovativnim rešitvam obravnavanih problemov, • kritično analizirati kompleksna znanja, koncepte, pristope in strategije k uporabi metod in načrtovanju modelov, • sintetizirati informacije s področja metod in modelov PLS, ter prepoznati vrednosti znanja ali procesov z vidika predmeta in prakse. Študijski rezultati se bodo preverjali (in merili) na različne načine, kot je to definirano v deležih (v %) pri načinih ocenjevanja.	• understand the use of methods and models of BLS with the ability of in-depth problem analysis and systems thinking in this area, • able to cooperate creatively in solving problems in business logistics environments, • acquire general and specific knowledge in the field of methods and models of BLS, • develop the ability to integrate various concepts in the field of methods and models of BLS, which lead to innovative solutions to the problems addressed, • develop the ability to critically analyze complex knowledge, concepts, approaches, and strategies related to methods and models of BLS, • able to synthesize information in the field of methods and models of BLS innovatively and recognize the value of knowledge or processes from the subject and practice perspective. Study results will be checked (and measured) in different ways, as defined in shares (in%) in assessment methods.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predmet vključuje različne metode poučevanja in učenja, kot so: predavanja v klasični obliki, predavanja preko video predstavitev, filmov in webinarjev, predstavitve študentov in samostojni študij študentov. Predavanja: pri predavanjih študent spozna teoretične vsebine predmeta. Del predavanj se izvaja na klasični način v predavalnici, del pa v obliki e-predavanj (e-predavanja se lahko izvajajo na videokonferenčni način ali s pomočjo posebej v ta namen didaktično pripravljenih e-gradiv v virtualnem elektronskem učnem okolju). Vaje: pri vajah študent utrdi teoretično znanje in spozna aplikativne možnosti. Del vaj se izvaja na klasični način v predavalnici, del pa v obliki e-vaj (e-vaje se lahko izvajajo na videokonferenčni način ali s pomočjo posebej v ta namen didaktično pripravljenih e-gradiv v virtualnem elektronskem učnem okolju).	The subject includes various teaching and learning methods, such as: lectures in classical form, lectures via video presentations, films and webinars, student presentations and independent student studies. Lectures: Students understand the theoretical frameworks of the course. Part of the lecture course is in a classroom while the rest is in the form of e-learning (e-lectures may be given via video-conferencing or with the help of specially designed e-material in a virtual electronic learning environment). Tutorials: Students enhance their theoretical knowledge and are able to apply it. Part of the seminar is in a classroom while the rest is in the form of e-learning (e-Tutorials: may be given via video-conferencing or with the help of specially designed e-material in a virtual electronic learning environment).

Načini ocenjevanja:	Delež (v %) / Share (in %)	**Assessment methods:**
Opravljene obveznosti e-predavanj in e-vaj so pogoj za pristop k izpitu		Successful completion of e-lectures and e-tutorials is a prerequisite for entering the exam
• Pisni izpit	30%	• Written examination

• Ustni izpit • Naloge pri e-predavanjih in e-vajah • Raziskovalna naloga	30% 10% 30%	• Oral examination • E-lecture and e-tutorial tasks • Research task

Reference nosilca / Course coordinator's references:

IVANUŠA, Teodora, DRAGAN, Dejan, PODBREGAR, Iztok, HRIBAR, Gašper, ŽIROVNIK, Janez. *Intelligence and security challenges of the European migrant crisis : an insight into an innovative forecasting model*. *New York: Nova Science Publishers*, cop. 2018. X, 127 str., ilustr., graf. prikazi. European political, economic, and security issues. ISBN 978-1-53613-045-4 . [COBISS.SI-ID 7989779].

Vlado Popović, Milorad Kilibarda, Milan Andrejić, Borut Jereb, Dejan Dragan. A New Sustainable Warehouse Management Approach for Workforce and Activities Scheduling. *MDPI Sustainability*. vol. 13, 2021. https://doi.org/10.3390/su13042021.

HAMMAD, Mahmoud A., JEREB, Borut, ROSI, Bojan, DRAGAN, Dejan. Methods and models for electric load forecasting : a comprehensive review. *Logistics & sustainable transport*. [Spletna izd.]. Feb. 2020, vol. 11, iss. 1, str. 51-76, ilustr. ISSN 2232-4968. https://doi.org/10.2478/jlst-2020-0004 , DOI: 10.2478/jlst-2020-0004. [COBISS.SI-ID 513089597].

DRAGAN, Dejan, KESHAVARZSALEH, Abolfazl, INTIHAR, Marko, POPOVIĆ, Vlado, KRAMBERGER, Tomaž. Throughput forecasting of different types of cargo in the Adriatic Seaport Koper. 2020. *Taylor-Francis Maritime policy & management*. [Spletna izd.]. ISSN 1464-5254. https://doi.org/10.1080/03088839.2020.1748242 , DOI: 10.1080/03088839.2020.1748242. [COBISS.SI-ID 513118781], [JCR, SNIP, WoS, Scopus].

DRAGAN, Dejan, KESHAVARZSALEH, Abolfazl, KRAMBERGER, Tomaž, JEREB, Borut, ROSI, Maja. Forecasting US tourists' inflow to Slovenia by modified holt-winters damped model : a case in the tourism industry logistics and supply chains. *Logistics & sustainable transport*. [Spletna izd.]. 2019, vol. 10, no. 1, str. 11-30, ilustr. ISSN 2232-4968. https://doi.org/10.2478/jlst-2019-0002 , DOI: 10.2478/jlst-2019-0002. [COBISS.SI-ID 513008701].

DRAGAN, Dejan, MULEJ, Matjaž. Some consequences of socially irresponsible, un-systemic behavior in ports : a case. *Wiley Systems research and behavioral science : the official journal of the International Federation for Systems Research*. 2019, vol. 36, iss. 6, str. 799-807. ISSN 1092-7026. https://doi.org/10.1002/sres.2646 , https://onlinelibrary.wiley.com/doi/pdf/10.1002/sres.2646, DOI: 10.1002/sres.2646. [COBISS.SI-ID 513043261], [JCR, SNIP, WoS do 15. 11. 2020: št. citatov (TC): 1, čistih citatov (CI): 1, Scopus].

DRAGAN, Dejan, KESHAVARZSALEH, Abolfazl, JEREB, Borut, TOPOLŠEK, Darja. Integration with transport suppliers and efficiency of travel agencies. *Inderscience International journal of value chain management*. 2018, vol. 9, no. 2, str. 122-148, ilustr. ISSN 1741-5365. http://www.inderscience.com/info/ingeneral/forthcoming.php?jcode=ijvcm#70101, DOI: 10.1504/IJVCM.2018.10013594 . [COBISS.SI-ID 512918845], [SNIP].

DRAGAN, Dejan, ROSI, Bojan, AVŽNER, Toni. Synergies between an observed port and a logistic company : application of the discounted cash-flow model and the Monte Carlo simulation. *Logistics & sustainable transport*. [Spletna izd.]. May 2017, vol. 8, no. 1, str. 1-18, ilustr. ISSN 2232-4968. https://doi.org/10.1515/jlst-2017-0001 , DOI: 10.1515/jlst-2017-0001. [COBISS.SI-ID 512846141].

INTIHAR, Marko, KRAMBERGER, Tomaž, DRAGAN, Dejan. Container throughput forecasting using dynamic factor analysis and ARIMAX model. *Promet*. [Print ed.]. 2017, vol. 29, no. 5, str. 529-542, ilustr. ISSN 0353-5320. [COBISS.SI-ID 512879421], [JCR, SNIP, WoS do 10. 8. 2020: št. citatov (TC): 6, čistih citatov (CI): 4, Scopus do 10. 8. 2020: št. citatov (TC): 5, čistih citatov (CI): 5].

DRAGAN, Dejan, KRAMBERGER, Tomaž, TOPOLŠEK, Darja. Efficiency and travel agencies : Bayesian structural equation model. V: KRAMBERGER, Tomaž (ur.), POTOČAN, Vojko (ur.), IPAVEC, Vesna Mia (ur.). *Sustainable logistics and strategic transportation planning*. Hershey: IGI Global, cop. 2016. Str. 211-235, ilustr. Advances in logistics, operations, and management science book series (Print). ISBN 978-1-5225-0001-8 . ISSN 2327-350X. http://www.igi-global.com/book/sustainable-logistics-strategic-transportation-planning/141939, DOI: 10.4018/978-1-5225-0001-8.ch010 . [COBISS.SI-ID 512762173].

DRAGAN, Dejan, KRAMBERGER, Tomaž, PRAH, Klemen. Transport optimization and estimation of reduced CO2 emissions. V: KRAMBERGER, Tomaž (ur.), POTOČAN, Vojko (ur.), IPAVEC, Vesna Mia (ur.). *Sustainable logistics and strategic transportation planning*. Hershey: IGI Global, cop. 2016. Str. 405-436, ilustr. Advances in logistics, operations, and management science book series (Print). ISBN 978-1-5225-0001-8. ISSN 2327-350X. http://www.igi-global.com/book/sustainable-logistics-strategic-transportation-planning/141939, DOI: 10.4018/978-1-5225-0001-8.ch019 . [COBISS.SI-ID 512762429].