Study program / study programs: Business Analytics

Degree level: MSc

Course:

Time Series Analysis and Forecasting

Teacher:Bulajić V. Milica,Vukmirović V. Dragan

Course status: Elective

ECTS points: 6

Prerequisites:

Course objective

The introduction to concepts and methods of time series analysis. Qualifying students for individual application of these methods for solving practical problems with the special emphasis to financial time series.

Learning outcomes

The course denotes the wide applicability of methods of time series analysis and prepares students for their application in process modeling.

Course structure and content

Theoretical instruction:

L-01: The concept and classification of random processes. White noise. Poisson's process L-02: The stationary random processes. L-03: The linear transformations of stationary processes. L-04: The time series. L-05: Stationarity. The correlation and autocorrelation function. L-06: Linear trend. Smoothing techniques. L-07: Methods for analysis of stationary time series. L-08: The nonstationary time series. L-09: ARIMA models. L-10: The conditional heteroscedastic models, ARCH model. GARCH model and its modifications. L-11: Forecasting techniques. L-12: SPSS software application. L-13: Nonlinear models and theirs application. L-14: The analysis of multidimensional time series. L-15: The modelling of financial and economic time series.

Practical instruction:

P-01: The concept of random process. P-02: The classification of random processes. P-03: The stationary random processes P-04: The linear transformations of stationary processes. P-05: The time series. P-06: The correlation and autocorrelation function. P-07: Methods for analysis of stationary time series. P-08: The nonstationary time series. P-09: ARIMA models. P-10: ARCH model. GARCH model. P-11: Forecasting techniques. P-12 SPSS software application. P-13: Nonlinear models and theirs application. P-14: The analysis of multidimensional time series. P-15: The analysis of financial time series.

Literature/Readings

1. Kovačić Z., *Analiza vremenskih serija*, Ekonomski fakultet, Beograd, 1995.
2. Montgomery C.D., Jennings C.L., Kulahci M., *Introduction to Time Series Analysis and Forecasting*, Wiley, 2009.
3. Box G.E.P., Jenkins G.M., Reinsel G.C., *Time Series Analysis - Forecasting and Control*,

Wiley, 2008.
4. Cryer J.D., Chan K.S., *Time Series Analysis - With Applications in R*, Springer, 2010.
5. Tsay R.S., *Analysis of Financial Time Series*, Wiley, 2010.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs:** 2	**Workshops:**	**Research study:**	

Teaching methods

The traditional way of lecturing, with the use of whiteboard and computer

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	5	Written exam	25
Participation in labs	5	Oral exam	25
Colloqia	20		
Seminar work	20		

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Data analysis and software package R

Teacher:Jeremić M. Veljko

Course status: Elective

ECTS points: 6

Prerequisites:

Course objective

Learning of techniques of data analysis which provide insights about changes in a model. Examining mutual links of methods of statistical analysis and methods and techniques of data mining.

Learning outcomes

Capability for data analysis, analysis of data structures and construction of models. Capability for making decisions based on data visualization and graphics.

Course structure and content

Theoretical instruction:

L01: Classification of methods of multivariate statistical analysis. Types of data and measuring scales. L02: Data Visualization and Graphics. L03: A multidimensional data analysis. L04: Visualization of complex data and content of complex databases. Algorithms for data visualising. L05: Knowledge discovery in databases. Classification. An assessment. L06: Prediction. Link analysis. L07: Modelling of dependence. Memory-based decisions. L08: Clusters detection. Link analysis. L09: Decision tree. Exploratory data analysis. L10: Evaluation of discovered knowledge. L11: The role of statistics in databases knowledge discovery process. L12: Knowledge discovery in statistical databases. L13: Computer support for statistical research. Statistical inference in software package R. L14: Jackknife and Bootstrap methods. L15: Meta analyses in software package R.

Practical instruction:

P01: Multivariate statistical analysis. Types of data and measuring scales. P02: Data Visualization and Graphics. P03: A multidimensional data analysis. P04: Visualization of complex data. P05 to P09: Methods and techniques of knowledge discovery in databases. Basics of software package R. P10: Evaluation of discovered knowledge. P11: The role of statistics in knowledge discovery process. P12: Knowledge discovery in statistical databases. P13: Computer support for statistical research. Statistical inference in software package R. P14: Jackknife and Bootstrap methods. P15: Meta analyses in software package R.

Literature/Readings

1. Michael S.L.B., *Data Analysis: an Introduction*, Sage, 1995.
2. Cohen Y., Cohen J., *Statistics and Data with R: An applied approach through examples*, Wiley, 2008.
3. Chambers J.M., *Software for Data Analysis: Programming with R*, Springer, 2009.
4. Tuffery S., *Data Mining and Statistics for Decision Making*, Wiley, 2011.
5. Schumacker R., Tomek S., *Understanding Statistics Using R*, Springer, 2013.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs:** 2	**Workshops:**	**Research study:**	

Teaching methods

The traditional way of lecturing, with the use of whiteboard and computer.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	5	Written exam	25
Participation in labs	5	Oral exam	25
Colloquial	20		
Seminar work	20		

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Process Analysis and Petri Nets

Teacher:Vujošević B. Mirko,Makajić-Nikolić D. Dragana

Course status: Elective

ECTS points: 6

Prerequisites:

Course objective

To acquire the basic concepts and methods of process modeling, the theory of Petri nets and its applications in system modeling, design, and verification. To be able to use Petri net-based computer-aided tools in typical applications.

Learning outcomes

The acquired knowledge and experience will allow the students to actively use Petri nets and the computer-aided tools based on them in modeling, design, verification, and implementation of various classes of systems.

Course structure and content

Theoretical instruction:

Process definition and characteristics. Process modelling. Managing Dependencies. Coordination mechanisms. Decomposition, specialization, synchronization. Conflict and concurrent processes.. Alternative process modelling technique. Graph theory basic. Petri Net (PN) informal and formal definition. PN classification. Coloured Petri Net. Hierarchical PN. Timed PN. Stochastic PN. Fuzzy PN. Incidence matrix and State equation. PN properties. PN analysis methods. PN simulation. State space analysis. PN model verification and validation. PN typical applications.

Practical instruction:

Plan is in accordance with theoretical instructions plan. Main topics of the practical instructions are standards and available software packages for solving case studies.

Literature/Readings

<table>
<tr><td colspan="5">1. K. Jensen , L.M. Kristensen, Coloured Petri Nets. Modelling and Validation of Concurrent Systems, Springer, 2009.
2. K. Jensen, Coloured Petri Nets. Basic Concepts, Analysis Methods and Practical Use, Springer-Verlag 1997
3. Д. Макајић-Николић, Примена обојених Петријевих мрежа у реинжењерингу пословних процеса, ФОН, Београд 2002</td></tr>
<tr><td colspan="4">The number of class hours per week</td><td>Other classes:</td></tr>
<tr><td>Lectures: 2</td><td>Labs:2</td><td>Workshops:</td><td>Research study:</td><td></td></tr>
<tr><td colspan="5">Teaching methods Theory and practical classes are designed as a combination of traditional learning with the use of whiteboard and computer, case studies, consultations and mentoring</td></tr>
<tr><td colspan="5">Evaluation/Grading (maximum 100 points)</td></tr>
<tr><td colspan="2">Pre-exam requirements</td><td>Points</td><td>Final exam</td><td>Points</td></tr>
<tr><td colspan="2">Participation in class</td><td>10</td><td>Seminar</td><td>50</td></tr>
<tr><td colspan="2">Participation in labs</td><td>20</td><td>Oral exam</td><td>20</td></tr>
</table>

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Biostatistics and telemedicine

Teacher: Veljko Milutinović; Miloš, P, Žarković; Marina, Jovanović-Milenković; Veljko, M, Jeremić; Aleksandar, M, Đoković; Selena, K, Totić; Marina, P, Dobrota

Course status: Elective

ECTS points: 6

Prerequisites:

Course objective

Biostatistics is the branch of statistics that deals with the statistical evaluation of experimental studies and clinical studies. The application of statistical methods in biology and medicine. Through the development of biostatistics, research offers the possibility of improving the functioning of telemedicine as a model of providing medical information using information and communication technologies.

Learning outcomes

Training for performing methodological research in biostatistics and related areas, as well as active participation in state, national and international statistical community.

Course structure and content

Theoretical instruction:

P01: The design of research studies and sampling. P02: Biostatistical methods. P03: Statistical methods in epidemiology and clinical trials. P04: Statistical inference. P05: Basics of epidemiology. P06: Survival analysis. P07: The analysis of categorical data. P08: A longitudinal and cohort analysis. P09: Priority and post a priority prediction. P10: The importance of ICT in health systems. P11: Health information and integrated systems telemedicine. Q12: Evaluation of integrated health care system. P13: Integration of health data in biostatistical research. P14: Computer support biostatistical research. Q15: Evaluation and testing.

Practical instruction:

V01: Design research studies and sampling. V02: Biostatistical methods. V03: Statistical methods in epidemiology and clinical trials. V04: Statistical inference. V05: Basics of epidemiology. V06: A survival analysis. V07: The analysis of categorical data. V08: A longitudinal and cohort analysis. V09: Priority and post a priority prediction. V10: The importance of ICT in health systems. V11: Health information and integrated systems telemedicine. Q12: Evaluation of integrated health care system. V13: Integration of health data in biostatistical research. V14: Computer support biostatistical research. Q15: Evaluation and testing.

Literature/Readings

1. Stanton A. G., *Primer of Biostatistics*, McGraw-Hill, New York, 2005.
2. Janošević S., *Medicinska statistika*, Medicinski fakultet, Beograd, 2000.
3. Anders A., *Biostatistics for Epidemiologists*, CRC Press, Stockholm, 1993

4. Wootton R., Craig J., Patterson V., *Introduction to telemedicine, Second Edition*, The Royal Society of Medical Press Ltd, London, 2006.
5. Darkins W. A., Cary A. M., *Telemedicine and Telehealth: Principles, Policies, Performances and Pitfalls*, Springer, 2000.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs:** 2	**Workshops:**	**Research study:**	

Teaching methods

The traditional way of lecturing, through the use of whiteboard and computer

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	5	Written exam	25
Participation in labs	5	Oral exam	25
Colloquial	20		
Seminar work	20		

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Econometrics of Financial Markets

Teacher:Bulajić V. Milica,Vukmirović V. Dragan

Course status: Elective

ECTS points: 6

Prerequisites:

Course objective

The introduction to concepts, models and methods of econometric analysis. Qualifying students for individual application of these methods for solving practical problems with the special emphasis to financial markets.

Learning outcomes

The course denotes the wide applicability of econometric methods in different areas and prepares students for their application in process modeling.

Course structure and content

Theoretical instruction:

Lectures: L-01: Definition and classification of methods of multivariate statistical analysis. L-02: The subject of econometrics. Linear regression models (LRM). Method of least squares (MLS). LRM with two variables. Forecasting. L-03: Multivariate LRM. L-04: The concept of random process. The classification of random processes. L-05: The linear transformations of stationary processes. Ergodicity. Martingales. L-06: The time series. L-07: Stationarity. The correlation and autocorrelation function. L-08: Methods for analysis of stationary time series. L-09: The nonstationary time series. L-10: ARIMA models. L-11: The conditional heteroscedastic models, ARCH model. L-12: GARCH model and its modifications. L-13: Nonlinear models and theirs application. L-14: The analysis of multidimensional time series. L-15: The analysis of financial time series.

Practical instruction:

P-01: The econometric models. P-02: LRM with two variables. MLS. P-03: The concept of random process. P-04: The classification of random processes. P-05: The stationary random processes. P-06: The time series. P-07: The correlation and autocorrelation function. P-08: Methods for analysis of stationary time series. P-09: The nonstationary time series. P-10: ARIMA models. P-11: ARCH model. P-12: GARCH model. P-13: Nonlinear models and theirs application. P-14: The analysis of multidimensional time series. P-15: The analysis of financial time series.

Literature/Readings

1. Kovačić Z., *Analiza vremenskih serija*, Ekonomski fakultet, Beograd, 1995.
2. Helfert E., *Financial Analysis Tools and Techniques: A Guide for Managers*, McGraw Hill

Professional, 2001.

3. Bragg S.M., *Financial Analysis: A Controller's Guide*, Wiley, 2007
4. Tsay R.S., *Analysis of Financial Time Series*, Wiley, 2010.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs:** 2	**Workshops:**	**Research study:**	

Teaching methods

The traditional way of lecturing, with the use of whiteboard and computer

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	5	Written exam	25
Participation in labs	5	Oral exam	25
Colloquial	20		
Seminar work	20		

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Combinatorial Optimization and Metaheuristics

Teacher:Stanojević J. Milan,Čangalović M. Mirjana

Course status: Elective

ECTS points: 6

Prerequisites: No

Course objective

To educate students about standard problems of combinatorial optimization and modern metaheuristic methodology for their solving.

Learning outcomes

Students will be capable for individual work on modelling and application of metaheuristics in solving real world combinatorial problems using adequate software.

Course structure and content

Theoretical instruction:

Computation complexity of algorithms and problems. Integer programming. Branch and bound method. Cutting plains method. Optimal paths and trees in graph: shortest path problem, minimal spanning tree problem. Network flows – maximal network flow problem. Traveling salesman problem. Heuristic approach to solving optimization problems. Definition of heuristics. Basic principles of metaheuristic methodologies. Definition of neighborhood. Basic metaheuristic methodologies: simulated annealing, tabu search, variable neighborhood search, genetic algorithms. Examples of application of metaheuristics for solving some of the combinatorial optimization problems: knapsack problem, traveling salesman problem as well as some real world scheduling problems.

Practical instruction:

Application of existing software packages (CONCORDE, GENOCOP) for heuristic solving combinatorial optimization problems.

Literature/Readings

1. Cvetković D., Čangalović M., Dugošija Đ., Kovačević Vujčić V., Simić S., Vuleta J., Combinatorial optimization, mathematical theory and algorithms, Yugoslav Operational Research Society, Belgrade, 1996. (in Serbian)

2. Cook W.J., at al, Combinatorial optimization, John Wiley&Sons, Inc., 1998.

3. Gendreau M., Jean-Yves P. (Ed.), Handbook of Heuristics, Springer, 2010.

4. Günther Z., Roland B., Michael B., Metaheuristic Search Concepts, Springer, 2010.

5. Vujošević M., Optimization methods in engineer management, Faculty of Organizational Sciences,

Belgrade, 2012. (in Serbian)				
The number of class hours per week				**Other classes:**
Lectures: 2	**Labs:** 2	**Workshops:**	**Research study:**	
Teaching methods Supervised individual work and/or classical (ex cathedra) with use of computer.				
Evaluation/Grading (maximum 100 points)				
Pre-exam requirements		**Points**	**Final exam**	**Points**
Participation in class		30	Oral exam	70

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Mathematical Programming

Teacher:Vujčić V. Vera,Mladenović M. Nenad,Čangalović M. Mirjana,Mihić R. Olivera

Course status: Elective

ECTS points: 6

Prerequisites: none

Course objective:

The objective is to give an introduction to theory and methods of mathematical programming and the software support for optimizatiion problems.

Learning outcomes

Students learn how to model real-world optimization problems using mathematical programming methodology and how to find optimal solutions using standard software packages.

Course structure and content

Theoretical instruction:

1. Modeling different real-life problems using mathematical programming methodology. 2. Classical optimization. Method of elimination. Method of Lagrange multipliers.3. Onedimensional optimization. Golden section method. Approximation methods. 4. Unconstrained optimization without evaluation of derivatives. 5. Unconstrained optimization of differentiable functions. 6. Convex programming. 7. Nonconvex programming. 8. Nonlinear programming methods. 9. Penalty function methods. 10. Interior point methods for linear and quadratic programming. 12. Global optimization. 13. Software packages for mathematical programming problems. 14-15. Software package GLOB for global optimization.

Practical instruction:

Solving selected mathematical programming problems by standard software.

Literature/Readings

S. Zlobec, J. Petrić, Nonlinear programming, Scientific Publishers, Belgrade, 1989.

2. V. Vujčić, M. Ašić, N. Miličić, Mathematical Programming, Mathematical Institute of the Serbian Academy of Sciences and Arts, Belgrade, 1980.

3. A. Sofer, S. Nash, Linear and Nonlinear Programming, McGraw Hill, 1996.

4. Williams H.P., Model building in Mathematical Programming, John Wiley&Sons, 2003.

The number of class hours per week	**Other classes:**

Lectures: 2	**Labs:** 2	**Workshops:**	**Research study:**	
Teaching methods: Classroom lectures and consultations				
Evaluation/Grading (maximum 100 points)				
Pre-exam requirements		**Points**	**Final exam**	**Points**
Participation in class		30	oral exam	40
Participation in labs		30		

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Business Systems Efficiency Measurement

Teacher:Martić M. Milan,Savić I. Gordana

Course status: Elective

ECTS points: 6

Prerequisites: Undergraduate studies

Course objective

Introduction of performance measures and tools for their evaluations. Students will learn advanced concepts of mathematical programming methods – Data Envelopment Analyses (DEA). The method is used for comparative analyses of business systems performances, determine best practices and defining operating and strategic objectives and monitoring their implementation.

Learning outcomes

Students will be able to independently apply data envelopment analysis and specialized DEA software packages as the basis of business intelligence and decision making.

Course structure and content

Theoretical instruction:

Measuring the performance of business systems. Processes and systems to measure and improve performance (eg traditional ratio analysis or Balanced Score Card - BSC) Determination performance measures (key performance indicators). Comparative performance analysis. Quantitative methods for measuring performance. Data envelopment analysis (DEA). Basic and advanced DEA models. Modifications DEA models: models for ranking, Non-radial measures and models with non-convex efficiency frontier, Resource allocation models. Comparison of DEA methods and the multi-criteria analysis. Nonparametric analysis of efficiency. Stochastic frontier efficiency analysis (SFA). Statistical method for efficiency index correction. Implementation of the method and the data quantitative analysis. Software for DEA and SFA to support business intelligence. Models for the following of dynamics. Of the system performance. Comparison of different systems in order to define strategic plan and its adjustments.

Practical instruction:

Measurement and measures of the performance of business systems. The key performance indicators. Data analysis and selection of performance indicators - case study. Comparative analysis of the performance of a specific example. Quantitative models for performance measurement system. Input and output -oriented DEA models. Limiting of the weights. Target inputs and outputs. Andersen - Petersen, additive and FDH models. Profit-oriented DEA models for resource allocation. DEA and multi-criteria analysis. SFA analysis. Modelling and solving problems in MS Excel and specialized software. Business Game: Determining the best practices and business and adjusting plan.

Literature/Readings

Cooper W, Seiford L, Tone K, "Introduction to Data Envelopment Analysis and its Applications, With DEA-Solver Software", Springer, 2006,

Zue J, " Quantitative Models for Performance Evaluation and Benchmarking: Data Envelopment Analysis with Spreadsheets - Applications and implementations issues ", Springer, 2009.

Bogetoft P, "Performance Benchmarking - Measuring and Managing Performance", Springer, 2012.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs: 2**	**Workshops:**	**Research study:**	

Teaching methods

Lectures are followed by the corresponding presentations; all models will be illustrated in the hypothetical example. Students will, through case studies and business games using appropriate software, analyze the input and output factors, define plans and target valuable asset for improving the performance of business systems.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	10	Written exam	80
Participation in labs	**10**		

Study program / study programs:Business Analytics

Degree level: MSc

Course:

Measuring stakeholder preferences

Teacher: Kuzmanović S. Marija

Course status: Elective

ECTS points: 6

Prerequisites:

Course objective

To introduce students with methods for measuring preferences and with application possibilities of these methods for modeling and analyzing strategic behavior of businesses, as well as for the simulation of the effects of strategic decisions in a complex and interactive business environment.

Learning outcomes

Students are able to implement methods for measuring the preferences of businesses, also to use the results for modeling and analyzing strategic behavior of businesses, as well as to simulate the effects of strategic decisions in real-world problems.

Course structure and content

Theoretical instruction:

P1: Introductory lecture: Basic concepts of methods for measuring preferences and application in business decision making. **P2: Methods for measurement of attitudes:** Multiattribute models, concept and types. **P3-P4: Perceptual Mapping:** Concept. Methods and techniques. Composite mapping. Applications. **P5: Preferences measurement methods:** Concept and types. Methods of revealed vs. methods of stated preferences. Composite versus decomposite techniques. **P6: Conjoint analysis:** Concept and types. Comparison with other methods of evaluation. The advantages of application. **P7-P8: Planning and implementation of Conjoint analysis:** Method selection. Identifying the attributes and their levels. Construction of the experimental design. The research plan and the method of concepts presentation. Data collection techniques. **P9-P10: Data Analysis:** Procedures for utility calculation. Individual versus aggregate model. Regression models. Hierarchical Bayesian method. Random coefficient model. Models of discrete choices. **P11-P12: Simulation of results.** Cluster analysis and segmentation. Conjoint simulation models. **P13-P15: Application of Conjoint analysis:** review of the applications in business decision making in various manufacturing and service industries.

Practical instruction:

Case studies and interactive discussions according to the content of lectures. Introduction to the appropriate software (SPSS, Sawtooth Software, Excel ...). Research work with consultations during the development of an individual projects.

Literature/Readings

1. Kuzmanovic Marija, Kvantitativne metode u marketingu: Primena Conjoint analize, Društvo operacionih istraživača, Beograd, 2006.

2. Anders Gustafsson, Andreas Herrmann, Frank Huber, editors, Conjoint measurement: methods and applications, 4. Edition, Berlin [etc.] : Springer, cop. 2007.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs: 2**	**Workshops:**	**Research study: 0**	

Teaching methods

Lectures accompanied by appropriate presentations and multimedia. Creative workshops based on interactive work with students through the analysis of case studies along with simulations in the conditions of turbulent environment. Teamwork in designing a project by using modern software for study design, data processing and analysis, simulation of results and the presentation of business solutions proposal.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	10	Final exam	30
Project	60		

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Multivariate Analysis-Selected Chapters

Teacher:Bulajić V. Milica,Jeremić M. Veljko

Course status: Elective

ECTS points: 8

Prerequisites:

Course objective

The introduction to models and methods of multivariate analysis and their application in different area. The application of SPSS software in this area.

Learning outcomes

The course denotes the wide applicability of methods and models of multivariate analysis in different area and prepares students for their application.

Course structure and content

Theoretical instruction:

L-01: Types of data and measuring scales. The methods of multivariate analysis. L-02: Regression models. Simple regression. Least square method. L-03: Multivariate linear regression models. L-04: Simultaneous equations. L-05: Canonical correlation analysis. L-06: MANOVA. L-07: Covariance analysis. L-08: Discriminative analysis. L-09: Principal component analysis. L-10: Factor analysis. L-11: Hierarchical methods of clustering. L-12: Non-hierarchical methods of clustering. L-13: Time series analysis. L-14: The multivariate analysis with SPSS software. L-15: I- distance method. Distance based analysis (DBA).

Practical instruction:

P-01: Random variables and their distributions. Types of data and measuring scales. P-02: The methods of multivariate analysis. P-03: Regression models in SPSS. Simple regression. Least square method. P-04: Multivariate linear regression models. P-05: Simultaneous equations. P-06: Canonical correlation analysis in SPSS. P-07: MANOVA in SPSS. P-08: Covariance analysis in SPSS. P-09: Discriminative analysis in SPSS. P-10: Principal component analysis in SPSS. P-11: Factor analysis in SPSS. P-12: Hierarchical and non-hierarchical methods of clustering in SPSS. P-13: Time series analysis in SPSS. P-14: I- distance method in SPSS. P-15: DBA in SPSS. Bootstrap and jack-knife in DBA method.

Literature/Readings

1. Kovačić Z., *Multivarijaciona analiza*, Ekonomski fakultet, 1998.
2. Hair J., Black W., Babin B., Anderson R., *Multivariate Data Analysis*, Pearson, 2013.
3. Johnson R. A., Wichern D. W., *Applied Multivariate Statistical Analysis*, Pearson, 2007.

4. Bulajić M., Jeremić V., Radojičić Z., *Advance in Multivariate Data Analysis – Contributions to Multivariate Data Analysis*, FON, 2012.
5. Boslaugh S., *Statistics in a nutshell*, O'Reilly, 2013.
6. Spiegel M. R., Schiller J., Srinivasan R. A., *Probability and Statistics*, McGraw-Hill, 2008.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs:** 2	**Workshops:**	**Research study:**	

Teaching methods

The traditional way of lecturing, with the use of whiteboard and computer

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	5	Written exam	25
Participation in labs	5	Oral exam	25
Colloquia	20		
Seminar work	20		

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Advance Planning and Scheduling

Teacher:Stanojević J. Milan,Makajić-Nikolić D. Dragana,Savić I. Gordana

Course status: Elective

ECTS points: 6

Prerequisites: No

Course objective

Course objective is to educate students about possibilities and application of advanced planning and scheduling systems, especially in production and business systems. Train students to recognize the situations when it is possible to apply such systems and to estimate company's benefits.

Learning outcomes

Students will be trained to use and create advanced planning and scheduling systems. This capability is considered prerequisite for companies' development and sometimes survival in nowadays business environment.

Course structure and content

Theoretical instruction: Role and importance of advanced planning and scheduling systems software. Algebraic modelling languages and environments: AMPL, AIMMS, LINDO&LINGO, etc. Optimization software in spreadsheet environment. Connecting optimization software to data bases. Application of advanced planning and scheduling systems in the production.

Practical instruction: Modelling mathematical programming problems in some of algebraic languages. Development of advanced planning and scheduling software – simple example. Work on a case study with application of advanced planning and scheduling software.

Literature/Readings

1. R. Fourer, D.M. Gay, B.W. Kernighan, AMPL: A Modeling Language for Mathematical Programming, Duxbury Press / Brooks /Cole Publishing Company, 2002.
2. J. Bisschop, M. Roelofs, AIMMS – The Users Guide, Paragon Decision Technology, 2000.
3. What's Best! – The Spreadsheet Solver, Lindo Systems Inc. 2011.
4. A. Makhorin, Modeling Language GNU MathProg Language Reference, Free Software Foundation, 2013.

(Literature 2 and 4 are freely available in electronic form on the sites of their copyright owners.)

The number of class hours per week				**Other classes:**
Lectures:	**Labs:**	**Workshops:**	**Research study:**	
30	10	15	5	

Teaching methods

Lectures – classic ex cathedra, labs – interactive classes, research study – supervisor work.			
Evaluation/Grading (maximum 100 points)			
Pre-exam requirements	**Points**	**Final exam**	**Points**
Activities during classes	20	Defence of seminar work	30
Activities during research study	30	Oral exam	20

Study program / study programs: **Business Analytics**

Degree level: MSc

Course:

Advanced planning in marketing

Teacher: Martić M. Milan, Janičić R. Radmila, Makajić-Nikolić D. Dragana

Course status: Elective

ECTS points: 6

Prerequisites: Applied marketing research

Course objective: The aim of the course is to provide students with the knowledge of how marketing information can be used to explain and predict consumer behavior and how marketing managers can use marketing information to make optimal decisions.

Learning outcomes: Students are trained to identify, model and solve real problems in terms of making optimal decisions and plans, and to use software tools for solving identified problems in marketing.

Course structure and content

Theoretical instruction:

Decision-making processes in marketing. Decision-makers in marketing. Strategic and operational decisions in marketing and the role of advanced planning methods in their adoption. Descriptive and normative decision-making in marketing. Application of advanced planning model in marketing. Planning instruments of marketing mix based on quantitative methods and models. Creating a marketing information system. Elements of marketing analysis, based on quantitative methods and models. Optimization in marketing. Modeling and solving optimization problems in marketing: the optimal choice of media, optimization of schedule of special events, optimization of media advertising, etc. Risk analysis in execution of marketing activities.

Practical instruction: Labs, Workshops, Research study

Analysis of case studies and interactive discussions in line with the content of theoretical instruction. Introducing the appropriate software (Excel, GLPK, ...). Monitored research work during project preparation.

Literature/Readings

1. Filipović V., Kostić Stanković M., Marketing menadžment, FON, Beograd, 2011.
2. Kostić-Stanković M., Marketinško komuniciranje u upravljanju odnosa sa kupcima, Zadužbina Andrejević, Beograd, 2013.
3. Filipović V., Janičić R., Strateški marketing, FON, Beograd, 2010.
4. Banasiewicz A., Marketing Database Analytics: Transorming Data for Competitive Advantage, PrenticeHall, 2013.
5. Diamantopoulod A., Wolfgang F., Hildebrandt L., Quantitative Marketing and Marketing Management: Marketing Models and Methods in Theory and Practice, PrenticeHall, 2012.
6. W. L.Winston, Marketing Analytics: Data-Driven Techniques with Microsoft Excel, Wiley, 2013.

The number of class hours per week				**Other classes**
Lectures: 2	**Labs**: 2	**Workshops**: 0	**Research study**: 0	

Teaching methods Lectures are standard, labs are case studies, using available software tools.			
Evaluation/Grading (maximum 100 points)			
Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	10	Written exam	
Practical instruction	10	Oral exam	30
Term paper(s)	50		

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Numerical methods in finances

Teacher:Lazović P. Rade,Đorić S. Dragan,Manojlović P. Vesna

Course status: Elective

ECTS points: 6

Prerequisites: -

Course objective

The course gives an introduction to mathematical models of financial flows and mathematical tools for their analysis

Learning outcomes

Students master application of numerical methods for financial flow analysis.

Course structure and content

Theoretical instruction:

1-2. Introduction. Numerical computations in financial transactions. Relation to numerical methods. Software support. 3-8. Basics of numerical analysis. Errors of approximate values of numbers and functions. Iterative methods for solving systems of linear equations. Direct and iterative methods. Solving systems of nonlinear equations. Approximation of functions. Interpolation. Least-squares approximation. Finite element method for partial differential equations. 9.-12. Mathematical models of finantial flows. Portfolio optimization. Dynamics of price of stock exchange shares. Black-Scholl model. Monte Carlo simulation. Applications of finite element method. 13.-15. Basics of MATLAB. Applications in analysis of mathematical models in finances.

Practical instruction:

Examples of finantial flow models. Implementation of numerical methods in MATLAB. Analysis of mathematical models of financial flows.

Literature/Readings

1. Djurica Jovanov, Numerical Analysis, theory, algorithms, examples, FON, Belgrade, 2005.
2. Rade P. Lazović, Numerical methods, FON, Belgrade, 2013.
3. Rade P. Lazović, Numerical analysis, theory review, examples, problems, FOS, Belgrade, 2009.
4. S. Benninga, Numerical Techniques in Finance, MIT Press, 1989.
5. D. Djorić, Mathematics and MATLAB, Higher School for Electrotechnics, Belgrade, 2003.
6. Paolo Brandimarte: "Numerical Methods in Finance and Economics: A MATLAB-Based Introduction", John Wiley & Sons, Inc.

7. S. Ross, An Elementary Introduction to Mathematical Finance, Cambridge University Press, 2003.				
The number of class hours per week				**Other classes:**
Lectures: 2	**Labs**: 2	**Workshops:**	**Research study:**	
Teaching methods Classroom teaching and computer labs				
Evaluation/Grading (maximum 100 points)				
Pre-exam requirements		**Points**	**Final exam**	**Points**
Participation in class		10	Written exam	20
Participation in labs		30	Oral exam	40

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Data mining

Teacher:Suknović M. Milija,Delibašić V. Boris

Course status: Optional

ECTS points: 6

Prerequisites: /

Course objective

Introduction to the important business problems for which data mining can be applied, and gaining skills for using selected data analysis tools.

Learning outcomes

Students have acquired skills to recognize cases where data mining can be used, and how to apply data mining tools for analsis.

Course structure and content

Theoretical instruction:

L-01: Introduction to data mining. L-02: Market basket analysis with case study. L-03: Credit scoring with case study. L-04: Churn prediction with case study. L-05: Electricity load prediction with case study. L-06: Market segmentation with case study. L-07: Gene expression clustering with case study. L-08: Student success prediction with case study. L-09: Collaborative filtering for recommendation systems with case study. L-10: Spam detection with case study. L-11: User comment analysis with case study. L-12: Attribute selection with medical application. L-13: Image analysis with case study. L-14: Anomaly detection in data. L-15: Preparation for the final exam.

Practical instruction:

E-01: Introduction to software tools. E-02: Market basket analysis using software. E-03: Credit scoring using software. E-04: Churn prediction using software. E-05: Electricity load prediction using software. E-06: Market segmentation using software. E-07: Gene expression clustering using software. E-08: Student success prediction using software. E-09: Collaborative filtering for recommendation systems using software. E-10: Spam detection using software. E-11: User comment analysis using software. E-12: Attribute selection with medical application. E-13: Image analysis using software. E-14: Anomaly detection in data. E-15: Preparation for the final exam.

Literature/Readings

1. RapidMiner: Data Mining Use Cases and Business Analytics Applications Edited by Ralf Klinkenberg, Chapman and Hall/CRC 2013, Print ISBN: 978-1-4822-0549-7, eBook ISBN: 978-1-4822-0550-3

The number of class hours per week	**Other classes:**

Lectures: 2	Labs: 2	Workshops:	Research study:	
Teaching methods Classic lecture, lab exercises.				
Evaluation/Grading (maximum 100 points)				
Pre-exam requirements		**Points**	**Final exam**	**Points**
Participation in class			Project work	80
Participation in labs			Written exam	20

Study program / study programs:Business Analytics

Degree level: MSc

Course:

Business analytics and optimization

Teacher:Vujošević B. Mirko,Čangalović M. Mirjana,Martić M. Milan,Stanojević J. Milan,Kuzmanović S. Marija,Savić I. Gordana,Makajić-Nikolić D. Dragana

Course status: Mandatory (Elective in study program Information systems and technologies)

ECTS points: 6

Prerequisites: none

Course objective

To provide the students with basic knowledge in business analytics and optimization and to enable them to apply optimization methods in the process of decision making.

Learning outcomes

Students will examine the importance of optimization in business analytics and decision-making. They will be able to recognize situations in which it is possible to successfully apply the methods and techniques of optimization, and to develop decision support systems based on optimization.

Course structure and content

Theoretical instruction:

Introduction to business analytics. Development and trends of business analytics. Business analytics and business decisions. Business intelligence as a part of business analytics. Operations research methods in business analytics. Mathematical modelling of business systems. The architecture of decision support system based on optimization. Algebraic programming languages and their use in developing optimization models. The use of databases Optimization in business analytics – case studies. Postoptimal and sensitivity analyses. Optimization under uncertainty.

Practical instruction:

Work on case studies using available software.

Literature/Readings

1. S. Krčevinac i dr, Operaciona istraživanja 1, FON, Beograd, 2013.

2. S. Krčevinac i dr, Operaciona istraživanja 2, FON, Beograd, 2013.

3. M. Vujošević, Metode optimizacije u inženjerskom menadžmentu, FON, Beograd, 2012.

4. M. Vujošević, Linearno programiranje, FON, Beograd, 2013.

5. J.A. Lawrence, B.A. Pasternack, Applied Management Science, John Wiley & Sons Inc. 2002.

6. R. Fourer, D.M. Gay, B.W. Kernighan, AMPL: A Modeling Language for Mathematical Programming, Duxbury Press / Brooks /Cole Publishing Company, 2002.

7. A. Makhorin, Modeling Language GNU MathProg Language Reference, Free Software Foundation, 2013.

8. R. Saxena, A. Srinivasan, Business Analytics: A Practitioner's Guide, Springer, 2013

9. J. R. Evans, Business Analytics: Methods, Models and Decisions, Pearson, 2013

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs:1**	**Workshops:1**	**Research study:**	

Teaching methods: Classical lessons, work in computer laboratory; workshops.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	5	Written exam - project	50
Participation in labs	**5**	Oral exam	40

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Business Statistics

Teacher:Bulajić V. Milica,Radojičić A. Zoran,Jeremić M. Veljko

Course status: Compulsory

ECTS points: 6

Prerequisites:

Course objective:

The course provides an overview of statistical methods and models which can be applied in decision making process in various fields of management, with the special emphasis on marketing and finance. Moreover, it introduces students to different ways of use of predictive statistical models and methods of statistical interference.

Learning outcomes

The content of this course enables students for modelling and solving practical problems in the field of management using methods of statistical analysis. Moreover, students will be thought to adequately employ statistical prediction in order to gain greater accuracy and assurance in interference and decision making process.

Course structure and content

Theoretical instruction:

T01: Data collection, sample and sample planning. T02: Automatic control and correction of errors. T03: Construction and logical design of questioner. Sample data processing. T04: Hypothesis testing. T05: Parametric and non-parametric interference. T06: Bayesian interference. T07: Multivariate statistical analysis. Models. T08: Computational support to statistical research. T09: Prediction, classification and analysis of business risk. T10: Coefficient of preference. Relative risk and ratio. T11: Ekonometric modelling. T12: Analysis of financial time series. T13: ARIMA, ARCH and GARCH models. T14: Applicability and model valuation. T15: Solving practical problems.

Practical instruction:

P01: Data collection, sample and sample planning. P02: Automatic control and correction of errors. P03: Construction and logical design of questioner. Sample data processing. P04: Hypothesis testing. P05: Parametric and non-parametric interference. P06: Bayesian interference. P07: Multivariate statistical analysis. Models. P08: Computational support to statistical research. P09: Prediction, classification and analysis of business risk. P10: Coefficient of preference. Relative risk and ratio. P11: Ekonometric modelling. P12: Analysis of financial time series. P13: ARIMA, ARCH and GARCH models. P14:

Applicability and model valuation. P15: Solving practical problems.

Literature/Readings

1. Giudici P., Figini S., *Applied Data Mining for Business and Industry*, Wiley, 2009.
2. Metcalfe A. V., *Statistics in Management Sciences*, Oxford University Press, 2000.
3. Keller G., Warrack B., *Statistics for Management and Economics, Abbreviated Edition*, Thompson, 2006.
4. Agresti A., *An Introduction to Categorical Data Analysis*, Wiley, 2007.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs:** 2	**Workshops:**	**Research study:**	

Teaching methods: Traditional with the use of whiteboard and computer

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	5	Written exam	25
Participation in labs	**5**	Oral exam	25
Colloquium	**20**		
Seminar	**20**		

Study program / study programs: Business Analytics

Type of study and the level: MSc

Course:

Computer Statistics

Teacher: Radojičić A. Zoran,Jeremić M. Veljko

Inventory Status: Electioneers

Number of extra ECTS: 6

Condition:

Inventory Goal

In a course are able linking methods statistical analysis and modern information technology. Computer statistics is an area specialization statistics, which reimpose mean percentage visualization, and other computer methods statistics, are conceived on statistical methods.

Inventory Outcome

Training for use of sweeping opportunities application of statistical methods in computer science environment. Practical application of complex statistical methods on real data and adequate interpretation of it.

Inventory Content

Theoretical learning

P01: techniques for discovering structure data. P02: Problems obeying density, clustering or classification. P03: gatherings data large dimensions. P04: Statistical learning and detection of legality in data. P05: methods analysis extremely large gatherings data. P06: Bootstrap and jackknife methods. P07: computer analysis methods. P08: Monte Carlo methods. P09: methods sampling rates. P10: methods statistical risk modeling. P11: Classical statistical models. P12: models based on differential equations. P13: Bayes hierarchical models and naive Bayes classificatory. P14: numerical methods for statistical analysis (statistical calculations). P15: methods for statistical problems that have a significant "Computer was" aspect.

Practical classes: exercise, other forms of teaching, study and research work

V01: Statistical packages. V02: an SPSS statistical package. V03: Case Study in an SPSS statistical package. V04: Statistical Package Statistica. V05: Case Study in statistical package Statistica. V06: Statistical Package culture. V07: Case Study in different statistical package. V08: Case Studies using Monte Carlo methods. V09: Open Source statistical software's. V10: Statistical Package DAP. V11: Case Study in statistical package DAP. V12: Statistical Package S. V13: Case Study in statistical package S. V14: exercise statistical estimate. V15: Statistical methods from the aspect of computer science.

Literature

1. Gentle J. E. , *available at Computational*, Springer, 2009.
2. Gentle J. E., Hardle W. , during its transitional Y. , *Handbook of Computational available at*, Springer, 2004.
3. Pallant J. , *an SPSS survival mm*, , Allen & Unwin, 2011.
4. Givens G. H. ,Hoeting J. A. , *Computational available at*, Wiley, 2006.
5. Leech N. L. , Barrett K. C. , Morgan G. A. , *IBM an SPSS for Intermediate available at: professionalization and interpretation*, Taylor & Francis, 2011.

Number of hours used active continue				Other Classes
Lectures: 2	Exercise: 2	Other forms of teaching:0	Study research work :0	
Methods of performing classes: Classic way, using boards and computers.				
Grocery knowledge (maximum number of points 100)				
Prior exam obligations		**Points**	**Final exam**	**Points**
Activity in the course lectures		5	A written exam	25
Practical classes		5	Oral exam	25
Museums-and		20		
The seminar-and		20		

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Simulation models in finance - selected chapters

Teacher: Marković M. Aleksandar,Knežević P. Snežana,Jeremić M. Veljko

Course status: elective

ECTS points: 6

Prerequisites: none

Course objective

The aim of the course is for students to master the techniques of modeling in spreadsheet programs, to be able to create complex financial spreadsheet models, to realize the importance of using simulation models in finance, to gain knowledge in the field of Monte Carlo simulation to solve financial problems, to learn that it is possible to use a variety of simulation models in the analysis of financial problems.

Learning outcomes

Independent construction and use of a spreadsheet simulation model for financial decision-making, learning the techniques of advanced spreadsheet modeling, the ability to use models to make decisions in the field of financial management and financial risks management.

Course structure and content

Theoretical instruction: Introduction – application of the models in finance; the role and importance of financial models. Modeling in spreadsheet programs - advanced techniques. Simulation in spreadsheet programs. Sensitivity analysis in spreadsheet programs. Stochastic modeling of financial problems. Using the simulation results in the analysis of financial problems. Advanced use of add-in programs for spreadsheet models. A number of practical financial spreadsheet model applications.

Practical instruction: Advanced spreadsheet modeling techniques - MS Excel. Development and construction of complex spreadsheet models: Model for determining the value of the shares on the Stock Exchange; Applying Solver & Goalseek modules in the sensitivity analysis; Models for corporate financial planning; Model for portfolio analysis. Model for determining the value of the investment at risk - VaR. Application of Black Scholes model in finance. Spreadsheet models in the management of investments; Models for risk analysis in the @RISK software.

Literature/Readings

Charnes, J. *Financial Modeling with Crystal Ball and Excel*, John Wiley & Sons, Hoboken, New Jersey, 2012.

Chan, N.H., Wong, H.Y. *Handbook of Financial Risk Management – Simulations and Case Studies*, John Wiley & Sons, Hoboken, New Jersey, 2013.

Rees, M. *Financial Modelling in Practise*, John Wiley & Sons, West Sussex, 2008.

Benninga, S. *Financial Modeling*, MIT Press, Cambridge, Massacusetts, 2008.

Proctor, S. *Building Financial Models with Microsoft Excel*, John Wiley & Sons, Hoboken, New Jersey, 2010.

Guide to Using @RISK, Risk Analysis and Simulation Add-In for Microsoft Excel, Palisade Corporation.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs:** 2	**Workshops:**	**Research study:**	

Teaching methods

Classes on the board in the computer classroom, presentations, practical work at the computer, assignments, homeworks.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	10		
Essay/project	40	Oral exam	50

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Business inteligence

Teacher: Suknović M. Milija,Delibašić V. Boris

Course status:Obligatory/Elective

ECTS points: 6

Prerequisites: /

Course objective

Students should be introduced with concepts of Business intelligence. Additionally students should be familiar with Business intelligence tools and techniques in order to get practical knowledge and skills that should enable them efective usage of data with the goal of quality decision making.

Learning outcomes

At the end of the course students should be able for timely decision making in the situationce when there is the need for big data analysis and when decision making time is limited for making right decisions.

Course structure and content

Theoretical instruction

01: Decision support systems and Business intelligence. 02: Decision making modeling and decision support. 03: Basics of Business intelligence. 04: Data Warehousing. 05: Business analytics and data visualization. 06: Data, text and web mining. 07: Neural networks in data mining. 08: Enterprise performance management. 09: Group and collaborative decision support systems. 10:Knowledge management. 11: Expert systems. 12: Intelligent systems for decision support. 13: Integration and the future of the decision support.14: Business intelligence system - case study 1. 15: Business intelligence system - case study 2.

Practical instruction

01: Decision support systems. 02: Decision support. 03: Introduction to Business intelligence. 04: OLAP cubes. 05: Analytics and visualization. 06: Data mining. 07: Neural networks. 08: Key performance indicators. 09: Group decision support systems. 10: knowledge management. 11: Expert systems. 12: Intelligent decision support systems. 13: Hybrid systems.14: Case study 1. 15: Case study 2.

Literature/readings

1. Turban, E., Aronson, EJ., Liang, TP. & Sharda, R. (2007) Decision Support and Business Intelligence Systems (8th Edition).
2. Suknović M, Delibašić V (2010) Business intelligence and decision support systems, Faculty of Organizational sciences, Belgrade, Serbia.

The number of class hours per week				Other classes:
Lectures: 2	Labs: 2	Workshops:	Research studies:	

Teaching methods Classical teaching and exercises. Case studies. Work on projects in small groups. Presentation of project results			
Evaluation/Grading (maximum 100 points)			
Pre-exam requirements	**Points**	Final Exam	**Points**
Homework project	50	Project proposal	30
		Oral exam	20

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Data warehouse

Teacher: Suknović M. Milija,Delibašić V. Boris

Course status: Elective

ECTS points: 6

Prerequisites: /

Course objective

Development of business reporting systems through following steps: aquisition of customers requirements, data warehouse structure design, data cleansing, integration and loading data and implementation of reporting systems in web environment.

Learning outcomes

Students should be capable for acquisition of customers requirements, data warehouse design and implementation as well as implementing reporting system in Microsoft technologies (Integration and Reporting services).

Course structure and content

Theoretical instruction

1. Data warehouse as a part of Business intelligence systems 2. Understanding and acquisition of customers requirements 3. Relational and multidimensional data models 4. Multidimensional data models - Case studies 5. Data warehouse properties - Granularity, integrality 6. Data warehouse properties - time dimension, slowly changing dimensions. 7. ETL - data cleansing 8. ETL - integration 9. OLAP systems and technologies 11.OLAP reporting - case studies. 12. New trends: master data management 13. New trends: Real-time reporting

Practical instruction

1. Pivot report design 2. Design of simple OLAP model 3. Subject selection for project work and definition of business reports. 4. Data warehouse design - multidimensional model definition 5. Data warehouse desogn - definition of granularity levels, slowly changing dimensions and aggregations 6. Introducing to Microsoft integration services 7. ETL - identification of inconsistencies and errors in data. 8. ETL - data cleansing 9. ETL - data integration 10. Data aggregation and OLAP cube design 11. Design of OLAP cube reports in Microsoft Power Pivot technology 12. Introduction to Reporting services 13. Design of reporting system in web environment

Literature/readings

1. Suknović M, Delibašić V (2010) Business intelligence and decision support systems, Faculty of Organizational sciences, Belgrade, Serbia.
2. Kimball, R., & Caserta, J. (2006). The data warehouse ETL toolkit, Wiley Publishing, Inc.
3. Inmon, W. H. (1996). Building the data warehouse, Wiley Publishing, Inc.
4. Mundy, J., & Thornthwaite, W. (2008). *The Microsoft Data Warehouse Toolkit: With SQL Server2005*

and the Microsoft Business Intelligence Toolset. Wiley Publishing, Inc.				
The number of class hours per week				Other classes:
Lectures: 2	Labs: 2	Workshops:	Research studies:	
Teaching methods Classical teaching, Lab exercises				
Evaluation/Grading (maximum 100 points)				
Pre-exam requirements		**Points**	Final Exam	**Points**
			Project proposal	80
			Oral exam	20

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Statistics in management – selected chapters

Teacher:Jeremić M. Veljko

Course status: Elective

ECTS points: 6

Prerequisites:

Course objective

The course provides an overview of statistical methods and models which can be used as decision making support in different areas of management. Special attention is devoted to methods that are used in marketing, financial management and quality management, as well as areas in which methods of statistical analysis are frequently in use.

Learning outcomes

Content of this course will prepare students for modelling and solving practical problems in the management by applying statistical analysis methods.

Course structure and content

Theoretical instruction:

L01: Collection of data, sample and sample planning, preparation and logically design questionnaire. L02: Automatic control and correction of errors. L03: Hypothesis testing. L04: Parametric and nonparametric inference. L05: Multivariate statistical analysis. L06: Computer supported statistical research. L07: TURF method. L08: Structural equations modelling. L09: AMOS and LISREL. L10: SERVQUAL model analysis. L11: Statistical quality control. L12: Econometric modelling. L13: Financial time series analysis. L14: Practical problems resolving. L15: Practical problems resolving**.**

Practical instruction:

P01: Collection of data, sample and sample planning, preparation and logically design questionnaire. P02: Automatic control and correction of errors. P03: Hypothesis testing. P04: Parametric and nonparametric inference. P05: Multivariate statistical analysis. P06: Computer supported statistical research. P07: TURF method. P08: Structural equations modelling. P09: AMOS and LISREL. P10: SERVQUAL model analysis. P11: Statistical quality control. P12: Econometric modelling. P13: Financial time series analysis. P14: Practical problems resolving. P15: Practical problems resolving**.**

Literature/Readings

1. Metcalfe A.V., *Statistics in Management Sciences*, Hodder Education Publishers, 2001.
2. Rossi P.E., Allenby G.M., McCulloch R., *Bayesian Statistics and Marketing*, Wiley, 2005.
3. Keller G., Warrack B., *Statistics for Management and Economics, Abbreviated Edition*, Cengage

Learning, 2011.

4. Levin R., *Statistics for Management*, Pearson Education, 2011.
5. Shayib M.A., *Applied Statistics*, Bookboon, 2013.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs:** 2	**Workshops:**	**Research study:**	

Teaching methods

The traditional way of lecturing, with the use of whiteboard and computer

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	5	Written exam	25
Participation in labs	5	Oral exam	25
Colloquial	20		
Seminar work	20		

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Theory of the Algorithms

Teacher:Stojanović A. Milica,Manojlović P. Vesna

Course status: Required/Elective

ECTS points: 6

Prerequisites: Finished undergraduate studies

Course objective: Presentation of the basic elements of the numerical complexity and analysis of the algorithms. Teaching students to make algorithms in different fields (graph theory, algebra, geometry, sequences, set theory)

Learning outcomes: After course, students will be able to create algorithms and to determine their numerical complexity.

Course structure and content

Theoretical instruction:

1. Time and space complexity of an algorithm and a problem. 2. Deterministic and nondeterministic Turing machine. 3. NP class of problems. NP completeness and NP hard problems. 4. Construction of algorithms by the induction, examples. 5. Strengthening the inductive hypothesis; proving correctness of the algorithm. 6. Algorithms on the graphs: detour in graph; the shortest paths. 7. Problem of the matching in the graph; transportation network; Hamiltonian paths. 8. Geometrics algorithms: problems with polygon; convex hull. 9. Algebraic algorithms: problems with polynomials. 10. Problems with matrices. 11. Algorithms over sequences and sets. 12. Some of the algorithms in cryptography. 13. Parallel algorithms; algorithms for computer networks. 14. Seminar work.

Practical instruction:

Creating algorithms in field which were studied theoretically and analysis of their complexity.

Literature/Readings

1. M. Živković: Algorithms, Math. Faculty, Belgrade, 2000. (in Serbian)
2. Z. Ognjanović, N. Krdžavac: Introduction into theoretical computer science, FON, Belgrade, 2004. (in Serbian)
3. Leung Joseph, ed.: Handbook of scheduling: algorithms, models, performance analysis, Boca Raton [etc.]: Chapman and Hall/CRC, 2004.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs: 2**	**Workshops:**	**Research study:**	

Teaching methods: mentor and/or classical

Evaluation/Grading (maximum 100 points)			
Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	15	written exam	25
Participation in labs		oral exam	25
Project	35		

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Game Theory and Business Strategy

Teacher: Kuzmanović S. Marija,Martić M. Milan

Course status: Elective

ECTS points: 4

Prerequisites:

Course objective

The course is designed to introduce students to the basic concepts, principles and models of game theory with the goal of providing the student with the tools and the ability to enhance their abilities for strategic and analytical thinking as well as for modeling and analyzing strategic interaction in the complex and interactive business environment.

Learning outcomes

Students will be provided with the tools and the ability to enhance their abilities for strategic and analytical thinking and application of game theory concepts in modeling and solving real world problems.

Course structure and content

Theoretical instruction: P01: Introduction and basic principles: Course objectives. Terminology. Strategic Thinking. Understanding the rules. Rationality and Common Knowledge. Equilibrium. P02-P03. General classes of games and strategies: Cooperative and Non-cooperative games. Simultaneous Games. Sequential Games. Mixed games. Repeated games. P04. Typical games: Prisoner's Dilemma – solving and application. P05-P06. Games with strategic moves: Strategic use of information. Commitment and credibility. Strategic substitutes and complements. Games with asymmetric information. Bayesian games. Signaling games. P07. Cooperative games: Coalitions. The core. The Shapley value. P08-P11. Oligopoly models: Cournot, Bertrand and Stackelberg competition. P12-P15. Applications: Economics. Business. Marketing. Finance. Computer science. Other applications.

Practical instruction: Modeling strategic interaction. Typical games: Prisoner's dilemma, Coordination, Battle of the sexes, Chicken game, Hawk and Dove. Analogy of the typical games with real situations through examples. Methods and techniques for solving the strategic equilibrium in static and dynamic games. Solving equilibrium in duopoly models. The interpretation of the strategic equilibrium. Software for solving games and simulation. Case Studies: Price war, Market entry, Strategic investment, Negotiation, Auctions.

Literature/Readings

1. Krčevinac, S. et al., Operaciona istraživanja 1, FON, Beograd, 2006.

2. Stojanović, B., Teorija igara - elementi i primena, Službeni glasnik, 2005.

3. Dixit A., and Skeath S., Games of Strategy, 2nd edition, Norton, New York, 2004.

4. Hillas, J., Schiff, A., Game theory and Economic Applications, Lecture notes, 2002.

5. www.gametheory.net

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs:** 2	**Workshops:**	**Research study:**	

Teaching methods

Lectures accompanied by appropriate presentations and multimedia content. Exercises based on realistic and illustrative examples. Creative workshops based on interactive work with students through analysis of case studies, experimental games and simulations.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Class Participation	10	Written exam	30
Practical lectures	30		
Seminar work	30		

Study program / study programs:Business Analytics

Degree level: MSc

Course:

Supply Chain Management 2

Teacher: Vasiljević V. Dragan,Vujošević B. Mirko

Course status: Compulsory for Management and Organization

ECTS points: 6

Prerequisites: Integrated Logistics Systems or some of the courses which offer quantitative support to operations management.

Course objective: To broaden and deepen the existing knowledge of students with contemporary concepts of supply chain management as well as models for supply chain performance measurement.

Learning outcomes: Theoretical and practical knowledge which enable students to perform operations in the field of supply chain management and supply chain processes optimization.

Course structure and content

Theoretical instruction:

T-01: Course introduction.

T-02: Theoretical basics of *VMI* concept.

T-03: Theoretical basics of *CPFR* and *Flowcasting* concepts.

T-04: Preparation for writing term paper.

T-05: *E-SCM.*

T-06: Strategic alliances: definition, role and forms.

T-07: Ecological aspects of supply chains.

T-08: Theoretical basics of network location problems.

T-09: Inventory management under uncertainty.

T-10: Risk management in supply chain.

T-11: Multi-criteria optimization in supply chains.

T-12: Performance measurement in supply chain.

T-13: Software support for SCM.

T-14: Control test.

T-15: Presentation of term papers.

Practical instruction:

P-01: Communication and contracting skills in supply chains.

P-02: The *VMI* concept: case study.

P-03: The *CPFR* and *Flowcasting* concepts: case studies.

P-04: Aggregate planning in supply chains.

P-05: Routing in distribution networks.

P-06: Test 1.

P-07: Designing the distribution network.

Literature/Readings:

1. Vasiljevic D., Jovanovic B., *Logistics and Supply Chain Management*, ISBN 978-86-7680-150-3, FOS, Belgrade, 2008. (in Serbian)
2. Simchi-Levi, D., Kaminsky, P. And Simchi-Levi, E., *Designing and Managing the Supply Chain, Concepts, Strategies, and Case Studies*, McGraw-Hill International Editions, 2000.
3. Voss S., Woodruff D.L., *Introduction to computational optimization models for production planning in a supply chain*, Springer Verlag, Berlin, 2003.

The number of class hours per week				Other classes:
Lectures: 2	Labs: 2	Workshops:	Research study:	

Teaching methods: Ex cathedra teaching, interactive teaching methods (creative workshops and case studies analysis), practical and lab exercieses.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	10	Oral exam	30
Participation in labs	15		
Tests	20		
Term paper	25		

Method of knowledge evaluation:

Grades	**5**	**6**	**7**	**8**	**9**	**10**
Points	[0-55]	[56-65]	[66-75]	[76-85]	[86-95]	[96-100]

Study program / study programs: Business Analytics

Degree level: MSc

Course:

Risk Management in Engineering

Teacher:Vujošević B. Mirko,Makajić-Nikolić D. Dragana

Course status: Elective

ECTS points: 6

Prerequisites: Probability Theory

Course objective

Course objective is to provide the students with skills needed to identify, evaluate and reduce risk in practice using engineering and risk management concepts and techniques.

Learning outcomes

The acquired knowledge and experience will qualify the students to identify main hazard of engineering project and to create appropriate risk management strategy in order to avoid, reduce, share or accept risk.

Course structure and content

Theoretical instruction:

Introduction – course objective and content. Terminology and definitions in Risk and Risk management. Sociological and psychological aspects of risk. Domain related risk definition and management risk techniques: technique-technology systems, process safety, project risk, financial risk, computer systems risk, information systems risk, ecological risk, life and health risk, radiation risk, electrical systems risk etc. Basic concepts of Preventive engineering and Risk management. Hazard analysis technique. Failure Mode, Effects, and Criticality Analysis. Fault tree analysis. Preliminary Risk Analysis. HAZOP. Decision Making Under Uncertainty.

Practical instruction:

Practical work is in accordance with theoretical instructions plan. Main topics of the practical instructions are standards and available software packages for solving case studies.

Literature/Readings

1. M. Modarres, M. Kaminskiy, V. Krivtsov, Reliability Engineering and Risk Analysis, CRC Press, New York, 1999

2. C. A. Ericson II, Hazard analysis techniques for system safety, Wiley, 2005

3. Y. Y. Haimes, Risk Modeling, Assessment, and Management, Wiley, 2005

4. T. Bedford, R. Cooke, Probabilistic Risk Analysis - Fonadtions and methods, Cambridge, 2001

5. И. М. Макаров (уредник), Управление риском, Наука, Москва, 2000

6. Guidelines for risk analysis software packages.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs: 1**	**Workshops: 1**	**Research study:**	

Teaching methods Theoretical classes – traditional. Practical classes manly with the use available software packages for reliability and risk analysis.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	10	Written exam	40
Participation in labs	20	Oral exam	30

Study program / study programs: Business Analytics

Degree level: Master study

Course:

Practice Specification

Teacher: All teachers involved in the study program

Course status: Mandatory

ECTS points: 4

Prerequisites: /

Course objective

Training students to do independent research and professional work in identifying and solving specific tasks in the program of study, in real conditions of practice and / or research laboratories and centers.

Learning outcomes

Gaining experience and mastery of skills in the use of deepening and enriching the acquired theoretical and practical knowledge for the purpose of identifying and resolving specific issues and tasks that occur in the real system.

Course structure and content

Elements of the project task; Defining the objectives and tasks of the research; Identification and description of the basic problems through the development of key thesis; The basic methods, techniques and tools for the project professional practice - selection of appropriate methods TOR and predicted empirical research; Basic elements of the presentation of research results - the principles of successful presentations and various forms and characteristics of individual forms, such as the content of written documents, oral, electronic presentations; Defining a specific project task of professional practice for each student - goals and tasks, duties and responsibilities of the student organization (if it is implemented in a particular organization), mode, form and content of the final report, and etc.

Literature/Readings

The *number of class hours* per *week*				
Lectures:	**Labs:**	**Workshops:**	**Research study:**	**Other classes:**
			20	

Teaching methods

The application of different methods of research, consultations (individual and group). The use of different teaching methods with practical work.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**

Seminar	50	Written exam	50

Study program / study programs: Business Analytics

Degree level: Master study

Course:

Research proposal

Teacher: All teachers involved in the study program

Course status: Mandatory

ECTS points: 8

Prerequisites: /

Course objective

The main objective is to prepare students for Degree - Master of work, so he is the first phase of development of master work. With the help of mentors, students will be prepared that, with the conquest of the necessary methods and with the use of basic acquired during their studies, scientific-technical and professional application of knowledge, solve a specific problem within the selected areas. As part of these preparations student studying the broader context of the problem, its structure and complexity.

Based on literature student meets with the existing approaches to solving similar tasks and good practice. Based on the conducted comparative analysis of available solutions student brings a proposal of its own approach to solving the complex problems. The aim of the activities of students in this part of the research is to gain the necessary experience through solving complex problems and tasks and identifying opportunities for the application of previously acquired knowledge into practice.

Learning outcomes

Engineer should improve their previous titles acquired those skills and knowledge which enables him to solve the most complex problems. In addition to the knowledge and skills acquired in undergraduate studies, students are trained for research work. Acquire the necessary knowledge in specific scientific fields, methods of scientific research and skills (oral presentation, group communication, etc.). Because creative approach to the interpretation of other people's knowledge and experience can exercise and less scientific contributions. In this way gain a better performance on the market work, and acquired competencies enable them to find employment in research and development centers and institutes, or in companies that are committed to improving their own work and open to new approaches and solutions in the areas of organization and management. In the access student work defines the topic, purpose, research methods, literature you will use.

Course structure and content

The content of the work depends on the particular rešavanog problems and is aligned with the objectives of the case. The work includes the object and purpose of the research, initial hypotheses, research methods, the contribution of access and conclusions.

Literature/Readings

The *number of class hours* per *week*	**Other**

Lectures:	Labs:	Workshops:	Research study:	classes:
			20	

Teaching methods

After discussions with the supervisor about topics of the future specialist labor, student, with the approval of the selected mentors and task-specific, starts making the access operation. During the preparation of this paper, mentor conduct regular consultations to learn about the progress of the student, critically evaluate current work and provides additional guidance in the form of student guidance or reference to a particular literature.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	Points	Final exam	Points
Creation paper specification	50	Defense graduate paper specification	50

Study program / study programs: Business Analytics

Degree level: Master studies

Course:

Graduate paper specification

Teacher: All teachers involved in the study program

Course status: Mandatory

ECTS points: 18

Prerequisites: /

Course objective

Engineer of organizational sciences should demonstrate an increased ability to research in the case of new or unfamiliar problems in this area, linking the acquired knowledge and skills in solving complex problems, and the ability to follow and adopt papers and research results.

Learning outcomes

Graduate engineers - masters improve their previous knowledge acquired those skills and knowledge that they provide better performance on the market work, and acquired competencies enable them to find employment in research and development centers and institutes, enterprises or their own organizations. Students gain specialization in the above sub-group can independently or in a team to solve the most complex problems, because they deepen previously acquired academic skills and knowledge, understanding and skills. Are trained to solve complex problems. They independently investigate, process the data obtained in the research, draw conclusions, write and defend the results.

Course structure and content

By creating and defending the master's thesis students are usavšavaju in the scientific field that is the subject of their master academic studies and acquire a graduate engineer in the field of master academic studies. Engineer - master has deepened academic theoretical and practical knowledge and skills in the chosen specific scientific field, knows in academia and beyond the accepted methodology for solving complex problems and is able to be independent and creative application in solving the problems that will occur in practice.

Literature/Readings

The *number of class hours* per *week*				**Other classes:**
Lectures:	**Labs:**	**Workshops:**	**Research study:**	

Teaching methods

After accepting the diploma master work of a candidate under the supervision of a mentor approach to designing work. Creating work should be carried out in accordance and in the implementation plan exposed in the application work. Candidate in the laboratory and / or field work independently on the practical aspects of the problems solved. In consultation with the supervisor if necessary checks the work plan, in terms of the elements it contains, or the dynamics of additional sources.

Evaluation/Grading (maximum 100 points)			
Pre-exam requirements	**Points**	**Final exam**	**Points**
Creation graduate paper specification	50	Defense graduate paper specification	50