ADA
ADVANCED DATA ANALYTICS IN BUSINESS

Advanced Data Analytics in Business (ADA)
EACEA 598829-EPP-1-2018-1-RS-EPPKA2-CBHE-JP

Co-funded by the European Union

Analysis of status of various courses related to business analytics at Serbian universities

contacts: Prof. Dr Jelena Stanković, University of Niš, jelena.stankovic@eknfak.ni.ac.rs
Prof. Dr Mirko Savić, University of Novi Sad, savicmirko@ef.uns.ac.rs

Project acronym:	ADA
Project full title:	Advanced Data Analytics in Business
Project No:	598829-EPP-1-2018-1-RS-EPPKA2-CBHE-JP
Funding scheme:	ERASMUS+
Project start date:	November 15, 2018
Project duration:	36 months

Abstract	This document is aimed to provide the comparative analysis of master courses at Serbian universities related to the field of business and data analytics. It is a part of first activity Analysis of best practise and comparative analysis in Work Package 1. The analysis includes the four largest state universities in the Republic of Serbia.

Title of document:	Analysis of status of various courses related to business analytics at Serbian universities
Work package:	WP1: Development of a new program in Advanced Data Analytics in Business
Activity:	Analysis of best practise and comparative analysis
Last version date:	2019/03/15
File name:	Analysis of BA master programs as Serbian universities.docx
Number of pages:	15
Dissemination level:	Project team, Department/Faculty, Institution, Regional, National

VERSIONING AND CONTRIBUTION HISTORY

Version	Date	Revision description	Partner responsible
Ver. 1	2019/03/15	First version	UNI

Contents

Analysis of best practice and comparative analysis

The first activity in Work Package 1 “Analysis of best practise and comparative analysis” is aimed to provide an analysis of best practise at EU universities and comparative analysis of status in the field of business analytics (BA) in Serbia. This is essential and primary activity in the process of development of a new master program Advanced Data Analytics in Business.

The analysis of best practise at EU universities and comparative analysis of status in the field of BA in Serbia will be accompanied with an analysis of learning outcomes and competencies which must have any business analyst, taking into account particular situation in Serbia. The outcome of the activity is consensus about best practice achieved among partners. Based on joint results of the analysis above, learning outcomes and competencies, the curriculum (program, syllabi of all the courses, potential modules, and ECTS) will be developed. In order to do this in an optimal way, visits of EU experts in the field of BA will be organized. Once finished, the program will be verified through the accreditation process as soon as possible. For curriculum development, courses in statistics, operational research, econometrics, risk analysis, supply chain management, data mining, predictive modelling, multivariate testing, will be revised in order to be more compatible with business analytics, while completely new courses will be machine learning, big data analytics, text analytics, data visualization, business intelligence reporting, and self-service analytics platforms.

Tasks within activity 1.1 Analysis of best practise and comparative analysis (WP1) are:

- Analysis of best practice at EU partner universities;
- Survey on stakeholders about their needs in business analytics and
- Analysis of status of various courses related to business analytics at Serbian universities.

This report refers to the third task that completes the analysis of the first activity in order to achieve the aim of “Advanced Data Analytics in Business” (ADA) project application, i.e. to develop and implement study and lifelong learning programs based on contemporary techniques, methods and theoretical approaches in advanced data analytics.

The indicator of realized task is the report and concluding remarks that provide clear picture of comparative master courses related to business analytics that exist in Serbian universities, as well as to provide basis for development of the more competitive master course Advanced Data Analytics in Business.

Universities in Serbia and the scope of the analysis

There are 18 universities in Serbia, of which 8 were founded and financed by the state, while 10 universities are privately owned. State owned universities are: University of Belgrade, University of Novi Sad, University of Niš, University of Kragujevac, State University in Novi Pazar, University of Prishtina with temporary headquarters in Kosovska Mitrovica, University of Arts in Belgrade and University of Defence in Belgrade.

The last two in a row are universities in specific areas where there are no faculties whose field can be associated to data analysis or business analytics. State University in Novi Pazar, as well as University of Prishtina with temporary headquarters in Kosovska Mitrovica are far smaller and with a smaller scientific impact than the four largest universities in Serbia, members of the ADA project consortium, so we found them neither comparative nor competitive in such analysis. On the other hand, private universities have a couple of master courses related to business analytics, or at least a group of subjects devoted to data analysis. However, if you take a closer look at the contents of those courses or subjects, it can be noted that this is an elementary level of statistics, with minimum or no application of modern business analytics tools.

Further analysis of the status and content of various master courses related to business analysts refers to the four largest universities in Serbia: University of Belgrade, University of Novi Sad, University of Niš and University of Kragujevac.

Comparative analysis of master courses related to BA at universities in Serbia

The analysis includes faculties, members of the four largest universities in Serbia, in the field of economics and management, organizational sciences, business informatics, but as well faculties in the field of science and mathematics and technical sciences.

University of Belgrade

The faculties that are included in analysis are:

- Faculty of Economics, University of Belgrade, http://www.ekof.bg.ac.rs/?lang=en
- Faculty of Organizational Science, University of Belgrade, http://www.fon.bg.ac.rs/eng/

- Faculty of Mathematics, University of Belgrade, http://www.matf.bg.ac.rs/eng/
- School of Electrical Engineering, University of Belgrade, https://www.etf.bg.ac.rs/en

Faculty of Economics

At the Faculty of Economics there are two competing master curricula: Quantitative Analysis (QA) and International Master Quantitative Finance (IMQF).

Quantitative Analysis

Overview: An umbrella program containing 6 different modules (Econometrics, Statistics, Operational research, Demographics, Actuarial mathematics, Informatics and cybernetics). The modules share the same structure and offer very similar list of courses. Mainly differ in courses' status (core or elective).

Language of study: Serbian

Staff: Local

ECTS: 60

Duration: 1 academic year (no part time option)

Obligatory master thesis: Yes (18 ECTS)

Number of students according to accreditation: total 50 (10 pay no fee)

Admissions requirements: 240 ECTS on undergraduate studies (not restrictive in terms of majors), obligatory entrance exam, and tuition fee (if applied).

Tuition fee (approx.): EUR 1.500

Module of Econometrics (representative):

Curriculum structure: 3 core courses and 3 electives (out of 15), each 7 ECTS.

Core courses: 1. Statistics, 2. Econometric models of cross-sectional and panel data, 3. Applied analysis of time series

Elective courses (not exhaustive): 1. Mathematics, 2. Informatics, 3. Business decisions information systems, 4. Operational research, 5. Mathematical programing, 6. Game theory, 7. Statistics, 8. Multivariate analysis, 9. Time series analysis, etc.

Module of **Statistics** core courses: 1. Mathematics, 2. Statistics, 3. Statistics II.

Module of **Operational research** core courses: 1. Mathematics, 2. Operational research, 3. Mathematical programming.

International Master Quantitative Finance (IMQF)

Overview: Started in year 2003, advertised as one of the most innovative finance programs in Europe. Integrated with learning how to program in Wolfram Language (of which Mathematica is the predecessor).

Language of study: English

Staff: International and local (balanced)

ECTS: 60 (coursework and master thesis)

Duration: 1 academic year (no part time option)

Obligatory master thesis: Yes (15 ECTS)

Number of students according to accreditation: total 25 (tuition fee applied)

Admissions requirements: 240 ECTS on undergraduate studies (not restrictive in terms of majors, but in terms of academic reputation of institution that awarded degree), two letters of recommendation, applicant's knowledge assessment applied, and tuition fee.

Tuition fee (max.): EUR 6.000 (reductions applied up to 50 percent)

Curriculum structure: 7 core (required) courses and 2 electives (out of 4), each 5 ECTS.

Core courses: 1. Mathematics and modelling for finance, 2. Microeconomic theory, 3. Financial statements, valuation, and corporate finance, 4. Investment and Introduction to programming in Wolfram language (WL), 5. Financial economics and mathematics of financial markets (WL), 6. Financial derivatives and fixed income securities (WL), 7. International finance.

Elective courses: 1. Advanced economic research methods with applications in finance, 2. Finance risk management with preparation for FRM and FRM certificates (WL), 3. Advanced risk modelling.

Faculty of Organisational Science

At the Faculty of Organisational Science there is one master program **Business Analytics** with two study groups: Operational Research and Business Statistics.

Duration: 2 semesters

ECTS: 60

Courses: 2 compulsory + 3 elective (6 ECTS each)

Other ECTS activities: compulsory internship (4 ECTS), preparatory paper (8 ECTS) and

master thesis (18 ECTS)

Accreditation: 2014, 35 students, TT field

Language: Serbian, English

The curriculum of this study program includes courses similar to those planned in the ADA curriculum. The courses are highly oriented towards business analytics. Obligatory courses include:

1. Business Analytics and Optimization and
2. Business Statistics.

One elective course is chosen among 7 options. Study group ***Operational research*** offers the following electives: Games Theory and Business Strategies, Risk Management, Process Analysis and Petri Nets, Combinatorial Optimization and Metaheuristics, Measuring the Efficiency of Business Systems, Advanced Planning and Scheduling and Measuring the Preferences of Business Systems.

Study group ***Business Statistics*** includes the 7 following elective courses: Statistics in Management – selected chapters, Biostatistics and Telemedicine, Time Series Analysis and forecasting, Data Analysis and R-software, Econometrics of Financial Markets, Multivariate Analysis – selected chapters and Computational Statistics.

For both study groups, **two electives** are chosen among 23 courses (including afore mentioned 14): Data Mining, Business Intelligence Systems, Data Warehouse, Advanced Planning in Marketing, Simulation Models in Finance, Supply Chain Management 2, Numerical Methods in Finance, Theory of Algorithms, and Mathematical Programming.

Faculty of Mathematics

There are two master courses at the Faculty of Mathematics that partly corresponds to the field of interests similar with master course Advanced Data Analytics that we are plan to develop. Those are **Statistics, actuary and financial mathematics** and **Computer Science**. Only subject referring to the field of business analytics or data analysis are listed, while other subjects are strictly mathematical and in many ways different from the potential subjects that will be studied in the master course we are developing.

Statistics, actuary and financial mathematics

Referent subjects: Life insurance and Selected topics on mathematical statistics, probability theory and random processes.

Computer Science

Referent subjects: Data mining, Text processing and Data mining in bioinformatics.

School of Electrical Engineering

All master programs are too technically oriented, they relate exclusively to programming knowledge and as such are not comparable to the potential learning outcomes of the master course we are developing within the ADA project.

University of Novi Sad

The faculties that are included in analysis are:

- Faculty of Economics in Subotica, University of Novi Sad, http://www.ef.uns.ac.rs/english/index.php
- Faculty of Sciences, Department of Mathematics and Informatics, University of Novi Sad, http://www.dmi.uns.ac.rs/en/
- Faculty of Technical Sciences, University of Novi Sad, http://www.ftn.uns.ac.rs/n1386094394/faculty-of-technical-sciences

Faculty of Economics in Subotica

Faculty of Economics in Subotica offers several study programs on master studies in which sporadically occurring subjects belonging to the field of data analytics in business.

Business Information Systems

The program is accredited in 2014. It enrols 35 students. The program lasts two semesters and carries 60 ECTS.

The aim of this program is to educate a student in the field of business information systems. The courses that are taught within the course are trained by students mainly in the field of informatics. Studies are conducted in the Serbian language.

Language of study: Serbian

Staff: Local

ECTS: 60

Duration: 1 academic year (no part time option)

Obligatory study research (on the basis of master thesis): Yes (6 ECTS)

Obligatory master thesis: Yes (12 ECTS)

Mandatory subjects (8 or 6 ECTS each)**:** Methodology of scientific research, Business

Process Modelling, Methods and Techniques for Business Data Analysis and Management of Information Systems Project

Subject elective block (2 subjects to choose, 6 ECTS each): Performance management systems, E - Supply Chain Management, Business Negotiation and Financial Reporting by Business Segments.

Quantitative Economy

A program accredited in 2010 but there are no students. The aim of this study program is to deepen knowledge of students in the field of economics, on the one hand, and to enable them to work in the field of quantitative financial analysis, on the other. However, it is not functional yet.

Faculty of Sciences, Department of Mathematics and Informatics

The master course most related to data analytics is **Applied mathematics, data science**. The subjects that correspond to our field of interests are: Programming for data science, Shape recognition and machine learning, Big scale data analysis, Statistical theory of machine learning and signal processing and Big data analysis in medicine and biology.

Faculty of Technical Sciences

There are two master courses related to data analytics **Information engineering** and **Information and analytic engineering**. Subjects that that correspond to our field of interests are: Systems for data exploring and analysis, Detection and estimation, Neural networks, Quantitative methods for risk management, Stock market business, Computational text analysis and Financial mathematics.

University of Kragujevac

The faculties that are included in analysis are:

- Faculty of Economics, University of Kragujevac http://www.ekfak.kg.ac.rs/en/
- Faculty of Sciences, Department of Mathematics and Informatics, University of Kragujevac https://www.pmf.kg.ac.rs/?id=30

Faculty of Economics

Faculty of Economics organizes master academic studies in the following study programs:

- Study programme in **Economics** and
- Study programme in Business Economics and Management.

The Faculty of Economics enrols 90 students in the study program in Economics, and 120 student in the study programme in Business economics and management. Both graduate study programmes enable students to gain specific knowledge and skills through selecting specific modules. Students may earn 60 ECTS, and each module comprises 3 mandatory courses and 2 electives, a research project, and an MA thesis. By defending their thesis, students earn the academic title of Master in Economics, or in Management.

Master course **Electronic Business** is a part of Business Economics and Management:

Language of study: Serbian

Staff: Local

ECTS: 60

Duration: 1 academic year (no part time option)

Obligatory master thesis: Yes (20 ECTS)

Mandatory subjects (8 ECTS each): Electronic trade, Management Information Systems and Electronic payment systems

Subject elective block 1 (one subject to choose, 8 ECTS): Risk management of financial institutions and Quantitative Analysis in Marketing

Subject elective block 2 (one subject to choose, 8 ECTS): Quantitative methods and models in economics, Financial derivatives and Business Intelligence

Faculty of Sciences, Department of Mathematics and Informatics

There are two large study groups at the Faculty of Science – Mathematics and Computer Science. Within the study program Computer science is master course **Data science** (one year, 60ECTS, 2 core + 3 electives). The subject comparative to the study program we are developing are: Machine learning 1, Data preparation, Machine learning 2, Deep learning, Big data analysis, Financial modelling, Intelligent informational systems

University of Niš

The faculties that are included in analysis are:

- Faculty of Economics, University of Niš http://www.eknfak.ni.ac.rs/en/

- Faculty of Sciences and Mathematics, University of Nis https://www.pmf.ni.ac.rs/
- Faculty of Electrical Engineering, University of Nis http://www.elfak.ni.ac.rs/en/

Faculty of Economics

Faculty of Economics Niš has one study programme Economics at the graduate academic (Master's course) level. Within the programme Economics there are seven modules: (1) General Economics, (2) Accounting, Auditing and Financial Management, (3) Finance, Banking and Insurance, (4) Enterprise Management, (5) Marketing, (6) International Management and (7) Tourism Management.

None of the offered modules is related to a business analytics and subjects related quantitative economic analysis on these modules are electives.

Faculty of Sciences and Mathematics

At the Department of Computer Science master course **Information Processing.**

Referent subjects: Intelligent data processing, Natural language processing, Deep neural networks, Probability, Statistics,

At the Department of Mathematics master course **Financial Mathematics.**

Referent subjects: Actuary mathematics, Financial mathematics, Risk theory, Regression analysis in finance, Econometrics

Faculty of Electrical Engineering

The comparative master course at the Faculty of Electrical Engineering is **Informatics and computing**.

Referent subjects Intelligent systems (i.e. machine learning), Intelligent transport systems, Natural language processing, Intelligent informational systems, Systems for big data analysis

Concluding remarks

All the above data indicate that there is no master program in the Republic of Serbia that fully matches the idea we develop within the master course Advanced Data Analytics in Business.

Master programs that can be considered the main competitors of our program and which are significantly related to business analytics are at the University of Belgrade, or to be more

precise at the Faculty of Economics and the Faculty of Organizational Sciences. Master program Quantitative Analysis at the Faculty of Economics in Belgrade is a program of a wide range of quantitative subjects, with traditionally great interest of students. Nevertheless, this program is more focused on classical quantitative economic analyses, and less on contemporary tools of business analytics and data science. International Master Quantitative Finance is a contemporary master program that uses modern tools of business analytics in teaching. It has both local and international staff and classes are in English. With such characteristics it can be considered a master program with the greatest basis for comparison, but also a master program that is the most competitive in relation to the master course Advanced Data Analytics in Business that we develop within this project. Faculty of Organisational Sciences has a master course in business analytics, but with a significantly smaller number of subjects (only two obligatory) than what is proposed in the syllabuses of the master course. What needs to be emphasized is the wide range of elective courses that characterize this program.

At the economics faculties of the University of Kragujevac and the University of Novi Sad, master programs that are analysed are in the field of business information systems and do not have much in common with proposed Advanced Data Analytics in Business. Faculty of Economics, University of Niš does not have any matching master course.

Technical faculties, as well as faculties of mathematics, ta all four observed universities, have different learning outcomes and similarities are in particular groups of subjects.

The preview of concluding remarks is given in Table 1.

ADA – Analysis of status of various courses related to BA at Serbian universities 14

Table 1. Preview of comparative analysis of the various master programs related to BA in Serbian universities

University	Faculty	Master courses included in analysis	Strengths and weaknesses of existing master courses	Competitive advantage of the proposed master program Advanced Analytics Data
University of Belgrade	Faculty of Economics	Quantitative Analysis International Master Quantitative Finance	Recognizable master programs with traditionally great interest of students.	The field of business analytics is broader than quantitative finance and includes other areas of business.
	Faculty of Organizational Science	Business Analytics (with two study groups: Operational Research and Business Statistics)	The only master course that is entirely focused on business analytics. A smaller number of compulsory subjects and a wide range of elective.	The new approach, with a greater number of compulsory subjects which provide a stronger basis of data analysis.
	Faculty of Mathematics	Statistics, actuary and financial mathematics Computer Science	Focused on mathematics, just a few subjects related to data analysis.	Different learning outcomes.
	School of Electrical Engineering	-	All master programs are too technically oriented and relate exclusively to programming knowledge.	Different learning outcomes.
University of Novi Sad	Faculty of Economics in Subotica	Business Information Systems Quantitative Economy	Study program is focus on e-business, e-trade and management information systems.	The master program introduces new knowledge in the field of business analytics as well as tools that are not studied within the existing master course.
	Faculty of Sciences, Department of Mathematics	Applied mathematics, data science	Focused on mathematics, just a few subjects related to data analysis.	Different learning outcomes.
	Faculty of Technical Sciences	Information engineering Information and analytic engineering	Learning outcomes are technically oriented.	Different learning outcomes.
University of Kragujevac	Faculty of Economics	Electronic Business	Study program is focus on e-business, e-trade and management information systems.	The master program introduces new knowledge in the field of business analytics as well as tools that are not studied within the existing master course.
	Faculty of Sciences, Department of Mathematics	Data Science	Focused on mathematics, just a few subjects related to data analysis.	Different learning outcomes.
University of Niš	Faculty of Economics	-	No master course that is related to business data analytics.	Possibility to introduce a completely new study program, which has no competition at the University of Niš.
	Faculty of Sciences and Mathematics	Information Processing Financial Mathematics	Focused on mathematics, just a few subjects related to data analysis.	Different learning outcomes.
	Faculty of Electrical Engineering	Informatics and Computing	Learning outcomes are technically oriented.	Different learning outcomes.

The basic details on activity and team members

The basic details on Task 3, Activity 1.1 of Work Package 1 (WP1) are given below.

Table 2. Details on activity and team members

Responsible partner	University of Niš
Starts	Y1/M1
Ends	Y1/M4
The team that prepared the report	1. Jelena Stanković 2. Marija Džunić 3. Marko Petković 4. Vinko Lepojević 5. Srđan Marinković

.