MODULE OUTLINE ERM522

1. GENERAL INFORMATION

SCHOOL	FACULTY OF ECONOMICS AND MANAGEMENT, OPEN UNIVERSITY CYPRUS (OUC) & SCHOOL OF SOCIAL SCIENCES, HELLENIC OPEN UNIVERSITY (HOU)		
PROGRAM COURSE	ENTERPRISE RISK MANAGEMENT (ERM)		
LEVEL OF STUDY	POSTGRADUATE		
MODULE CODE	ERM522	**SEMESTER OF STUDY**	2nd
MODULE TITLE	**PREDICTIVE ANALYTICS IN RISK MANAGEMENT**		

INDEPENDENT TEACHING ACTIVITIES *in case credits are awarded for separate components/parts of the course, e.g. in lectures, laboratory exercises, etc. If credits are awarded for the entire course, give the weekly teaching hours and the total credits*	**HOURS**	**CREDIS**
Weekly teaching hours 19-23 hours x 13 weeks	**250-300**	**10 ECTS**

COURSE TYPE Compulsory, Optional, Optional mandatory	COMPULSORY
PREREQUISITE MODULES:	ERM512
LANGUAGE OF INSTRUCTION AND EXAMS	English
THE MODULE IS OFFERED TO ERASMUS STUDENTS	Yes
MODULE WEBSITE (URL)	https://www.ouc.ac.cy/index.php/el/studies/programmes/master/master-erm-2/thematikes-enotites-erm/3568-erm522 Each module has its own space in the Learning Management System of OUC (https://eclass.ouc.ac.cy/), with controlled access (use of code) for students and teaching staff.

2. LEARNING OUTCOMES

Learning Outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate (certain) level, which students will acquire upon successful completion of the course, are described in detail. It is necessary to consult:

Upon completion of this module, the students will be able to:

Knowledge

- Develop an understanding of the Data Science field with regard to competencies required in areas such as statistics, data analytics, machine learning, data wrangling, data visualization, communication, business foundations.
- Have a thorough understanding of how analytics are applied to critical tasks facing business decision-making in managing risks.
- Understand the proper use as well as advantages and disadvantages of the techniques employed in predictive analytics such as visualization, regression, clustering, and classification.
- Understand the basic principles of machine learning

Comprehension

- Distinguish between training data, validation data and test data in data analytics.
- Recognize that different models fit and perform better than others, depending on the circumstances, and can measure fit and performance appropriately.

- Explain the underpinnings of logistics and nominal regression models and explain their differences from linear regression models.
- Understand the advantages and disadvantages of Bayesian Learning, complete a Bayesian analysis of a basic problem, and discuss the differences between Bayesian and frequentists models
- Distinguish between supervised and unsupervised machine learning approaches and identify areas where those can be applied efficiently to mitigate risks.

Application

- Apply quantitative modelling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques.
- Specify and implement models with the following techniques: k-nearest-neighbor, Naive Bayes, Classification and Regression Trees and apply the models in real-world contexts.
- Use the logistical and nominal regression models, KNN and Bayesian classifiers to classify cases in a given data set.
- Formulate simple models to solve problems, and implement them using software appropriate for data science work.

Analysis

- Apply principles of Data Science to the analysis of business problems.
- Define training and validation data sets to develop a model and measure its validity and identify the optimum model to solve a given problem.
- In addition to performing exploratory and inferential procedures, students can fit complex models using dedicated statistical software (e.g., R, Minitab, SPSS).
- Analyse statistical data properly, in order to identify distribution patterns, possible relationships among data attributes, contingencies, and interaction among various factors.
- Analyse the statistical significance of a logistical regression model, and interpret the contribution of the explanatory variables in prediction and classification.

Synthesis

- Integrate data from disparate sources, can transform data from one format to another, and can program data management in relational databases.
- Integrate results from clustering and classification algorithms with qualitative aspects of the problem under consideration in order to provide business solutions.
- Consolidate and interpret results of statistical analysis of empirical data in context in order to communicate relative information for supporting business decision making.

Evaluation

- Compare the performance of multiple methods and models, recognize the connections between how the data were collected and the scope of conclusions from the resulting analysis, and articulate the limitations and abuses of formal inference and modelling.
- Choose appropriate data management strategies, can carry out relevant analyses, can interpret and apply the results to inform understanding and solve specific problems in context, and can communicate the work to a technical audience.
- Evaluate the “fitness” and the predictive power of logistics and nominal regression model in making predictions and classifications.

General Competences

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and are mentioned below), at which of the following does the course attendance aim?

Search for, analysis and synthesis of data and *Project planning and management*

information, by the use of technologies that are necessary according the case *Adapting to new situations* *Decision-making* *Independent work* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Introduction of innovative research*	*Respect for difference and multiculturalism* *Environmental awareness* *Social, professional and ethical responsibility and sensitivity to gender issues* *Critical consciousness, criticism and self- criticism* *Development of free, creative and inductive thinking*

- Search for, analysis and synthesis of data and information by the use of appropriate technologies
- Adapting to new situations
- Decision-making
- Independent work
- Team work
- Working in an interdisciplinary environment
- Introduction of innovative research
- Project planning and management
- Respect for diversity and multiculturalism
- Environmental awareness
- Critical consciousness, criticism and self- criticism
- Development of free, creative and inductive thinking

3. MODULE CONTENT

This Thematic Unit / Module is designed to introduce students to a range of applications of advanced analytics that are suitable in risk management context. The module emphasizes more on how predictive analytics can be effective tools in reducing risk rather than the theoretical underpinnings of the models.

In the last decade, the amount of data available to organizations has reached unprecedented levels. Companies and individuals who can use this data together with analytics give themselves an edge over the competition. Predictive analytics is transforming risk management as it helps organizations by informing them what is arriving in the future. The Module covers a wide area of models and techniques from simple visual models and extending to statistical and machine learning techniques as well as some basic financial risk models. The approach is to focus on practical and conceptual issues involved in substantive applications of risk management.

The main objective of the module is to train students in employing methodologies and techniques for extracting information from existing data in order to determine patterns and predict future outcomes and trends, with an acceptable level of reliability, including what-if scenarios and risk assessment.

Students develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modelling, and statistics. Through the study of proper case studies, students will be able to identify the inputs and outputs involved in each modelling approach and the suitability of the models to specific instances, gain practical, hands-on experience with statistics programming languages and big data tools through coursework, and practical assignments.

The subjects covered by this module are:

- Visualization Models – Decision Making
- Statistical Models – Logistical & Nominal Regression, Classification models
- Introduction to Machine Learning Algorithms – (Apriori algorithm for Association rule learning, Bayesian classifiers, K nearest neighbor-KNN).
- Financial models – Value at Risk, Portfolio risk assessment, CAPM

4. TEACHING METHODS--ASSESSMENT

<table>
<tr><td>MODES OF DELIVERY
Face-to-face, in-class lecturing, distance teaching and distance learning etc.</td><td>Distance education complemented with:
6 Group Consulting Meetings (GCM) of 2 hours each
Personal communication and feedback, where needed (consulting role of tutors)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY
Use of ICT in teaching, Laboratory Education, Communication with students</td><td>The potential of ICT is exploited in the digital platform eclass which constitutes a modern distance learning environment (e.g. a space for dialogue and creative activities).

Remote meeting tools (Blackboard) and presentation software (powerpoint) are used in GCMs.

Office automation tools, web browsers and e-readers for digital books are also used by the students.</td></tr>
<tr><td>MODULE DESIGN
Description of teaching techniques, practices and methods: Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, Internship, Art Workshop, Interactive teaching, Educational visits, projects, Essay writing, Artistic creativity, etc

The study hours for each learning activity as well as the hours of selfdirected study are given following the principles of the ECTS.</td><td><table><tr><th>Activity</th><th>Annual Workload</th></tr><tr><td>6 GCMs (x 2 hours)</td><td>12</td></tr><tr><td>12 interactive activities (12 x 2-2.5 ώρες)</td><td>25-30</td></tr><tr><td>3 written assignments (3 x 25-30 ώρες)</td><td>75-90</td></tr><tr><td>Exams</td><td>0</td></tr><tr><td>Individual study ((13 weeks *~10 hours) (2 weeks *~20 hours))</td><td>138-168</td></tr><tr><td>Total module workload (hours)</td><td>250-300</td></tr></table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION/ASSESSMENT METHODS
Detailed description of the evaluation procedures.

Language of evaluation, assessment methods, formative or summative (conclusive), multiple choice tests, short- answer questions, open-ended questions, problem solving, written work, essay/report, oral exam, presentation, laboratory work, other……etc.

Specifically defined evaluation criteria are stated, as well as if and where they are accessible by the students</td><td>Students are evaluated with 9, if they collect 90% of the possible grade, I.e. 90%*10=9, etc.
Passing rate
50% of the Assignments and weekly interactive learning activities, Students are allowed to participate in the final exam of a Module, if they have overall collected the minimum grade (> = 50%) in their assignments and weekly interactive learning activities.
50% of the Final exam
Grades with decimal points, are rounded to the nearest half unit.</td></tr>
</table>

5. SUGGESTED BIBLIOGRAPHY

Compulsory Bibliography

- Batzias, F. & Res, Z., Decision Making, Hellenic Open University, MBA60 Vol. 3 2005 (available as PDF at the University).
- Field, A. (2017). Discovering statistics using IBM SPSS statistics, 5th edition, Sage.
- Field, A. (2013). Discovering statistics using IBM SPSS statistics, 3rd edition, Sage.
- Provost, F., & Fawcett, T. (2013). Data Science for Business: What you need to know about data mining and data-analytic thinking. " O'Reilly Media, Inc."

- M. Capinski and T. Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, 2nd edition, Springer 2010.
- Digital Material available on e-class
    - Recording of Group Advisory Meetings
    - PowerPoint presentations on eClass
    - Binomial Logistic Regression.pdf (available on e-class) Page. 27 Joint Postgraduate Programme in Enterprise Risk Management Enterprise Risk Management
    - Ordinal and Cardinal Binomial Logistic Regression.pdf (available on e-class)
    - Notes on SPSS hypothesis testing and logistic regression procedures
    - Notes (PDF) on SPSS Regression Analysis routines.pdf
    - Logistic regression (videos, lecture notes questions: https://ocw.mit.edu/courses/sloan-school-of-management/15-071-the-analytics-edge-spring-2017/logistic-regression/ (MIT Open Courseware)
    - Notes (PDF) on examples of software implementation of ML algorithms.pdf
    - Data mining (videos, and lecture notes: https://ocw.mit.edu/courses/sloan-school-of-management/15-062-data-mining-spring-2003/lecture-notes/), MIT Sloan Scholl of Management Open Courseware

Optional Bibliography

- Engineering Risk-Benefit Analysis: https://ocw.mit.edu/courses/engineering-systems-division/esd-72-engineering-risk-benefit-analysis-spring-2007/ (MIT Open Courseware
- Hosmer Jr, David W., Stanley Lemeshow, and Rodney X. Sturdivant. Applied logistic regression. Vol. 398. John Wiley & Sons, 2013
- Wu, X., Kumar, V., Quinlan, J. R., Ghosh, J., Yang, Q., Motoda, H., ... & Steinberg, D. (2008). Top 10 algorithms in data mining. Knowledge and information systems, 14(1), 1-37.
- Bertsimas, D., Allison, K. O., & Pulleyblank, W. R. (2016). The analytics edge. Dynamic Ideas LLC.
- Judge, Jury, and Classifier: An Introduction to Trees, MIT Sloan Scholl of Management Open Courseware, https://ocw.mit.edu/courses/sloan-school-of-management/15-071-the-analytics-edge-spring-2017/trees/
- Topics in Mathematics with Applications in Finance (videos, and lecture notes: https://ocw.mit.edu/courses/mathematics/18-s096-topics-in-mathematics-with-applicationsin-finance-fall-2013/lecture-notes/), MIT Sloan Scholl of Management Open Courseware