

## SYLLABUS / FIȘA DISCIPLINEI

### 1. Information on the study programme / Date despre programul de studii

|   |   |
|---|---|
| 1.1. Institution / Instituția de învățământ superior      | Universitatea de Vest din Timișoara               |
| 1.2. Faculty / Facultatea                                 | Matematică și Informatică                         |
| 1.3. Department / Departamentul                           | Computer Science (Informatică)                    |
| 1.4. Study program field                                  | Computer Science (Informatică)                    |
| 1.5. Study cycle/ Ciclul de studii                        | MSc / master                                      |
| 1.6. Study programme / Programul de studii / calificarea* | Artificial Intelligence and Distributed Computing |

### 2. Information on the course / Date despre disciplină

|  |   |                           |   |  |   |   |   |
|--|---|---------------------------|---|--|---|---|---|
| 2.1. Title of the course / Denumirea disciplinei                           |   | Data Analysis in R        |   |  |   |   |   |
| 2.2. Teacher in charge of the course / Titularul activităților de curs     |   | Lect. dr. Raluca Muresan  |   |  |   |   |   |
| 2.3. Teacher in charge of the seminar / Titularul activităților de seminar |   | Lect. dr. Raluca Muresan  |   |  |   |   |   |
| 2.4. Study year / Anul de studii   | 1 | 2.5. Semester / Semestrul | 1 | 2.6. Examination type / Tipul de evaluare:<br>E(xam)/C(olloquim) | E | 2.7. Course type / Regimul disciplinei:<br>M(andatory)/ E(lective)/ F(acultative) | M |

### 3. Estimated study time (number of hours per semester) /Timpul total estimat (ore pe semestru al activităților didactice)

|  |     |  |    |                        |                   |
|--|-----|--|----|------------------------|-------------------|
| 3.1. Attendance hours per week / Număr de ore pe săptămână   | 3   | out of which din care: 3.2 lecture/ curs | 2  | 3.3. seminar/laborator | 1                 |
| 3.4. Attendance hours per semester / Total ore din planul de învățământ  | 42  | out of which: 3.5 lecture / curs         | 28 | 3.6. seminar/laborator | 14                |
| <b>Distribution of the allocated amount of time / Distribuția fondului de timp*</b>  |     |  |    |                        | <b>hours/ ore</b> |
| Individual study /Studiu după manual, suport de curs, bibliografie și notițe   |     |  |    |                        | 42                |
| Supplementary documentation at library or using electronic repositories / Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate |     |  |    |                        | 28                |
| Preparing for laboratories, homework, reports etc. /Pregătire seminarii/laboratoare, teme, referate, portofolii și eseuri                                    |     |  |    |                        | 24                |
| Exams / Examinări  |     |  |    |                        | 4                 |
| Tutoring / Tutorat   |     |  |    |                        | 10                |
| 3.7. Total number of hours of individual study / Total ore studiu individual   | 108 |  |    |                        |                   |
| 3.8. Total number of hours per semester / Total ore pe semestru  | 150 |  |    |                        |                   |

|  |   |
|--|---|
| 3.9. Number of credits (ECTS) / Număr de credite | 6 |
|--|---|

#### 4. Prerequisites (if it is the case) / Preconțiții (acolo unde e cazul)

|                                 |                            |
|---------------------------------|----------------------------|
| 4.1. curriculum / de curriculum | Probability and Statistics |
| 4.2. skills / de competențe     | programming skills         |

#### 5. Requirements (if it is the case) / Condiții (acolo unde e cazul)

|   |  |
|---|--|
| 5.1. for the lecture / de desfășurare a cursului                              | room with video projector  |
| 5.2. for the seminar, laboratory / de desfășurare a seminarului/laboratorului | lab with computers with internet connection and the R software installed |

#### 6. Acquired skills / Competențe specifice acumulate

|   |  |
|---|--|
| Professional skills / Competențe profesionale | <ul style="list-style-type: none"> <li>Advanced knowledge of theoretical, methodological, and practical developments in computer science;</li> <li>Demonstrate advanced modeling skills for specific phenomena and processes in the domains: economic, technic, medical, social etc., by using fundamental mathematical, statistical, and computer science knowledge;</li> </ul> |
| Transversal skills / Competențe transversale  | <ul style="list-style-type: none"> <li>Advanced communication skills within different professional environments, appropriate use of computer science vocabulary, good English knowledge;</li> <li>Team work abilities, assuming different execution and leading roles, performing professional tasks with considerable amounts of autonomy and responsibility</li> </ul>         |

#### 7. Objectives of the course / Obiectivele disciplinei (reieșind din grila competențelor specifice acumulate)

|  |   |
|--|---|
| 7.1. General objective / Obiectivul general al disciplinei | Getting accustomed to a series of important techniques for data analysis and the tools provided by the R software for exploratory data analysis and statistical modeling  |
| 7.2. Specific objectives / Obiectivele specifice           | <p><i>Cognitive objectives (OC):</i> (1) knowing the necessary steps of a data analysis process; (2) presenting specific methods and algorithms for data analysis</p> <p><i>Skills objectives (OAb):</i> (1) identifying the type of analysis suitable for a given practical problem and dataset; (2) using the appropriate R tools for various types of analyses; (3) interpreting and evaluating the results; (4) communicating results correctly and rigorously</p> <p><i>Attitudinal objectives (OAt):</i> (1) providing arguments regarding the importance of data analysis for an IT specialist</p> |

#### 8. Content / Conținuturi\*

| 8.1. Lecture / Curs   | Teaching strategies / Metode de predare | Remarks, details / Observații  |
|---|---|--|
| C1. (2h) General facts about R. Objects and attributes (OAb2, OAt1)   | Lecturing, conversation, demonstration  | Each lecture is correlated with the corresponding seminar for the achievement of established objectives.<br><br>Resources:<br><br>[1], Ch. 1 |
| C2. (2h) Lists, matrices and dataframes (OAb2)  | Lecturing, conversation, demonstration  | Resources:<br><br>[1], Ch. 1   |
| C3. (2h) Elements of programming in R (OAb2, OAb3)  | Lecturing, conversation, demonstration  | Resources:<br><br>[4], Ch. 4   |
| C4. (2h) Probability distributions. Generating random numbers following a particular probability distribution (OC2, OAb2, OAb3) | Lecturing, conversation, demonstration  | Resources:<br><br>[4], Ch. 5   |
| C5. (2h) Elements of descriptive statistics in R (OC1, OAb1 – OAb4)   | Lecturing, conversation, demonstration  | Resources:<br><br>[1], Ch. 2, [2], Ch. 2,3   |
| C6. (2h) Tools for visualization. The ggplot2 package. Multivariate exploratory analysis (OC1, OC2, OAb1 – OAb4)                | Lecturing, conversation, demonstration  | Resources:<br><br>[1], Ch. 2, [2], Ch. 2,3   |
| C7-8. (4h) Tools for estimation and statistical hypothesis testing (OC1, OC2, OAb1 – OAb4)                                      | Lecturing, conversation, demonstration  | Resources:<br><br>[1], Ch. 4, [2], Ch. 6   |
| C9-10. (4h) Predicting continuous responses: correlation and linear regression (OC1, OC2, OAb1 – OAb4, OAt1)                    | Lecturing, conversation, demonstration  | Resources:<br><br>[1], Ch. 5   |
| C11-12. (4h) Predicting quantitative responses (OC1, OC2, OAb1 – OAb4, OAt1)  | Lecturing, conversation, demonstration  | Resources:<br><br>[2], Ch. 9, [3], Ch. 7-11  |
| C13. (2h) Social network analysis (OC1, OC2, OAb1 – OAb4, OAt1)   | Lecturing, conversation, demonstration  | Resources:<br><br>[3], Ch. 20  |
| C14. (2h) Management of large data sets in data analysis with R   | Lecturing, conversation,                | Resources:   |

|   |  |  |
|---|--|--|
| (OC1, OAb1 – OAb4)  | demonstration  | [2], Ch. 12  |
| <b>Recommended bibliography / Bibliografie</b><br>1. J. Maindonald, W. J. Braun, Data Analysis and Graphics using R – An Example – based Approach, 3rd ed., Cambridge University Press, 2003<br>2. T. Fischetti, Data Analysis with R, Packt Publishing, 2015<br>3. J. Ledolter, Data Mining and Business Analytics with R, Wiley, 2013<br>4. W. J. Braun, D. J. Murdoch, A First Course in Statistical Programming with R, Cambridge University Press, 2007<br>5. J. M. Chambers, Software for Data Analysis. Programming with R, Springer, 2008 |  |  |
| <b>8.2. Seminar, lab / Seminar, laborator</b>   | <b>Teaching/learning strategies / Metode de predare/ învățare</b>    | <b>Remarks, details / Observații</b>   |
| S1. (2h) 1. Introduction to R. Objects and attributes. Dataframes. Packages (OAb2, OAb3)  | Dialogue with students, cooperative learning, modeling, case studies | For each seminar, the students must read and be familiar with the materials presented in the corresponding lectures. |
| S2. (2h) Programming in R. Estimating probability by simulation (OC2, OAb2, OAb3, OAb4)   | Dialogue with students, cooperative learning, modeling, case studies |  |
| S3. (2h) Tools for descriptive statistics (OC1, OC2, OAb1 – OAb4)   | Dialogue with students, cooperative learning, modeling, case studies |  |
| S4. (2h) Testing statistical hypotheses with R (OC1, OC2, OAb1 – OAb4)  | Dialogue with students, cooperative learning, modeling, case studies |  |
| S5. (2h) Univariate and multivariate linear regression (OC1, OC2, OAb1 – OAb4)  | Dialogue with students, cooperative learning, modeling, case studies |  |
| S6. (2h) Logistic regression models (OC1, OC2, OAb1 – OAb4)   | Dialogue with students, cooperative learning, modeling, case studies |  |
| S7. (2h) Social network analysis (OC1, OC2, OAb1 – OAb4)  | Dialogue with students, cooperative learning, modeling, case studies |  |
| <b>Recommended bibliography / Bibliografie</b><br>same as for the lecture   |  |  |

**9. Correlations between the content of the course and the requirements of the IT field / Coroborarea conținuturilor disciplinei cu așteptările reprezentanților comunității epistemice, asociațiilor profesionale și angajatorilor reprezentativi din domeniul aferent programului**

The course is consistent with similar ones from representative universities and covers the most important aspects regarding data analysis. The concepts are presented using the open source software R, currently one of the most widely used tools for data analysis, in teaching, research, as well as practical applications.

**10. Evaluation / Evaluare\***

|                   |   |                  |                 |
|-------------------|---|------------------|-----------------|
| Activity / Tip de | 10.1. Evaluation criteria / Criterii de | 10.2. Evaluation | 10.3. Weight in |
|-------------------|---|------------------|-----------------|

| activitate  | evaluare**  | methods / Metode de evaluare***                             | the averaged mark / Pondere din nota finală        |
|---|---|---|--|
| 10.4. Lecture / Curs  | Knowing and following the appropriate steps in a data analysis process (OC1)  | Project presentation (during exam session)                  | 60%  |
|   | Knowledge of specific methods and algorithms and using suitable techniques to solve a practical problem (OC2, OAb1) | Test on the computer (during exam session)                  | 20%  |
| 10.5. Seminar/ lab  |   | Using R tools to analyse a dataset (OAb1, OAb2, OAb3, OAb4) | Lab activity during the semester (oral evaluation) |
| <b>10.6. Minimal knowledge for passing / Standard minim de performanță</b>  |   |   |  |
| Minimal standards (knowledge and skills for the grade 5) <ul style="list-style-type: none"> <li>• Exploratory data analysis: producing simple graphical representations to investigate the relation between two or more variables and interpreting them</li> <li>• Prediction: describing a regression technique</li> </ul> <p>The final grade is the weighted average of grades obtained for components 10.4 and 10.5. The exam is passed if the final grade is at least 5 (it is not necessary for each grade to be greater than 5). For every exam session, the grade is computed by the same rule.</p> <p>During the semester, students may attend tutoring hours, during which the teacher answers their questions and provides supplementary explanations regarding the lecture, lab applications and homework.</p> |   |   |  |

Date/ Data completării

5.10.2018

 Signature (lecture) /  
Semnătura titularului de curs  
Lect. dr. Raluca Muresan

 Signature (seminar)  
Semnătura titularului de seminar  
Lect. dr. Raluca Muresan

 Signature (director of the department)  
Semnătura directorului de departament  
Conf.dr. Victoria Iordan