

## COURSE OUTLINE

### (1) GENERAL

|  |   |                       |         |
|--|---|-----------------------|---------|
| SCHOOL   |   |                       |         |
| ACADEMIC UNIT  | Interdisciplinary Graduate Programme in the BRAIN and MIND sciences                                       |                       |         |
| LEVEL OF STUDIES   | 7   |                       |         |
| COURSE CODE  | B&M-232   | SEMESTER              | Fall    |
| COURSE TITLE   | Introduction to Statistics and Programming  |                       |         |
| INDEPENDENT TEACHING ACTIVITIES<br><i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i> |   | WEEKLY TEACHING HOURS | CREDITS |
| Lectures   |   | 3                     | 3       |
|  |   |                       |         |
| <i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>   |   |                       |         |
| COURSE TYPE<br><i>general background, special background, specialised general knowledge, skills development</i>  | General Background  |                       |         |
| PREREQUISITE COURSES:  | N/A   |                       |         |
| LANGUAGE OF INSTRUCTION and EXAMINATIONS:  | English   |                       |         |
| IS THE COURSE OFFERED TO ERASMUS STUDENTS  | YES   |                       |         |
| COURSE WEBSITE (URL)   | <a href="https://elearn.uoc.gr/course/view.php?id=4439">https://elearn.uoc.gr/course/view.php?id=4439</a> |                       |         |

### (2) LEARNING OUTCOMES

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| <p><b>Learning outcomes</b></p> <p><i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> <li>• <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i></li> <li>• <i>Descriptors for Levels 6, 7 &amp; 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i></li> <li>• <i>Guidelines for writing Learning Outcomes</i></li> </ul> <p>The first objective of the course is to introduce students to the principles of statistics and probability. Emphasis is given on challenges encountered in neuroscientific research and biostatistics. Additionally, resampling, bootstrapping, and permutation techniques, which have recently gained widespread application in biomedical and neuroscientific research, are discussed.</p> <p>The second objective of the course is to equip students with an understanding of basic programming principles. Within this framework, students are introduced to the Matlab or Python programming languages. Moreover, during practical implementation, students are asked to solve programming exercises to deepen their understanding of the concepts taught. To support this, students receive educational materials, such as notes and sample codes in Matlab or Python, which they are asked to adapt and modify. As part of practical implementation, students are tasked with analyzing neural signals from electrophysiological recordings, applying in practice the concepts they have been taught.</p> <p>Upon successful completion, students gain the ability to understand and apply a wide range of statistical analyses and address challenges arising in the statistical analysis of electrophysiological data.</p> |
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Additionally, they achieve proficiency in the Matlab or Python environments and can implement statistical methods within these frameworks.

### General Competences

*Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*

|   |   |
|---|---|
| <i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i> | <i>Project planning and management</i>  |
| <i>Adapting to new situations</i>   | <i>Respect for difference and multiculturalism</i>  |
| <i>Decision-making</i>  | <i>Respect for the natural environment</i>  |
| <i>Working independently</i>  | <i>Showing social, professional and ethical responsibility and sensitivity to gender issues</i> |
| <i>Team work</i>  | <i>Criticism and self-criticism</i>   |
| <i>Working in an international environment</i>  | <i>Production of free, creative and inductive thinking</i>                                      |
| <i>Working in an interdisciplinary environment</i>  | .....   |
| <i>Production of new research ideas</i>   | <i>Others...</i>  |
|   | .....   |

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Working in an interdisciplinary environment
- Production of new research ideas
- Criticism and self-criticism
- Production of free, creative and inductive thinking

### (3) SYLLABUS

#### Introduction to Statistics

- 1. Central Tendency and Dispersion Measures**
  - Mean, median, mode
  - Range, variance, standard deviation
- 2. Probabilities**
  - Contingency operations
  - Conditional probability
  - Bayes' theorem
- 3. Probability Distributions**
  - Normal, binomial, and Poisson distributions
- 4. Confidence Intervals**
  - One-sided and two-sided confidence intervals
  - t-distribution
- 5. Statistical Hypothesis Testing**
  - One-tailed and two-tailed hypothesis tests
  - Types of errors, statistical power, sample size considerations
- 6. Comparison of Means**
  - Parametric methods for comparing two means
  - Analysis of Variance (ANOVA)
- 7. Non-Parametric Methods**
  - Wilcoxon signed-rank test
  - Wilcoxon rank-sum test
- 8. Resampling Methods**
  - Bootstrapping
  - Permutation tests
- 9. Correlation**
  - Pearson's and Spearman's correlation coefficients

## **10. Regression**

- Linear regression
- Least squares method

### **Introduction to Programming**

#### **1. Variables**

- Types of variables

#### **2. Vectors and Tables**

- Initialization and manipulation
- Additional data structures

#### **3. Arithmetic and Logical Operators**

- Numerical operators
- Logical operators

#### **4. Functions**

- Creation and structure

#### **5. Loops**

- Iteration loops

#### **6. Control Flow**

- Conditional statements
- Logical conditions

#### **7. Statistics in Matlab or Python**

- Practical applications and examples

#### **8. Graphs**

- Creating basic visualizations
- Presenting statistical results

#### (4) TEACHING and LEARNING METHODS - EVALUATION

|   |  |                          |
|---|--|--------------------------|
| <b>DELIVERY</b><br><i>Face-to-face, Distance learning, etc.</i>   | Face-to-face   |                          |
| <b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b><br><i>Use of ICT in teaching, laboratory education, communication with students</i>   | Integration of ICT in teaching<br>Utilizing the elearn platform for uploading teaching materials<br>Communication via "e-learn" and e-mail   |                          |
| <b>TEACHING METHODS</b><br><i>The manner and methods of teaching are described in detail.<br/>                     Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i><br><br><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i>              | <b>Activity</b>  | <b>Semester workload</b> |
|   | Lectures   | 20                       |
|   | Practical exercises  | 25                       |
|   | Non-directed study   | 30                       |
|   |  |                          |
|   |  |                          |
|   |  |                          |
|   |  |                          |
|   | Course total   | <b>75</b>                |
| <b>STUDENT PERFORMANCE EVALUATION</b><br><i>Description of the evaluation procedure</i><br><br><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i><br><br><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i> | Evaluation Language: English<br>Assessment Methods: Multiple-choice questionnaires, short-answer questions<br>Written exam (oral examination available in special cases)<br>The written examination accounts for 70% of the final grade.<br><br>After each lecture, students are assigned exercises that combine theoretical and practical problems. They solve and submit these exercises, with their performance contributing 30% to the final grade<br><br>Evaluation criteria are outlined in the study guide and communicated to students at the beginning of the course. |                          |

#### (5) ATTACHED BIBLIOGRAPHY

- Principles of Biostatistics, M. Pagano και K. Gauvreau
- Introduction to the Practice of Statistics, DS Moore, GP. McCabe, BA. Craig, Publisher: WH Freeman
- Biostatistics: A Foundation for Analysis in the Health Sciences, WW Daniel, CL Cross, Publisher: Wiley