# Syllabus

## 1. Programme information

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| 1.1. Institution | THE BUCHAREST UNIVERSITY OF ECONOMIC STUDIES |
| 1.2. Faculty | Economic Cybernetics, Statistics and Informatics |
| 1.3. Departments | Department of Applied Mathematics |
| 1.4. Field of study | Cybernetics and statistics |
| 1.5. Cycle of studies | Master Studies |
| 1.6. Education type | Full-time |
| 1.7. Study programme | Applied data analytics |
| 1.8. Language of study | English |
| 1.9. Academic year | 2025-2026 |

## 2. Information on the discipline

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|---|---|---|---|---|---|---|---|---|---|
| 2.1. Name | **Applied Mathematics – Probabilities Theory** | | | | | | | | |
| 2.2. Code | **25.0318IF1.1-0001** | | | | | | | | |
| 2.3. Year of study | **1** | 2.4. Semester | **1** | 2.5. Type of assessment | **Exam** | 2.6. Status of the discipline | **O** | 2.7. Number of ECTS credits | **7** |

| | | | |
|---|---|---|---|
| 2.8. Leaders | C(C) | **prof.univ.dr. IFTIMIE Bogdan** | iftimieb@csie.ase.ro |
| | S(S) | **prof.univ.dr. IFTIMIE Bogdan** | iftimieb@csie.ase.ro |

## 3. Estimated Total Time

| | | | |
|---|---|---|---|
| 3.1. Number of weeks | 14.00 | | |
| 3.2. Number of hours per week | 4.00 | of which | |
| | | S(S) | 2.00 |
| | | C(C) | 2.00 |
| 3.3. Total hours from curriculum | 56.00 | of which | |
| | | S(S) | 28.00 |
| | | C(C) | 28.00 |
| 3.4. Total hours of study per semester (ECTS*25) | 175.00 | | |
| 3.5. Total hours of individual study | 119.00 | | |
| *Distribution of time for individual study* | | | |
| Study by the textbook, lecture notes, bibliography and student's own notes | 40.00 | | |
| Additional documentation in the library, on specialized online platforms and in the field | 15.00 | | |
| Preparation of seminars, labs, assignments, portfolios and essays | 15.00 | | |
| Tutorials | 7.00 | | |
| Examinations | 2.00 | | |
| Other activities | 40.00 | | |

## 4. Prerequisites

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| 4.1. of curriculum | Basics of Advanced Calculus, Probability Theory and Statistics |
| 4.2. of competences | R and Python Software |

### 5. Conditions

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| for the S(S) | The lectures take place in rooms with at least two blackboards and equipped with computer and videoprojector |
| for the C(C) | The lectures take place in rooms with at least two blackboards and equipped with computer and videoprojector |

### 6. Acquired specific competences

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| PREFESSIONAL | CC2 | STEM (science, technology, engineering, mathematics) skills – understanding the mathematical foundations of AI, statistical methods of data analysis applied in AI techniques. |
| PREFESSIONAL | CP1 | Applies statistical analysis techniques |
| PREFESSIONAL | CT1 | Demonstrates an understanding of mathematical terms and concepts and applies basic mathematical principles and processes for interpreting data and facts. |

### 7. Objectives of the discipline

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| 7.1. General objective | Presentation of theoretical background and of a multitude of applications of different types, required for modeling of random experiments from various domains.<br>Identification, accurate description and using of different modeling techniques for random phenomena, and their visualisation<br>Applications of theoretical models through special software packages |
| 7.2. Specific objectives | C1: Acquisition of advanced knowledge of applied statistical analysis concepts, methods, and techniques, including inference, stochastic modeling, econometrics, and Bayesian methods.<br>RA3: Continuous development of professional skills in accordance with technology trends and business environment |

### 8. Contents

| 8.1. C(C) | | Teaching/Work methods | Recommendations for students |
|---|---|---|---|
| 1 | Introductory oh Probability Theory: Events, field of probability, elementary probability: total probability formula, Bayes' formula.<br>-2 hours<br>Expected learning outcomes: C1, RA3 | Multimedia presentations/ in standard manner, at blackboard, by a continuos interaction with students | A first course in Probability, Sheldon Ross, pages 22-46, 58-88. |
| 2 | Random variables. Discrete random variables. Binomial and Poisson distributions.<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | A first course in Probability, Sheldon Ross, pages 117-146. |
| 3 | Continuous distributions. The Gaussian distribution. Exponential distribution. Expectation, Central moments, Variance.<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | A first course in Probability, Sheldon Ross, pages 186-224. |
| 4 | Central Limit type Theorems. Moivre-Laplace Theorem.<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | A first course in Probability, Sheldon Ross, pages 388-399. |
| 5 | Bidimensional random vectors of discrete type. Conditional distributions. Conditional expectations and variances.<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | A first course in Probability, Sheldon Ross, pages 232-235, 240-242, 285, 286, 331, 332, 334-336. |
| 6 | Bidimensional random vectors of continuous type.<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | A first course in Probability, Sheldon Ross, pages 236-239, 243-246, 252-258, 266-269, 332, 333, 338. |
| 7 | Markov Chains. Introductory facts. Applications in different domains of real life.<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 191-202. |
| 8 | Markov chains in discrete time. Examples. Classification of states.<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 204-211. |
| 9 | Stationary distributions. Applications. An ergodic theorem.<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 212-219, 243-245. |
| 10 | Markov chains in continuous time. Properties. Examples.<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 339-344, 371-376. |
| 11 | The Poisson process. The Compound Poisson process.<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 312-321, 346, 347. |
| 12 | Queueing Theory. Preliminaries: Cost equations, Steady-State probabilities. Examples.<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 377-390. |
| 13 | Exponential Models. A Single-Server Exponential Queueing system (M/M/1 Queue). A Single-Server Exponential Queueing System<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages pag. 395-405. |
| 14 | Revision.<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | To revise all was taught during all the lectures. |

***Bibliography***


- M. M. Rao, J. R. Swift, Probability Theory with Applications, Oxford Science Publications, 1993
- S. Ross, Introduction to probability and statistics for engineers and scientists, Academic Press, Elsevier, 2014
- S. Ross, A first course in Probability - 10th edition, Pearson Prentice Hall, 2020, Marea Britanie
- S. Ross, Introduction to Probability Models, Academic Press, Elsevier, 2024, Marea Britanie
- S. Karlin, H. M. Taylor, A first course in Stochastic Processes, Academic Press, Elsevier, 2014

| 8.2. S(S) | | Teaching/Work methods | Recommendations for students |
|---|---|---|---|
| 1 | Applications of theoretical notions studied at lecture 1<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Multimedia presentations/ in standard manner, at blackboard, by a continuos interaction with students | A first course in Probability, Sheldon Ross, pages 50-57, 102-107. |
| 2 | Applications of theoretical notions studied at lecture 2<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | A first course in Probability, Sheldon Ross, pages 172-180. |
| 3 | Applications of theoretical notions studied at lecture 3<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | A first course in Probability, Sheldon Ross, pages 224-231. |
| 4 | Applications of theoretical notions studied at lecture 4<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | A first course in Probability, Sheldon Ross, pages 412-416. |
| 5 | Applications of theoretical notions studied at lecture 5<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | A first course in Probability, Sheldon Ross, pages 287-291. |
| 6 | Applications of theoretical notions studied at lecture 6<br>-2 hours<br>xpected learning outcomes:C1, RA3 | Idem | A first course in Probability, Sheldon Ross, pages 287-291. |
| 7 | Applications of theoretical notions studied at lecture 7<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 275-277. |
| 8 | Applications of theoretical notions studied at lecture 8<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 230-234, 278-280. |
| 9 | Applications of theoretical notions studied at lecture 9<br>-2 hours<br>xpected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 281-285. |
| 10 | Applications of theoretical notions studied at lecture 10<br>-2 hours<br>Expected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 359-361. |
| 11 | Applications of theoretical notions studied at lecture 11<br>-2 hours<br>Expected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 354-357. |
| 12 | Applications of theoretical notions studied at lecture 12<br>-2 hours<br>Expected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 412-414. |
| 13 | Applications of theoretical notions studied at lecture 13<br>-2 hours<br>Expected learning outcomes: C1, RA3 | Idem | Introduction to Probability Models, Sheldon Ross, pages 415-418. |
| 14 | Revision.<br>-2 hours<br>Expected learning outcomes: C1, RA3 | Idem | To revise all was taught during all the lectures and seminaries. |

***Bibliography***


- S. Ross, Introduction to probability and statistics for engineers and scientists, Academic Press, Elsevier, 2014
- S. Ross, A first course in Probability - 10th edition , Pearson Prentice Hall, 2020
- S. Ross, Introduction to Probability Models, Academic Press, Elsevier, 2010
- S. Dedu, F. Serban, Matematici aplicate in economie. Culegere de probleme, Tipogrup Press, 2005


## 9. Corroboration of the contents of the discipline with the expectations of the representatives of the epistemic community, of the professional associations and representative employers in the field associated with the programme

The proposed themes of these lectures and seminars are according to international scientific literature of the domain and meets the requirements of the employeurs at both theoretical level and software packages

**10. Assessment**

| Type of activity | Assessment criteria | Assessment methods | Percentage in the final grade |
|---|---|---|---|
| 10.1. C(C) | Attendance at lectures and involvement in discussing issues | Number of attended lectures and interventions | 10.00 |
| 10.2. S(S) | Activity during seminars | Oral interventions. Homeworks. | 20.00 |
| 10.3. Final assessment | Assesement of notions aquired at lectures and seminaries. | Written exam. | 70.00 |
| 10.4. Modality of grading | Whole notes 1-10 | | |
| 10.5. Minimum standard of performance | The final grade is calculated as a weighted average between attendance (10%), seminar activity (20%) and the score obtained in the exam (70%).<br>The exam is passed with a final grade of at least 5.<br>To obtain the minimum score to pass the written exam, the student can accumulate at least 4 points from the exam subjects corresponding to the following topics:<br>- Two-dimensional random vectors;<br>- Markov chains in discrete time,<br>- Markov chains in continuous time,<br>having the possibility to complete the score from the other exam subjects. | | |

Date of listing,
04/28/2026

Signature of the discipline leaders,

Date of approval in the department

Signature of the Department Director,