**SYLLABUS**

## 1. Information regarding the programme

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| 1.1 Higher education institution | **Babeş - Bolyai University** |
| 1.2 Faculty | **Faculty of Mathematics and Computer Science** |
| 1.3 Department | **Department of Mathematics** |
| 1.4 Field of study | **Mathematics** |
| 1.5 Study cycle | **Bachelor** |
| 1.6 Study programme / Qualification | **Mathematics and Computer Science** |

## 2. Information regarding the discipline

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|---|---|---|---|---|---|---|---|
| 2.1 Name of the discipline | **Probability Theory** | | | | | | |
| 2.2 Course coordinator | **Prof. PhD. Agratini Octavian** | | | | | | |
| 2.3 Seminar coordinator | **Prof. PhD. Agratini Octavian** | | | | | | |
| 2.4. Year of study | **2** | 2.5 Semester | **4** | 2.6. Type of evaluation | **E** | 2.7 Type of discipline | **Compulsory/ Fundamental** |

## 3. Total estimated time (hours/semester of didactic activities)

| | | | | | |
|---|---|---|---|---|---|
| 3.1 Hours per week | 4 | Of which: 3.2 course | 2 | 3.3 seminar | 2 |
| 3.4 Total hours in the curriculum | 56 | Of which: 3.5 course | 28 | 3.6 seminar | 28 |
| Time allotment: | | | | | hours |
| Learning using manual, course support, bibliography, course notes | | | | | 14 |
| Additional documentation (in libraries, on electronic platforms, field documentation) | | | | | 7 |
| Preparation for seminars/labs, homework, papers, portfolios and essays | | | | | 10 |
| Tutorship | | | | | 6 |
| Evaluations | | | | | 7 |
| Other activities: ..... | | | | | - |

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| 3.7 Total individual study hours | 44 |
| 3.8 Total hours per semester | 100 |
| 3.9 Number of ECTS credits | 4 |

## 4. Prerequisites (if necessary)

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| 4.1. curriculum | • Mathematical Analysis 1, Mathematical Analysis 2, Algebra |
| 4.2. competencies | • Limit and Integral Calculus, Set Theory |

## 5. Conditions (if necessary)

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| 5.1. for the course | • Lecture room with blackboard and video projector |
| 5.2. for the seminar/lab activities | • Seminar room with blackboard |

**6. Specific competencies acquired**

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| Professional competencies | • C1.1. Identification of notions, description of theories and use of specific language<br>• C2.3. Application of appropriate theoretical models of analysis for solving given problems |
| **Transversal competencies** | • CT2. Efficient development of group work activities |

**7. Objectives of the discipline** (outcome of the acquired competencies)

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| 7.1 General objective of the discipline | • Acquire basic knowledge of Probability Theory, with focus on theoretical aspects as well as applications |
| 7.2 Specific objective of the discipline | • Application of classical probabilistic models to solve real life problems<br>• Become familiar with classical probability distributions<br>• Know the role of sequences of random variables in the study of social phenomena |

**8. Content**

| **8.1 Course** | Teaching methods | Remarks |
|---|---|---|
| 1. Experiments and events. Sigma fields | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |
| 2. Probability function. Conditional probability. Independence of events | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |
| 3. Classic probabilistic models (Samplings with / without replacement, Poisson, Pascal, Geometric) | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |
| 4. Sigma - fields and infinite probability spaces. Properties | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |
| 5. Random variables: definition, properties. Discrete random variables | • Interactive exposure<br>• Explanation<br>• Conversation | |

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|---|---|---|
| 6. Cumulative distribution function: definition, properties | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |
| 7. Probability density function: definition, properties. Continuous random variables | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |
| 8. Random vectors, joint distribution function, joint density function. Marginal distributions and marginal densities. Properties | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |
| 9. Operations with continuous random variables: addition, multiplication, division | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |
| 10. Numerical characteristics of random variables: expectation, variance, moments, covariance, correlation coefficient | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |
| 11. Characteristic function. Properties | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |
| 12. Sequences of random variables. Types of convergence | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |
| 13. Laws of large numbers. Weak law of large numbers. Strong law of large numbers | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |
| 14. Lindeberg condition and Central Limit Theorem Moivre - Laplace theorem. | • Interactive exposure<br>• Explanation<br>• Conversation<br>• Didactical demonstration | |

**Bibliography**

1. AGRATINI, O., *Capitole speciale de matematici*, Lito., Univ. Babeş-Bolyai, Cluj-Napoca, 1996.

2. LISEI, H., *Probability Theory*, Casa Cărţii de Ştiinţă, Cluj-Napoca, 2004..
3. SHELDON, R., *A First Course in Probability*, 8th edition, Pearson Prentice Hall, 2010.

| **8.2 Seminar** | Teaching methods | Remarks |
|---|---|---|
| 1. Euler's Gamma and Beta functions. Properties. Combinatorics | Explanation, conversation, examples. | |
| 2. Probability calculus on a finite field | Explanation, conversation, examples. | |
| 3. Conditional probability. Independent events. Bayes formula | Explanation, conversation, examples. | |
| 4. Classical probabilistic models | Explanation, conversation, examples. | |
| 5. Geometric probability. Exercises | Explanation, conversation, examples. | |
| 6. Discrete random variables. Operations and exercises | Explanation, conversation, examples. | |
| 7. Continuous random variables. Operations and exercises | Explanation, conversation, examples. | |
| 8. Random vectors. Exercises | Explanation, conversation, examples. | |
| 9. Numerical characteristics of random variables | Explanation, conversation, examples. | |
| 10. Classical inequalities for numerical characteristics of random variables | Explanation, conversation, examples. | |
| 11. Characteristic function. Exercises | Explanation, conversation, examples. | |
| 12. Sequences of random variables. Exercises | Explanation, conversation, examples. | |
| 13. Convergence of sequences of random variables | Explanation, conversation, examples. | |
| 14. Limit theorems. Applications | Explanation, conversation, examples. | |

**Bibliography**

**1.** LISEI, H., MICULA, S., SOOS, A., *Probability Theory through Problems and Applications*, Presa Universitară Clujeană, 2006.

**Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program**

- The content of the course is important because it covers basic concepts and topics in this field.
- The course exists in the studying program of all major universities in Romania and abroad.

**10. Evaluation**

| Type of activity | 10.1 Evaluation criteria | 10.2 Evaluation methods | 10.3 Share in the grade (%) |
|---|---|---|---|
| 10.4 Course | Know the basic principles in Probability Theory | Written exam. | 80% |
| 10.5 Seminar | Be able to apply course concepts on solving problems in this field | Continuous observation during the semester, seminar participation. | 20% |
| 10.6 Minimum performance standards | | | |
| • At least grade 5 (from a scale of 1 to 10) at the written exam | | | |

| Date | Signature of course coordinator | Signature of seminar coordinator |
|---|---|---|
| 28 April 2020 | Prof. PhD. Agratini Octavian | Prof. PhD. Agratini Octavian |
| | Date of approval | Signature of the head of department |
| | 30 April 2020 | Prof. PhD. Agratini Octavian |