SYLLABUS

1. Information regarding the programme

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

2.1 Name of the discipline	**Probability Theory**						
2.2 Course coordinator	**Prof. PhD. Agratini Octavian**						
2.3 Seminar coordinator	**Lect. PhD. Roşca Natalia**						
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/laboratory	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:					-

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)

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

5. Conditions (if necessary)

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

Professional competencies	• C1.1. Identification of notions, description of theories and use of specific language • 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)

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 • Become familiar with classical probability distributions • Know the role of sequences of random variables in the study of social phenomena

8. Content

8.1 Course	Teaching methods	Remarks
1. Experiments, events, operations with events. Finite fields and finite probability spaces. Formulas on finite probability spaces.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
2. Conditional probability. Independent events. Total probability formula. Bayes formula.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
3. Classical probabilistic models (binomial, hypergeometric, multinomial, Poisson, Pascal, geometric).	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
4. Sigma - fields and infinite probability spaces. Properties.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
5. Random variables: definition, properties. Discrete random variables.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	

6. Cumulative distribution function: definition, properties, examples.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
7. Probability density function: definition, properties. Continuous random variables.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
8. Random vectors, joint distribution function, joint density function. Marginal distributions and marginal densities.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
9. Operations with continuous random variables: sum, multiplication, division.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
10. Numerical characteristics of random variables: expectation, variance, standard deviation, moments, covariance, correlation coefficient.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
11. Characteristic function, definition, properties. Applications.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
12. Sequences of random variables. Convergence types and connections between them.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
13. Laws of large numbers. Weak law of large numbers. Markov, Chebyshev, Poisson and Bernoulli theorems. Strong law of large numbers.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
14. Lindeberg condition and central limit theorem. Moivre-Laplace theorem.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	

Bibliography

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

2. BLAGA, P., RĂDULESCU, M., *Calculul probabilităţilor*, Lito., Univ. Babeş-Bolyai Cluj-Napoca, 1987.

3. BLAGA, P., *Calculul probabilităţilor şi statistică matematică. Curs şi culegere de probleme*, Vol. II, Lito.,Univ. Babeş-Bolyai Cluj-Napoca, 1994.

4. LISEI, H., *Probability Theory*, Casa Cărţii de Ştiinţă, Cluj-Napoca, 2004.

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

6. 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. Elements of 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. AGRATINI, O., *Probabilităţi - Culegere de probleme*, Lito., Univ. Babeş-Bolyai Cluj-Napoca, 1992.

2. BLAGA, P., *Calculul probabilităţilor-Culegere de probleme*, Lito., Univ. Babeş-Bolyai Cluj-Napoca, 1984.

3. BLAGA, P., *Calculul probabilităţilor şi statistică matematică. Curs şi culegere de probleme*, Vol. II, Lito., Univ. Babeş-Bolyai Cluj-Napoca, 1994.

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

5. SHELDON, R., *A First Course in Probability*, 8th edition, Pearson Prentice Hall, 2010.

9. 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, participation to the seminar.	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
18 April 2018	Prof. PhD. Agratini Octavian	Lect. PhD. Roşca Natalia

Date of approval — Signature of the head of department

Prof. PhD.. Agratini Octavian