SYLLABUS

Probability Theory and Applications

University year 2025-2026

1. Information regarding the programme

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

2. Information regarding the discipline

2.1. Name of the dis	scipli	ne Probabili	Probability Theory and Applications			Discipline code	MLE0099		
2.2. Course coordinator			Dr Oana-Andrea Lang						
2.3. Seminar coordinator			Dr	Oana-A	ndrea I	Lang			
2.4. Year of study	2	2.5. Semester	. Semester 4 2.6. Type of evaluati			Е	2.7. D	iscipline regime	Compulsory

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

3.1. Hours per week	4	of which: 3.2 course	2	3.3 seminar/laboratory	2
3.4. Total hours in the curriculum	56	of which: 3.5 course	28	3.6 seminar/laboratory	28
Time allotment for individual study (ID) and self-study activities (SA)					
Learning using manual, course support, bibliography, course notes (SA)					14
Additional documentation (in libraries, on electronic platforms, field documentation)					7
Preparation for seminars/labs, homework, papers, portfolios and essays					10
Tutorship					
Evaluations					7
Other activities:					-
3.7. Total individual study hours44					
3.8. Total hours per semester	100				
3.9. Number of ECTS credits	4				

4. Prerequisites (if necessary)

4.1. curriculum	Mathematical Analysis, Algebra
4.2. competencies	Set Theory, Combinatorics

5. Conditions (if necessary)

5.1. for the course	Classroom with blackboard/video projector
5.2. for the seminar /lab activities	Classroom with blackboard/video projector
	14

6.1. Specific competencies acquired ¹

¹ One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

Professional/essential 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. C5.2 Using mathematical arguments to prove mathematical results.
Transversal competencies	CT1 Application of efficient and rigorous working rules, manifest responsible attitudes towards the scientific and didactic fields, respecting the professional and ethical principles.

6.2. Learning outcomes

Knowledge	 The student knows: fundamental notions related to Probability Theory and methods of applying them to areas of science related to Mathematics, Mechanics and Engineering. how to use at least a programming and editing environment to create attractive mathematical texts with formulas, diagrams and images.
Skills	 The student is able to ensure the formation of skills specific to the Mathematics-related disciplines needed to complete the assignments. explore some mathematical content independently, drawing on ideas and tools from previous coursework to extend their understanding.
Responsibility and autonomy:	 The student has the ability to work independently to extend mathematical ideas and arguments from previous coursework to a mathematical topic not previously studied. interpret articles or books from the mathematical literature and incorporate ideas and results from the literature in their written and oral presentations.

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 its applications.
7.2 Specific objective of the discipline	 Application of classical probabilistic models to solve real life problems. Become familiar with classical probability distributions. Properties of sequences of random variables.

8. Content

8.1 Course	Teaching methods	Remarks
 Introduction to Probability Theory. Experiments and events. 	Interactive exposure, explanation, conversation, didactical demonstration	

2. Probability function; conditional	Interactive exposure, explanation, conversation, didactical	
probability; independence of events.	demonstration	
_	Interactive exposure, explanation,	
3. Sampling with/without replacement.	conversation, didactical	
	demonstration	
4. Random variables; classical discrete	Interactive exposure, explanation,	
probability distributions.	conversation, didactical	
	Interactive exposure explanation	
5 Cumulative distribution function	conversation didactical	
5. Cumulative distribution function.	demonstration	
	Interactive exposure, explanation.	
6. Probability density function; classical	conversation, didactical	
continuous probability distributions.	demonstration	
7. Random vectors; joint cumulative	Interactive exposure, explanation,	
distribution function; joint density	conversation, didactical	
function.	demonstration	
9 Eurotions of random variables:	Interactive exposure, explanation,	
onerations with random variables	conversation, didactical	
	demonstration	
9. Numerical characteristics of random	Interactive exposure, explanation,	
variables: expectation, variance,	conversation, didactical	
moments.	demonstration	
10. Numerical characteristics of random	Interactive exposure, explanation,	
variables: covariance, correlation	conversation, didactical	
coefficient.	demonstration	
11. Moment generating function of a	Interactive exposure, explanation,	
	conversation, didactical	
random variable.	1	
random variable.	demonstration	
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conversation, individual and

group work

5. Cumulative distribution function

r		
6. Probability density function	Interactive exposure, explanation, conversation, individual and group work	
7. Joint cumulative distribution function; joint density function	Interactive exposure, explanation, conversation, individual and group work	
8. Functions of random variables; operations with random variables	Interactive exposure, explanation, conversation, individual and group work	
9. Numerical characteristics of random variables	Interactive exposure, explanation, conversation, individual and group work	
10. Probability inequalities	Interactive exposure, explanation, conversation, individual and group work	
11. Moment generating function of a random variable	Interactive exposure, explanation, conversation, individual and group work	
12. Sequences of random variables	Interactive exposure, explanation, conversation, individual and group work	
13. Laws of large numbers	Interactive exposure, explanation, conversation, individual and group work	
14. Applications of limit theorems	Interactive exposure, explanation, conversation, individual and group work	

Bibliography

• Grimmett G.R., Stirzaker D.R., One thousand exercises in probability. Oxford University Press, Oxford, 2003.

• Lisei H., Grecksch, W., Iancu, M., Probability: Theory, Examples, Problems, Simulations. World Scientific Publishing, Singapore, 2020.

• Lisei, H., Micula, S., Soos, A., Probability Theory trough Problems and Applications, Cluj University Press, Cluj-Napoca, 2006.

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 course exists in the studying program of all major universities in Romania and abroad.
- The knowledge and skills acquired in this course give students a foundation for launching a career in scientific research.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
	 to acquire the basic principles from Probability Theory 	• Writton over	7004
10.4 Course	• to be able to apply		30%
	course concepts on various applications	 Coursework 	
	 problem-solving 		
10.5 Seminar/laboratory	• to be able to apply the course	 Continuous observation during the 	Extra 10% possible

	concepts to solve problems	semester, active participation in the seminars						
10.6 Minimum standard of performance								
• At least 50% overal	11.							

11. Labels ODD (Sustainable Development Goals)²

General label for Sustainable Development									
							9 NDUSTRY, INNOVATION AND INFRASTRUCTURE		

Date: 11.04.2025 Signature of course coordinator

0 Lang

Signature of seminar coordinator

0 Lang

Date of approval: 25.04.2025

Signature of the head of department

Prof. dr. Andrei Mărcuș

² Keep only the labels that, according to the *Procedure for applying ODD labels in the academic process*, suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write *"Not applicable."*.