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 and Applications**				
2.2 Course coordinator			Dr Oana-Andrea Lang				
2.3 Seminar coordinator			Dr Oana-Andrea Lang				
2.4. Year of study	2	2.5 Semester	4	2.6. Type of evaluation	E	2.7 Type of discipline	DF / Compulsory
2.8 Code of the discipline		MLE0099					

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:					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, 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

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 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

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
1. Introduction to Probability Theory. Experiments and events.	Interactive exposure Explanation Conversation Didactical demonstration	
2. Probability function; conditional probability; independence of events	Interactive exposure Explanation Conversation Didactical demonstration	
3. Sampling with/without replacement	Interactive exposure Explanation Conversation Didactical demonstration	
4. Random variables; classical discrete probability distributions	Interactive exposure Explanation Conversation Didactical demonstration	
5. Cumulative distribution function	Interactive exposure	

	Explanation Conversation Didactical demonstration	
6. Probability density function; classical continuous probability distributions	Interactive exposure Explanation Conversation Didactical demonstration	
7. Random vectors; joint cumulative distribution function; joint density function	Interactive exposure Explanation Conversation Didactical demonstration	
8. Functions of random variables; operations with random variables	Interactive exposure Explanation Conversation Didactical demonstration	
9. Numerical characteristics of random variables: expectation, variance, moments	Interactive exposure Explanation Conversation Didactical demonstration	
10. Numerical characteristics of random variables: covariance, correlation coefficient	Interactive exposure Explanation Conversation Didactical demonstration	
11. Moment generating function of a random variable	Interactive exposure Explanation Conversation Didactical demonstration	
12. Sequences of random variables; types of convergence; laws of large numbers	Interactive exposure Explanation Conversation Didactical demonstration	
13. Limit theorems	Interactive exposure Explanation Conversation Didactical demonstration	
14. Review and preparation for the exam	Interactive exposure Explanation Conversation Didactical demonstration	

Bibliography

- Baron, M., *Probability and Statistics for Computer Scientists*, 2019
- Klenke, A., *Probability Theory: A Comprehensive Course*. Springer-Verlag, London, 2008
- Lisei, H., *Probability Theory*, Casa Cărţii de Ştiinţă, Cluj-Napoca, 2004
- Ross, S., *A First Course in Probability*, 9th edition, Pearson Education, 2014

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Combinatorics	Interactive exposure Explanation Conversation Individual and group work	

2. Probability calculus	Interactive exposure Explanation Conversation Individual and group work	
3. Conditional probability	Interactive exposure Explanation Conversation Individual and group work	
4. Classical probabilistic models	Interactive exposure Explanation Conversation Individual and group work	
5. Cumulative distribution function	Interactive exposure Explanation Conversation Individual and group work	
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

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	►to acquire the basic principles from Probability Theory ►to be able to apply correctly the course concepts on various applications ► problem-solving	Written exam Coursework	80% 20%
10.5 Seminar activities	►to be able to apply the course concepts to solve problems	Continuous observation during the semester, active participation in the seminars	Extra 10% possible
10.6 Minimum performance standards			
➢ At least grade 5 (on a scale from 1 to 10) at the written exam.			

Date	Signature of course coordinator	Signature of seminar coordinator
26.04.2024	O Lang	O Lang

Date of approval	Signature of the head of department
.....	Prof. Dr. Andrei Mărcuş