PROBABILITY in Fall 2018 (MA3005)

Course Code	MA3005	**Professor(s)**	Marie-France Derhy
Prerequisites	None	**Office Number**	SD1-08
Class Schedule	MR: 12:10-13:30 in SD-5	**Office Hours**	Wednesdays [14:00 - 15:00] or by appointment (SD-08)
Credits	4	**Email**	mderhy@aup.edu
Semester	Fall 2018	**Office Tel. Ext.**	650

Course Description

This course is designed to study the building blocks of Probability and to highlight the characteristics of a certain number of probability distributions. The course will begin with a general study of combinatorics so as to provide the students with the relevant insight before turning to the analysis of discrete & continuous distributions. The mathematical concepts of conditioning, independence and expectation will be highlighted, as well as the notion of moments. Joint distributions (discrete & continuous) will then be examined. Selected applications will shed light on the use of probability in various fields and a few computer lab sessions will be held to reinforce global understanding.
Additional topic for the fourth credit: Queuing theory (Poisson and Exponential distributions).

Course Learning Outcomes

Understand the relevance of combinatorics in highlighting probability features.
Understand the importance of the concepts of independence, conditioning and moment in probability theory.
Have knowledge of the distinctive characteristics of the continuous and discrete distributions studied (Normal, Exponential, Uniform, Gamma // Binomial, Negative Binomial, Hypergeometric, Poisson, Geometric) and acquire the ability to handle connected applications appropriately.
Extend this knowledge to joint (continuous and discrete) distribution functions and solve related problems.

General Education

[PLEASE EDIT OR REMOVE THE FOLLOWING TEXT AS APPLICABLE]
The general education program at AUP consists of four requirements: Speaking the World, Modeling the World, Mapping the World, and Comparing Worlds Past and Present.

This course can be used to fulfill the [INDICATE THE REQUIREMENT(S) FULFILLED BY THE COURSE] requirement and as such has the following learning outcomes:

[INDICATE THE GENERAL EDUCATION LEARNING OUTCOMES]

Course Outline

Topics:
I. Combinatorial Analysis
- Principles of Counting.
- Permutations (with & without repetition).
- Combinations (of sets and multisets).
- Tree diagrams.

II. Axioms, Conditional Probability & Independence
- Euclidean Sample Spaces & Events.
- Axioms & Equiprobable Spaces.
- Probability trees.
- Conditioning & Independence.
- Partitions & Bayes' Theorem.

III. Random Variables & Probability Distributions
A. Discrete Probability Distributions
- Expectation & Variance.
- The Binomial distribution [X ~ ß (n, p)] (and the Negative Binomial distribution).
- The Hypergeometric distribution [X ~ H (D, N, n)].
- The Poisson distribution [X ~ P (?)].
- The Multinomial distribution [X ~ M (n, p1, p2, ... pq)].
- The Geometric distribution [X ~ G (p)].
- Chebychev's Inequality.
- Moments.
B. Continuous Distributions
- Expectation & Variance.
- The Normal distribution [X ~ N (µ, s2].
- The Exponential distribution [X ~ E (l)].

- The Uniform distribution [X ~ U (a, ß)].
- The Gamma distribution [X ~ G (a, ?)].
- The Law of Large Numbers and the Central Limit Theorem.

IV. Joint Distribution Functions (Discrete & Continuous)
- Covariance & Correlation.
- Independent random variables.
- Sums of independent random variables.
- Conditional distributions.

The topics scheme given below is provisional:

Note: Exercises and applications are given on a daily basis and are corrected the class after.

WEEK	CONTENTS	Work & Readings
Week 1 [September 10– 14]	**General Introduction** **I Combinatorial Analysis (1)** • Principles of Counting • Permutations (1)	*Work:* Exercises & applications *Readings:* Chapter 1 (The corresponding sections)
Week 2 [September 17– 21]	**I Combinatorial Analysis (2)** • Permutations (2) • Combinations • Tree diagrams	*Work:* Exercises & applications *Readings:* Chapter 1 (The corresponding sections)
Week 3 [September 24– 28]	**II Axioms, Conditional Probability & Independence (1)** • Introduction • Euclidean Sample Spaces & Events • Axioms &equiprobable Spaces • Probability trees	*Work:* Exercises & applications *Readings:* Chapter 2 (The corresponding sections)
Week 4 [October	*Comprehensive Quiz* **II Axioms, Conditional Probability &**	*Work:* Exercises &

1– 5]	**Independence (2)** • Conditioning • Independence • Partitions & Bayes' Theorem	applications *Readings:* Chapters2 & 3 (The corresponding sections)
Week 5 (Half week) [October 8– 12]	**III Random variables & Probability distributions** • Introduction • Expectation & Variance *A. Discrete Random Variables (1)* • The Binomial distribution [X ~ ß (n, p)]	*Work:* Exercises & applications *Readings:* Chapter 4 (The corresponding sections)
Week 6 [October 15– 19]	*A. Discrete Random Variables (2)* • The Negative Binomial distribution). • The Hypergeometric distribution [X ~ H (D, N, n)]. • The Poisson distribution [X ~ P(l)].	*Work:* Exercises & applications *Readings:*Chapter 4 (The corresponding sections)
Week 7 [October 22 – 26]	*Mid-Semester Exam*l *A Discrete Random Variables (3)* • The Multinomial distribution [X ~ M (n, p1, p2, ...pq)]. • The Geometric distribution [X ~ G (p)]. • Chebychev's Inequality. • Moments	*Work:* Exercises & applications *Readings:*Chapter 4 (The corresponding sections)
Week 8 (Half-week) [October	*B. Continuous distributions (1)* • Expectation & Variance.	*Work:* Exercises & applications

29 – 30]		*Readings:* Chapter 5 (The corresponding sections)
	Mid-Semester Break [October 31 – November 4]	
Week 9 [November 5 – 9]	*B. Continuous distributions (2)* • The Normal distribution [X ~ N (m, s???? • The Exponential distribution [X ~ E(l)].	*Work:* Exercises & applications *Readings:* Chapter 5 (The corresponding sections)
Week 10 [November 12– 16]	*Queuing Theory: the link between discrete & continuous distributions* *B Continuous distributions (3)* • The Uniform distribution [X ~ U(a, b)]. • The Gamma distribution [X ~ G(a, l)]. • The Law of Large Numbers and the Central Limit Theorem.	*Work:* Exercises & applications *Readings:* Chapter 5 (The corresponding sections)
Week 11 [November 19– 23]	*Mid-Semester Exam* II **IV Joint distributions functions** **(discrete& continuous) (1)** • Joint distribution functions	 *Work:* Exercises & applications *Readings:* Chapter 6 (The corresponding sections)
Week 12 [November	**IV Joint distributions functions** **(discrete& continuous) (2)**	*Work:* Exercises &

26– 30]	• Covariance & Correlation. • Independent random variables	applications *Reading s:* Chapters6/7 (The corresponding sections)
Week 13 (1.5 weeks) [December 3 – 7] & [10 – 12]	*Project due* **IV Joint distributions functions (discrete& continuous) (3)** • Sums of independent random variables • Conditional distributions	*Work:* Exercises & applications *Readings:*Chapter 7 (The corresponding sections)
	Exam: December 17th	

Textbooks

Title	Author	Publisher	ISBN	Required
FIRST COURSE IN PROBABILITY, 9TH EDITION	ROSS, SHELDON	PEARSON EDUCATION	9781292024929	Yes

Attendance Policy

Students studying at The American University of Paris are expected to attend ALL scheduled classes, and in case of absence, should contact their professors to explain the situation. It is the student's responsibility to be aware of any specific attendance policy that a faculty member might have set in the course syllabus. The French Department, for example, has its own attendance policy, and students are responsible for compliance. Academic Affairs will excuse an absence for students' participation in study trips related to their courses.

Attendance at all exams is mandatory.

IN ALL CASES OF MISSED COURSE MEETINGS, THE RESPONSIBILITY FOR COMMUNICATION WITH THE PROFESSOR, AND FOR ARRANGING TO MAKE UP MISSED WORK, RESTS SOLELY WITH THE STUDENT.

Whether an absence is excused or not is ALWAYS up to the discretion of the professor or the department. Unexcused absences can result in a low or failing participation grade. In the case of excessive absences, it is up to the professor or the department to decide if the student will receive an “F” for the course. An instructor may recommend that a student withdraw, if absences have made it impossible to continue in the course at a satisfactory level.

Students must be mindful of this policy when making their travel arrangements, and especially during the Drop/Add and Exam Periods.

Grading Policy

Quizzes & Project: 30%
Mid-Term I: 20%.
Mid-Term II: 20%.
Exam: 30%

Other

***Package: various facilities &* DATADESK**