KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF MATHEMATICS

MATH 563: Probability Theory

Instructor: Dr. Brahim Mezerdi

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Office Hours: UTR 9:00 – 10:00 or by appointment

Time: UTR 10:00 – 10:50
Place: Building 3 – Room 114

Textbook: Paolo Baldi , Probability An Introduction Through Theory and Exercises, 1st edition (2023)

Additional References:

- **Williams David**, Probability with Martingales, Cambridge University Press, 1991.
- **Durrett Rick,** Probability: Theory and Examples, Cambridge University Press, 2019

Course Description:

Foundations of probability theory. Measure-theoretic approach to definitions of probability space, random variables and distribution functions. Modes of convergence and relations between the various modes. Independence, Kolmogorovtype inequalities. Tail events and the Kolomogorov 0-1 law. Borel-Cantelli lemma. Convergence of random series and laws of large numbers. Convergence in distribution. Characteristic functions. The central limit theorem. Weak convergence of probability measures. Conditional expectations and martingales.

Prerequisites: Graduate Standing

Course Objectives

1) To explain important notions in probability theory and state the different convergence criteria and describe how they relate to each other.
2) To introduce some of the most important theorems, e.g. the central limit theorem and the law of large numbers.
3) To introduce the joint conditional and marginal distributions, conditional expectation and use these concepts to study martingales

Assessment for this course is based on class activities (Quizzes), a midterm exam and a comprehensive final exam, as described in the following table.

Grading Policy:

	Date	**Time**	**Place**	**Materials**	**Percentage**
Midterm Exam	TBA	TBA	TBA	TBA	35 %
Final Exam	TBA	TBA	TBA	Comprehensive	45 %
Project					10 %
Class Work	It is based on quizzes, class tests or other class activities determined by the instructor.				10 %

Academic Integrity: All KFUPM policies regarding ethics and academic honesty apply to this course.
Important Attendance Notes:

- In accordance with University rules, **20 % , 6 unexcused absences** or 33.3 %, **10 excused-unexcused absences** will automatically result in a grade of **DN**.
- Attendance on time is very important. Mostly, attendance will be checked within the first five minutes of the class. Entering the class after that, is considered as one late, and every two times late equals to one absence. The student has to be available until the end of the class.

Suggested Problems:

- ✓ Suggested problems will be posted on the BLACKBOARD towards the end of each chapter.

Cheating in Exams:
Cheating or any attempt of cheating by use of illegal activities, techniques and forms of fraud will result in a grade of **DN** in the course along with reporting the incident to the higher university administration. Cheating in exams includes (but is not limited to)

- Looking at the papers of other students
- Talking to other students
- Using mobiles or any other electronic devices **including Smart Watch**

Missing an Exam: In case a student misses an exam (Midterm Exam or the Final Exam) for a legitimate reason (such as medical emergencies), she/he must bring an official excuse from Students Affairs. Otherwise,she/he will get zero in the missed exam.

The Usage of Mobiles in Class: Students are not allowed to use mobiles for any purpose during class time. Students who want to use electronic devices to take notes must take permission from their instructor. Violations of these rules will result in a penalty decided by the instructor.

Syllabus – A rough weekly guideline

Week #	Chapter	Topics
1	**Chapt 1: Elements of measure theory**	Measurable spaces , measurable functions
2	Chapt 1:	Measures and Integration
3	Chapt 1:	Lp spaces , Product measures
4	**Chapt 2: Probability**	Random Variables, laws, expectation, independence
5	Chapt 2	Moments, Variance, Covariance, Jensen inequality, Characteristic functions
6	Chapt 2	Laplace transform, Multivariate Guassian laws
7	**Chapt 3: Convergence**	Different types of convergence of random variables
8	Chapt 3	Weak and strong law of large numbers
9	Chapt 3	The central limit theorem
10	**Chapt 4: Conditioning**	Conditional expectation
11	Chapt 4	Conditional Laws
12	Chapt 4	Conditional laws of Gaussian vectors
13	**Chapt 5: Martingales**	General definition of a martingale
14	Chapt 5	The stopping time theorem
15	Chapt 5	L1 convergence and regularity