King Fahd University of Petroleum and Minerals
Department of Mathematics
DATA 201 Syllabus, Term 261 (2026-27)
Coordinator: Dr. Nasir Abbas (nasirabbas@kfupm.edu.sa)

Course Title: Probability for Data Science
Course Credit Hours: 3-0-3
Textbook: "Introduction to Probability for Data Science" by Stanley H. Chan (2021)
Software Package: R language and R studio.

Course Objective: By the end of the course, students will be able to:

- Explain key principles of probability, including discrete and continuous distributions, dependence, and conditioning, to model data science problems.
- Implement principles of Markov Chains, Markov Chain Monte Carlo (MCMC) methods, and Bayesian techniques for practical data science applications.
- Analyze and simulate probabilistic models and random processes using mathematical and computational tools.
- Make data-driven inferences using probabilistic methods and software.

Course Description: An introduction to probability, emphasizing the combined use of mathematics and programming. Discrete and continuous families of distributions. Bounds and approximations. Transforms and convergence. Markov chains and Markov Chain Monte Carlo. Dependence, conditioning, Bayesian methods. The multivariate normal, random permutations, symmetry, and order statistics. Use of numerical computation, graphics, simulation, and computer algebra.
Prerequisite: STAT 201 and (MATH 208 or MATH 225)

Course Learning Outcomes: Upon successful completion of the course, a student should be able to

- Discuss the concept of sampling distribution of a sample mean and proportion.
- Calculate the mean, the variance, and the probabilities for discrete and continuous distributions
- Estimate the unknown population mean and proportion using confidence interval technique and testing of hypothesis
- Summarize data using common graphical and numerical tools.
- Calculate the probabilities of operations on events based on sample space for random experiments
- Recognize the meaning of sample correlation coefficient and model real life problems using simple and multiple linear regression including estimation and testing of model parameters
- Use a statistical package to compute descriptive statistics, construct confidence intervals.

Grading Policy:

Activity	Weight
Classwork	10%
Project	10%
Major Exam 1	25%
Major Exam 2	25%
Final Exam (Comprehensive)	30%

Tentative Syllabus

Week	Chapter/Sections	Topics	Notes
1	Ch 1	Mathematical Background: Sets, Series, and Combinatorics	Review fundamental math concepts
2	Ch 2	Probability Space and Axioms	Probability basics and conditional probability
3	Ch 3	Discrete Random Variables	PMFs, expectations, and discrete distributions
4	Ch 4	Continuous Random Variables	PDFs, CDFs, Gaussian distributions
5	Ch 5	Joint Distributions and Covariance	Multivariate distributions and transformations
6	Ch 5	Joint Distributions and Covariance	Multivariate distributions and transformations
7	Ch 6	Sample Statistics and Central Limit Theorem	Moment-generating functions and theorems
8	Ch 8	Estimation Techniques (MLE and MAP)	Theory and real-world applications
9	Ch 8	Estimation Techniques (MLE and MAP)	Theory and real-world applications
10	Ch 9	Confidence Intervals	Constructing intervals
11	Ch 9	Hypothesis Testing	significance testing
12	Adhikari & Pitman (AP) Ch 10	Markov Chains	Introduction, transition matrices, steady-state behavior
13	AP Ch 11	Markov Chain Monte Carlo (MCMC)	Basics, Metropolis-Hastings algorithm, Gibbs sampling
14	Ch 9 & AP Ch 11	Applications of MCMC	Use cases in data science and sampling challenges
15	Review	Comprehensive Review of Course Topics	Q&A and key concept reinforcement
16	Final Exam	Comprehensive	Scheduled by registrar

Letter Grades: Final letter grades will be assigned according to a grading curve, which will be determined based on the overall performance of all students enrolled in the course. The exact cutoffs may change from one term to another, depending on how the scores are distributed.

Exam Questions: Exam questions will be similar in style and level of difficulty to the examples and exercises provided in the textbook.

Use of Mobile Devices in Class: The use of mobile phones during class is strictly prohibited. Students who wish to use laptops or tablets for notetaking must first obtain permission from the instructor. Any violation will result in a penalty determined by the instructor.

Examination Policies: You are expected to adhere to KFUPM policies for all examinations in this course, including quizzes, major exams, midterms, and final exams. The following policies are enacted in this course during examinations:

- Students are expected to arrive at the examination hall on time with proper University ID.
- Students are seated according to the instructor's seat assignment and may request a seat change only for legitimate reasons.
- Late arrival at the exam may result in the student being denied admission. Once a student has completed the examination and left the examination hall/room, no late student will be admitted.
- Students are not permitted to leave the examination room to use the restroom during an exam, except in rare cases involving a documented medical condition (e.g., diabetes, kidney disease). Any excused restroom leave will be fully supervised by a same-gender proctor.
- Students must leave all smart devices outside the examination hall, including smartphones, smartwatches, earbuds, and unauthorized calculators. Possession of any unauthorized device will be considered a cheating attempt and will be handled accordingly.
- Cheating attempts will be reported according to KFUPM policy and will result in a DN grade in the course, along with potential further penalties upon investigation.

Missing an Exam: In case a student misses an exam (Exam I, Exam II, or the Final Exam) for a legitimate reason (such as medical emergencies), the student must submit an official excuse approved by the Deanship of Student Affairs within **seven calendar days** of the missed exam date. Without an approved excuse, the student will receive a score of zero for the missed exam. When the excuse is accepted, the coordinator will arrange a makeup exam for the missed exam.

Class Attendance: Students are expected to arrive on time for class, consistent with expectations in professional settings. Recording attendance for another student, signing another student's attendance, or asking another student to record yours will be reported for investigation and may result in severe consequences for both students involved.
A DN grade will be given after two warnings if a student exceeds 9 unexcused absences (20% of the course) or exceeds a total of 15 absences whether excused or not (one-third of the course).

Honor code: Students of this course are expected to maintain the highest level of academic integrity and ethics. A KFUPM student does not cheat or tolerate those who do. Every student is expected to submit work that is entirely their own, to properly cite all sources used, and to refrain from any form of academic misconduct.

Plagiarism: Use of another person's ideas, processes, results, or words requires appropriate credit or reference to the author. Use of Generative AI tools is subject to the instructor's authorization. Submitting the same work in more than one course without the instructor's permission is not allowed.

Academic Integrity: All KFUPM academic integrity policies apply to this course. For details, students should refer to the Undergraduate Bulletin available on the Registrar’s website.