King Fahd University of Petroleum and Minerals
Department of Mathematics and Statistics
Dhahran, Saudi Arabia

STAT301: INTRODUCTION TO PROBABILITY THEORY (TERM 122)

Course Description: (3-0-3)

Basic classical models of probability. Set functions. Axiomatic definition of probability. Conditional probability and Bayes' theorem. Random variables and their types. Distributions, moments, and moment generating functions. Special discrete and continuous distributions. Random vectors and their distributions. Marginal and conditional distributions. Independent random variables. Functions of random variables. Sums of independent random variables. Weak law of large numbers and the central limit theorem.

Prerequisites: MATH201 and either STAT 201, STAT212, STAT213, or STAT319

Course Objectives:

To master the basics of probability theory and applying it to popular probability models. This will lay the foundation for students majoring Actuarial Science for the first Society of Actuaries (SOA).

Textbook: Ross, S.M. (2010) *A First Course in Probability* (8th Edition) Prentice Hall: Upper Saddle River, NJ.

Reference: ACTEX P/1 *Study Manual*, 2010th edition, by Broverman, S.A., ACTEX Publications Inc.: Winsted, CT.
Hassett, M.J. & Stewart, D.G.(1999). *Probability for Risk Management*. ACTEX Publications Inc.: Winsted, CT.

Instructor: Dr. Mohammad H. Omar **Office:** Bldg – 5, room – 508. **Phone:** 2471
E-mail: omarmh@kfupm.edu.sa (Not by WebCT/Blackboard email)
Office Hours: SW: 12.20pm-1.40pm and M 1.00pm -1.40pm or by appointment.

Assessment: Assessment for this course will be based on attendance, quizzes, one midterm exam and a comprehensive final exam, as in the following:

Activity	Weight
Home Works / Quizzes	20%
Major Exam 1 (Chapters 1 to 4) **Tuesday, Feb 26 – 1st Major Exam 0600pm - 730 pm in Building 59**	20%
Mid Term Exam (Chapters 4 to 6) **Sunday, Apr 21- 2-nd Major Exam 0630 pm - 0800 pm in Building 59**	20%
Final Exam (Comprehensive): see Registrar's website. **Wednesday, May 22 0800 am in Building TBA**	40%

IMPORTANT NOTE on GRADES: Students who ***miss 9 or more*** meetings will receive a **DN** grade. Students with **less than 50% total score** will receive an **F grade**. Students who obtain **more than 90%** on the class total will obtain an **A+** grade. Other grades starts as follows: **D (50%), D+ (55%), C (60%), C+ (70%), B (75%), B+ (80%),** and **A (85%).** There is no quota on the number of students who can get an A+ grade or any other grades.

General Notes:

- Students are required to carry **pens, note-taking equipment** and a **calculator** to **every lecture, quizzes, and exams**. It is strongly recommended to keep a **binder** for class-notes.
- Students are also expected to take notes and organize their solved questions in a **binder** for easy retrieval to help them in study and review for class, exams, etc. It is to the student's advantage to keep a binder for storing class notes, homework, and other graded assignments. Students who are **organized** will find it **easier** to find important materials when **studying for exams**.
- To successfully prepare for the exam, students must **solve problems** daily and with discipline. The selected assigned problems are specifically designed to prepare you for class quizzes, midterms and final exam. So, it is expected that you complete these problems **step-by-step** and with comprehension.
- ***Never round*** your intermediate results to problems when doing your calculations. This will cause you to lose calculation accuracy.
- For every exam, so you need to bring with yo*u* ***pens***, ***pencils***, ***a sharpener***, ***an eraser***, and a ***calculator***.

Important Notes:

✓ In accordance with University rules, ***20% or 9 (NINE) 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 being late twice equals to one absence.

Home Work Problems:

➢ Problems to be discussed will be posted on the WebCT or in the instructor home page. Students are expected to solve as many problems.

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

Syllabus (Tentative)

Week (Date)	**Topics**	***Notes***
1 (Jan 26-30)	**1 Combinatorial Analysis** 1.1 Introduction, 1.2 The Basic Principle of Counting, 1.3 Permutations, 1.4 Combinations, 1.5 Multinomial Coefficients	29-Jan Last day for late registration & adding courses.
2 (Feb 2-6)	**2 Fundamentals of Probability** 2.1 Introduction, 2.2 Sample Space and Events, 2.3 Axioms of Probability, 2.4 Some Simple Propositions, 2.5 Equally Likely Outcomes	6-Feb Last day for dropping course(s) without record
3 (Feb 9-13)	**3 Conditional Probability and Probabilistic Independence** 3.1 Introduction, 3.2 Conditional Probabilities, 3.3 Bayes Rule, 3.4 Probabilistic Independence	
4 (Feb 16-20)	**4 Random Variables** 4.1 Introduction, 4.2 Cumulative Probability Distribution Function, 4.3 Discrete Random variables, 4.4 Expected Value, 4.5 Expectation of a Function of a Random Variables, 4.6 Moments, 4.7 The Bernoulli and Binomial Probability Distribution,	
	Tuesday, Feb 26 – 1st Major Exam (chapters 1, 2, 3, & 4)	
5 (Feb 23-27)	4.8 The Poisson Probability Distribution, 4.9 The Geometric Probability Distribution, The Negative Binomial Probability Distribution	**Mar 2 (2 wks):** Midterm grade reports
6 (Mar 2-6)	The Hypergeometric Probability Distribution, The Zipf Probability Distribution, 4.9 The Cumulative Mass Function	**6 Mar:** Last day to Drop **courses** with grade of "W" online
7 (Mar 9-13)	**5 Continuous Random Variables** 5.1 Introduction, 5.2 Moments, Cumulative Probability Distribution Function, 5.3 The Uniform Random Variable, 5.4 The Normal Probability Distribution, Approximation of Binomial Probability, 5.5 The Exponential Probability Distribution, Hazard Rate Function,	
8 (Mar 16-20)	5.6 The Gamma Probability Distribution, The Weibull Probability Distribution, The Cauchy Probability Distribution, The Beta Probability Distribution, 5.7 The Probability Distribution of a Function of a Random Variable	
	MidTerm Vacation: Mar 21 – 29, 2013	
9 (Mar 30-Apr 3)	**6 Jointly Distributed Random variables** 6.1 Joint Probability Distributions, Joint Probability Distribution Function, 6.2 Independence of Random variables, 6.3 Sum of Independent Random variables, 6.4 Conditional Probability Distribution: Discrete Case,	
10 (Apr 6-10)	6.5 Conditional Probability Distribution: Continuous Case, 6.6 Order Statistics, 6.7 Joint Probability Distribution of a Function of Random Variables	**10 Apr:** Last day to withdraw from **all courses** with grade of "W" thru Registrar
11 (Apr 13-17)	**7 Properties of Expectation** 7.1 Introduction, 7.2 Expectation of a Sum of Random Variables, 7.3 Covariance, Variance of a Sum, and Correlation, 7.4 Conditional Expectation: Definition, Calculating Expectation by Conditioning, Calculating Probability by Conditioning, Conditional Variance, Conditional Expectation, Prediction and Regression Function	**13 Apr:** Early Registration & Coop
12 (Apr 20-24)	7.6 Moment Generating Function 7.7 Correlation and Independence of Sample Mean and Variance; Independence of Sample Mean and Variance in Normal Distribution	
	Sunday, Apr 21- 2-nd Major Exam (chapters 4, 5, & 6)	
13 (Apr 27-May 1)	**8. Limit Theorems** 8.1 Introduction, 8.2 Chebyshev's Inequality and the Weak Law of Large Numbers, 8.3 The Central Limit Theorem, 8.4 The Strong Law of Large Numbers, 8.5 Other Probability Inequalities	
14 (May 4-8)	**9. Additional Topics in Probability** (if time permits) 9.1 The Poisson Process, 9.4 Entropy	8 May: Last day "WP/WF" from **all courses** thru Registrar
15 (May 11-15)	**10. Simulation** (if time permits) 10.1 Introduction, 10.2 The Inverse Transformation Method, Simulating Exponential Random Variable, Simulating a circular normal variables by Box-Muller Transformation. Revision.	May 15: Last day of class

Student Learning Objectives (From SOA Exam P/1): Candidates should be able ***to use*** and ***apply*** the following concepts:

1. General Probability
   - Set functions including set notation and basic elements of probability
   - Mutually exclusive events
   - Addition and multiplication rules
   - Independence of events
   - Combinatorial probability

- Conditional probability
- Law of total probability

2. Univariate probability distributions (including binomial, negative binomial, geometric, hypergeometric, Poisson, uniform, exponential, chi-square, beta, Pareto, lognormal, gamma, Weibull, and normal)

   - Probability functions and probability density functions
   - Cumulative distribution functions
   - Mode, median, percentiles, and moments
   - Variance and measures of dispersion
   - Moment generating functions
   - Transformations

3. Multivariate probability distributions (including the bivariate normal)

   - Joint probability functions and joint probability density functions
   - Joint cumulative distribution functions
   - Central Limit Theorem
   - Conditional and marginal probability distributions
   - Moments for joint, conditional, and marginal probability distributions
   - Joint moment generating functions
   - Variance and measures of dispersion for conditional and marginal probability distributions
   - Covariance and correlation coefficients
   - Transformations and order statistics
   - Probabilities and moments for linear combinations of independent random variables