

**KING FAHD UNIVERSITY OF PETROLEUM & MINERALS**  
**DEPARTMENT OF MATHEMATICS & STATISTICS**  
**DHAHRAN, SAUDI ARABIA**

**STAT501: Probability and Mathematical Statistics I - Term 141 (3-0-3)**

**Course Description:**

Axioms and foundations of probability. Conditional probability and Bayes' theorem. Independence. Random variables and distribution functions and moments. Characteristic functions. Laplace transforms and moment generating functions. Function of random variables. Random vectors and their distributions. Convergence of sequences of random variables. Law of large numbers and the central limit theorem. Random Samples, sample moments, and their distributions. Order statistics and their distributions.

**Course Objectives:**

To master the basics of probability theory with an aim to apply it to popular probability models and to samples for statistical inference.

**Prerequisites:** Graduate standing

**Textbook and Package:**

1. Rohatgi, VK and Saleh, AK (2001) *An Introduction to Probability and Statistics*, Wiley.
2. MATHEMATICA.

**Reference:**

Probability exam syllabus on SOA site.

**Instructor:** Dr. Mohammad H. Omar

**Office:** Bldg – 5, room – 508. **Phone:** 2471

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**Office Hours:** UT: 2.00pm -3.00pm and 4.20pm -4.50pm, R:10.30am-11.55am or by appointment.

Assessment

Assessment for this course will be based on attendance, homework, Class project, 2 major exams and a comprehensive final exam, as in the following:

Activity	Weight
Attendance, homework	10%
Exam 1 (Joint Random Variables – Chap 1-3) <b>Tuesday (Oct 21 – week 6) , 5.00 pm (in class)</b>	20%
Exam 2 (Properties of Random Variables and Limiting Distributions) <b>Tuesday (Nov 25 - week 11), 5:00 pm (in class)</b>	20%
Project (Bivariate Distributions) <b>Tuesday (Dec 16 - week 14), due in class</b>	15%
Final Exam (Comprehensive) <b>Sunday January 4, 2015 7pm (will be updated by registrar website)</b>	35%

**IMPORTANT NOTE on GRADES:** There is no quota on the number of students who can get an A+ grade.

- ✓ **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 late (**2 lates= 1 Absence**) and
- ✓ **More than 10 minutes late = Absence** (regardless of any excuse).

Letter grade	A+	A	B+	B	C+	C	D+	D	F	DN
Cut-off	TBD	80	TBD	70	TBD	60	TBD	50%	<50%	≥ 6 absences

General Notes:

- Students are required to carry **pens, note-taking equipment** and a **calculator** to **EVERY lecture and exams**. It is strongly recommended to keep a **binder** for class-notes.
- Students are also expected to bring the book, 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 SOA exams, students MUST **solve problems** regularly and with discipline. The selected assigned problems are specifically designed to prepare you for major and final exams. So, it is expected that you complete these problems **step-by-step** and **with comprehension**.
  - If you happen to stumble upon a solution manual somewhere, remember 2 important points. (1) Due to publishing costs and deadlines, these solutions are brief and may have mistakes and (2) in your career as an actuary and your exams and quizzes in this

class, you are expected to know every step to a problem and to know if a solution is incorrect. Thus, the best way to solve problem is without these brief solutions.

- **Never round** your intermediate results to problems when doing your calculations. This will cause you to lose calculation accuracy. Your answers may then be different from the SOA exam key even when you use the right procedure.
- For every exam, so you need to bring with you **pens, pencils, a sharpener, an eraser**, and any scientific **calculator with statistical functions**.

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

### Syllabus (Tentative)

Week	Sections	Topics	Notes
1 (Aug 31-Sept 2)	Ch 1	A Mathematical Introduction, Elementary Probabilistic Methods	Sept 3: Last day for late registration & for adding courses
2 (Sept 7-9)	Ch 2	Elementary Probabilistic Methods (cont) Discrete Random Variables	
3 (Sept 14-16)	Ch 2	Properties of Discrete Random Variables Continuous Random Variables	
4 (Sept 21-23)	Ch 2	Properties of Continuous Random Variables	Sept 23: National Day Holiday
<b>Eid Al-Adha Vacation: Sept 26-Oct 11, 2014</b>			
5 (Oct 12-14)	Ch 3-5 (except 4.7, 5.4)	Mathematical Aspect of Selected Discrete Probability Models Mathematical Aspect of Selected Continuous Random Variables Joint Discrete Random Variables Joint Continuous Random Variables	<b>Choose your Project topic: Sunday Oct 19</b>
6 (Oct 19-21)	Ch 5	Joint Continuous Random Variables (cont)	<b>(2 wks):</b> Midterm grade reports starts
<b>Tuesday, Oct 21 – 1st Major Exam (chapters 1, 2, &amp; 3)</b>			
7 (Oct 26-28)	Ch 7	Fixed Sample, Random Sample, Discrete Sampling Distributions	
8 (Nov 2-4)	Ch 6	Continuous Sampling Distributions Limiting Distributions	
9 (Nov 9-11)	Ch 4.7	Limiting Distributions (cont) Discrete Order Statistics	
10 (Nov 16-18)	Ch 4.7	Continuous Order Statistics	
11 (Nov 23-25)	Ch 5.4	Bivariate Normal Distribution	
<b>Wednesday, Nov 25 – 2nd Major Exam (chapters 4, 5 &amp; 6)</b>			
12 (Nov 30-Dec 2)	Ch 7	Normal Sampling Distributions for Inference	
13 (Dec 7-9)	Ch 6	Large Sample Theory Simulation Continuous Bivariate Distributions	
14 (Dec 14-16)	Ch 5.4 +Assig read	Sampling Theories for Bivariate Normal Distribution	<b>Tues Dec 16:</b> Project Report due to instructor.
<b>Tuesday, Dec 16- (Bivariate Distribution Project due)</b>			
15 (Dec 21-23)	Ch 5.4 + Assig read	Continuous Multivariate Distributions Non-Central Probability Functions	
16 (Dec 28)	Review	Review	Dec 28: Normal Tuesday
<b>Final Exam (Comprehensive): TBA by Registrar</b>			

### Syllabus (Tentative)

Week	Sections	Topics	Assignments on WebCT
1 (Aug 31-Sept 2)	Ch 1	<b>A Mathematical Introduction, Elementary Probabilistic Methods</b>	
2	Ch 2	<b>Elementary Probabilistic Methods (cont), Discrete Random Variables</b>	Hwk 1 due
3 (Sept 14-16)	Ch 2	<b>Properties of Discrete Random Variables, Continuous Random Variables</b>	
4	Ch 2	<b>Properties of Continuous Random Variables</b>	
<b>Eid Al-Adha Vacation: Sept 26-Oct 11, 2014</b>			
5 (Oct 12-14)	Ch 3-5 (except 4.7, 5.4)	<b>Mathematical Aspect of Selected Discrete Probability Models Mathematical Aspect of Selected Continuous Random Variables Joint Discrete Random Variables, Joint Continuous Random Variables</b>	<b>Choose your Project topic: Sunday Oct 19</b>
6	Ch 5	<b>Joint Continuous Random Variables (cont)</b>	Hwk 2 due
<b>Tuesday, Oct 21 – 1st Major Exam (chapters 1, 2, &amp; 3)</b>			
7 (Oct 26-28)	Ch 7	<b>Fixed Sample, Random Sample, Discrete Sampling Distributions</b>	
8	Ch 6	<b>Continuous Sampling Distributions, Limiting Distributions</b>	Hwk 3 due
9 (Nov 9-11)	Ch 4.7	<b>Limiting Distributions (cont), Discrete Order Statistics</b>	Hwk 4 due
10	Ch 4.7	<b>Continuous Order Statistics</b>	
11 (Nov 23-25)	Ch 5.4	<b>Bivariate Normal Distribution</b>	
<b>Wednesday, Nov 25 – 2nd Major Exam (chapters 4, 5 &amp; 6)</b>			
12	Ch 7	<b>Normal Sampling Distributions for Inference</b>	Hwk 5 due
13 (Dec 7-9)	Ch 6	<b>Large Sample Theory, Simulation, Continuous Bivariate Distributions</b>	
14	Ch 5.4 +Assig read	<b>Sampling Theories for Bivariate Normal Distribution</b>	<b>Tues Dec 16: Project Report due to instructor.</b>
<b>Tuesday, Dec 16- (Bivariate Distribution Project due)</b>			
15 (Dec 21-23)	Ch 5.4 + Assig read	<b>Continuous Multivariate Distributions Non-Central Probability Functions</b>	
16 (Dec 28)	Review	<b>Review</b>	Dec 28: Normal Tuesday
<b>Final Exam (Comprehensive): TBA by Registrar</b>			

### Student Learning Outcomes: (From the Society of Actuaries Exam P/1 – Probability)

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