University of Texas -Austin Course Syllabus
Department of Mathematics
MF362K: Probability I
Summer 2011

I. Course Title: Probability I (Unique Number 92355)

II. Location and Time: RLM 5.118 – 41 individual seats – blackboard
Monday through Friday 8:30A-9:45A, June 2nd – July 7th, 2011

III. Instructor: Mark M. Maxwell, PhD, ASA
Clinical Professor of Mathematics
Paul V. Montgomery Fellow of Mathematics
Program Director of Actuarial Studies

Office: RLM 11.168
Summer Office Hours: MTWHF 10:00A-11:00A
June 1 – June 13, June 17 - July 8 and August 15 – 23
Tuesday June 14 – Thursday June 16 1:30P-2:30P

Available by appointment at 7:30A daily June 1- July 8 and August 15-23.

E-mail: maxwell@math.utexas.edu
Telephone: (512) 471-7169 – Work
(412) 716-5528 – Cellular

IV. Teaching Assistant: Jim Delfeld
jdelfeld@math.utexas.edu
Office: RLM 10.146
Phone: 512-475-9149
Office Hours: No office hours, homework grader only.

V. Prerequisite: M408D or M408L or M408S with a grade of 'C-' or better.

VI. Description of the Course: This is an introductory course in the mathematical theory of probability, thus it is fundamental to further work in probability and statistics. Principles of set theory and a set of axioms for probability are used to derive some probability density and/or distribution functions. Special counting techniques are developed to handle some problems. Properties associated with a random variable are developed for the usual elementary distributions. Both theorem proving and problem solving are required.

VII. Course Objectives: There is an emphasis on problem solving and intuition. Some advanced concepts are presented without proof, so as to devote more attention to the examples. Basic combinatorics: Counting principle, permutations, combinations. Basic concepts: Sample spaces, events, basic axioms and theorems of probability, finite sample spaces with equally likely probabilities. Conditional probability: Reduced sample space, independence, Bayes' Theorem. Random variables: Discrete and continuous random variables, discrete probability functions and continuous probability density functions,

distribution functions, expectation, variance, functions of random variables. Special distributions: Bernoulli, Binomial, Poisson, and Geometric discrete random variables. Uniform, Normal, and Exponential continuous random variables. Approximation of Binomial by Poisson or Normal. Jointly distributed random variables: Joint distribution functions, independence, conditional distributions, expectation, covariance Sums of independent random variables: expectation, variance. Inequalities and Limit theorems: Markov's and Chebyshev's inequalities, Weak and Strong Law of Large Numbers, Central Limit Theorem.

VIII. Learning Outcomes: Students 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
   - Bayes' Theorem / Law of total probability

2. Univariate probability distributions (including binomial, negative binomial, geometric, hyper-geometric, 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

IX: Instructor Goals for Students: In addition to mastering the mathematical content as described in section VIII: Learning Outcomes, I hope that students 1) be positive contributors in class, 2) are honest with yourself and others, 3) take responsibility for learning the course content, 4) improve yourself, and 5) for those wishing to become actuaries, master the material well enough to progress through the professional examination system and become valuable members of the actuarial profession.

1. Behavior that I wish to encourage: honesty (with self, peers, me), understanding (e.g. defining variables, you are the audience), learn about self and peers (names, strengths, weaknesses), participation, communication, taking responsibility.

2. Behavior that I wish to discourage: dishonesty (claim understand in class and while doing homework, but not on exams), memorizing formulas, looking at solutions prior to attempting yourself, use of words "very, like, it, this, that, they", ignorance, wasting the time of your classmates, excuses, complaining, whining, and crying.

3. Multiplication Factor: Each student will be assessed throughout the semester and will receive a multiplication factor $\rho \in (.95, 1.05)$. $E[\rho] \geq 1$. This factor will be multiplied by your raw average on graded work (e.g. quizzes and exams) to determine your course average. Examples of the multiplication factor:

    a. Missing half of the classes, spending class time sending text messages, copying solution manual work for recommended homework, dominating class discussion time in a wasteful manner, and/or I do not know your name: $\rho = .95$.

    b. Participation during group work, asking some questions, answering some questions, meeting some classmates: $\rho = 1.0$. I expect most students to receive a factor quite near 1.0.

    c. Asking intelligent questions, helping classmates on group work, presenting an example in class, organizing a helpful study session, and knowing everyone's name: $\rho = 1.05$.

IX. Instructional Materials:

A. Textbook: *Probability and Statistics with Applications: A Problem Solving Text,* 1st edition, authored by Len Asimow and Mark Maxwell published by ACTEX Publications ©-2010 is available through the University bookstore and is required. ISBN:978-1-56698-721-9.

B. Solutions Manual: A detailed solutions manual for Probability and Statistics with Applications is available through ACTEX Publications. www.ActexMadRiver.com. ***You should attempt all problems before relying on manual solutions.***

C. Calculator: Any calculator is acceptable. For students planning on taking the Society of Actuaries (SOA) and Casualty Actuarial Society (CAS) joint Exam P/1, I recommend that you choose the **TI BA II plus professional** calculator as your only calculator.

X. Delivery System: This is your class. The responsibility of learning the course objectives (section VII) and attaining the learning outcomes (section VIII) is entirely your responsibility. Classes typically begin by answering homework questions posed by the students.

A. **Maxwell Presentations:** My plan is to provide a fairly traditional lecture-oriented class and presenting course material at most of the time. I will provide opportunities for students to take more ownership.

B. **Student Presentations:** Students (individually or in a group) wishing to present material to the class may be allowed up to 20 minutes of class time. Such individuals will be required to meet with me at least two days prior to the class presentation. Presenting will have a direct impact on your course grade (positively or negatively). Presenters will have the opportunity to practice public-speaking (employers value this), to have additional access to me (for whatever that is worth), to have more investment in course content, and have the ability to demonstrate personal responsibility and initiative.

XI. Instructor Specific Course Policies:

A. Make-up work: Make-up work is a rare event. If you must miss a scheduled exam, you must make alternative accommodations with me (typically taking the exam before it is scheduled). You need to expect at most one opportunity to complete missed work, ever.

B. Cheating: It is bad, do not do it. Cheating will result in a course grade of 'F' and being placed on double-secret probation in perpetuity. I promise to pursue every channel to punish those who cheat.

C. Class Distractions: You will make the necessary arrangements so that cell phones, pagers, watch alarms, mechanical erasers and the like do not disturb class.

D. Learning Situations Outside of Class: Following presentations in class is a good start to understanding, being able to complete problems on your own shows a higher level of awareness, and being able to explain solutions to others demonstrates exceptional insight. Therefore, you are encouraged to form study groups. I am available during class, during scheduled office hours, and by appointment. I hope that you feel comfortable receiving help from me. I look forward to helping those motivated students who have attempted their homework. It is ineffective to learn a large amount of mathematics in a short period of time. If you are having difficulty, see me immediately.

E. Extra Credit: None. Extra work is not a substitute to learning the material in a timely fashion. It is inappropriate for you to request extra credit work.

F. Professionalism: Students are expected to maintain appropriate behavior in the classroom and other activities that reflect the actuarial program and university.

 **G. Course Philosophy:** Expectations, execution, no excuses, no exceptions. – Tony Dungy.

XII: University Policies and Services

A. Students with Disabilities: The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at (512) 471-6259, 471-4641 TTY.

B. Policy on Academic Dishonesty: Students who violate university rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failing in the course and/or dismissal from the University. For further information, visit the Student Judicial Services web site at www.utexas.edu/depts/dos/sjs/.

C. The UT Learning Center: Jester Center A332, (512) 471-3614.

D. Counseling and Mental Health Center

E. Computer Labs: RLM 8.118 and RLM 7.122.

XIII: Grading Information

A. Definition of Letter Grades:

A	Achievement of distinction with an unusual degree of intellectual initiative. I would expect 'A' students to pass Exam P/1.
B	Superior work. Students earning a 'B' could pass Exam P/1, but I would think that they would have to prepare quite a bit more.
C	Average knowledge attainment. The Bob Beaves' 2 things.
D	Unsatisfactory, but passing
F	Failing

B. Assessment During the Term: From the teacher - students will receive feedback on their projects, while working in groups, during question and answer periods, during office hours, and during competency examinations. From other students - during study sessions and projects. From oneself – while working on homework problems, in-class examinations, while discussing these concepts with others and while presenting material to students.

C. Grade Factors: Your ***grade*** will be ***entirely determined*** by your ***scores*** earned on ***pop quizzes, the in-class examinations and any other graded work*** and your multiplication factor  If you miss graded work, then you are responsible for the effect on your grade. No other factors enter into determining/assigning your grade. Note that students may be adversely affected by 25-point syllabus understanding penalties. See section XIV. H.

D. Homework Notebook: As mentioned previously, my goal is expose topics of probability to University of Texas, Austin students. I trust it is our goal to demonstrate content proficiency. We consider the prompt and accurate completion

of homework to be the single most important factor in student learning. All students are to keep (and bring to class) a homework notebook of all assigned problems (see schedule below). You may choose to keep some notes, other exercises, sample examinations, projects, etcetera with the study aid.

Assigned Problems: One of your goals should be to attempt and understand all assigned homework problems (from this text and elsewhere). If specific exercises will be collected, they will be noted in class.

Scoring Rubric: You will be given approximately twelve 10-point homework quizzes. We will drop your two lowest scores. You will NOT be allowed to make-up any homework quiz.

E. Course Calendar: Track your attendance and times that you study. This documentation will help you set goals and be honest/accountable with yourself.

F. Final Examination: There is no scheduled final examination during this summer semester.

G. Typical Point Scale, Known Examination Dates, and Multiplication Factor:

Examination 1 (June 20th)	100 - 150 points
Examination 2 (July 7th)	100 - 150 points
Homework Quizzes (about 12)	10 points each, drop lowest 2.
Pop Quizzes (Random and June 2nd)	20 points each

Multiplication factor: $\rho \in [.95, 1.05]$. See VIII. 3.

Penalties:

Syllabus Understanding	**-25** points for failure to understand this contract
Late work	Not accepted.

H. Letter Grade Ranges: The following scale will be used to assign grades at the end of the term. Be careful using this scale on any individually scored work. Some examinations are easier (most students score substantially higher) than other examinations. It is your job to maximize your total points.

[90%-100%]	A/A- range
[80%-90%)	B+/B/B- range
[70%-80%)	C+/C/C- range
[60%-70%)	D+/D/D- range
[0%-60%)	Failing

 **I. Syllabus Understanding Penalty:** Students WILL be assessed a 25-point syllabus understanding penalty for failure to understand this syllabus contract.

XIV. Course Calendar and Homework Assignments

Thursday 6/2
- Syllabus and First Day handout
- Quiz #1: Pre-requisites
- 1.1: The Probability Model
- 1.2: Equally Likely Outcomes
- Homework (1, 2, 4, 7, 11, 12, 17, 21, 24, 27, 32, 37)

Friday 6/3
- 1.3: Sampling and Distributions
- 1.4: Applications
- Homework (46, 48, 51, 53b, Sample Exam 9, 11, 12)

Monday 6/6
- 2.1: Sets, Sample Space and Events
- 2.2: Venn Diagrams, Axioms of Probability
- Homework (1, 6, 7, 14, 18, 21, 23)

Tuesday 6/7
- 2.3: Conditional Probability
- 2.4: Independence
- Homework (29, 35, 38, 40, 44, 47, 53)

Wednesday 6/8
- 2.5: Bayes' Theorem
- 2.6: Credibility
- Homework (56, 57, 59, 62, 63)

Thursday 6/9
- 3.1: Discrete Random Variables
- 3.2: Cumulative Probability Distributions
- Homework (1, 2, 5, 6, 9)

Friday 6/10
- 3.3: Measures of Central Tendency
- Homework (10, 12, 13, 14, 17, 20, 22)

Monday 6/13
- 3.4: Measures of Dispersion
- 3.5: Conditional Expectation
- Homework (26, 27, 28, 31, 35, 38, 40)

Tuesday 6/14

3.6: Jointly Distributed Random Variables
Homework (41, 42, 43, 45)

Wednesday 6/15

4.1: Discrete Uniform Random Variable
4.2: Binomial Distribution
Homework (6, 7, 9, 14, 17, 22, 23)

Thursday 6/16

4.3: Geometric Distribution
4.4: Negative Binomial Distribution
4.5: Hyper-Geometric Distribution
Homework (29, 30, 34, 40, 44, 46, 50, 52, 55)

Friday 6/17

4.6: Poisson Random Variable
Homework (56, 58, 59, 63, 64, 72, 73)

Monday 6/20

EXAMINATION 1 – Probability and Discrete Distributions

Tuesday 6/21

5.1: Cumulative Probability Distributions
5.2: Density Functions
Homework (1, 2, 5, 7)

Wednesday 6/22

5.3: Great Expectations
Homework (8, 9, 11, 14, 17, 19, 25)

Thursday 6/23

5.4: Mixed Distributions
5.5: Deductibles and Caps
Homework (28, 29, 33, 36, 37)

Friday 6/24

5.6: Moment Generating Function
Homework (43, 46, 47, 50, 51, 56, 58)

Monday 6/27

6:1: Uniform Random Variable

6.2: Exponential Distribution
Homework (1, 3, 6, 8, 9, 12, 14, 19)

Tuesday 6/28
6.3: The Normal Distribution
6.4: The Central Limit Theorem
Homework (25, 26, 27, 30, 31, 34, 36, 40, 42, 47, 50)

Wednesday 6/29
7.1: Joint Discrete Distributions
7.2: Conditional Distributions
7.3: Independence
Homework (3, 4, 6, 7, 8, 10)

Thursday 6/30
7.4: Covariance and Correlation
7.5: Joint Continuous Distributions
Homework (12, 14, 15, 17, 20, 22, 24, 25, 30, 34, 35, 37)

Friday 7/1
7.6: Conditional Distributions
7.7: Independence
Homework (43, 45, 46, 49, 50, 54, 57)

Monday 7/4 – 4th of July Holiday – No class

Tuesday 7/5
8.1: Transformations, Order Statistics
Homework (2, 3, 8, 13, 24, 27, 30, 34)

Wednesday 7/6
8.2: Moment Generating Function Method
Homework (42, 43)

Wednesday 7/7
EXAMINATION 2 – Continuous and Multivariate Distributions

XV. Bibliography of Related Readings:

1. *A First Course in Probability,* 8th edition, authored by Sheldon Ross published by

Pearson Prentice Hall ©-2009. ISBN : 0-13-185662-6.

2. Charles M. Grinstead and J. Laurie Snell, Introduction to Probability, 2nd revised ed., AMS 1977. This book has an interesting style that is different from the more standard format of Ross. It introduces some important ideas in examples and exercises, so the instructor needs to know what not to omit. There is much emphasis on computation for this course and is very well written, with many good examples and exercises.

3. Saeed Ghahramani, Fundamentals of Probability. Prentice Hall, 1996. Similar to Ross' text.

XV. Changes: This syllabus is subject to modification. Any changes will be announced in class.

MF362K (92355) – Probability I Summer 2011 Course Calendar

May 16	17	18	19	20
23	24	25	26	27
30 	31 *Registration for summer*	June 1 *Registration for summer*	2 Introduction, syllabus Quiz #1: Pre-requisites 1.1 The Probability Model 1.2 Equally Likely Outcomes (Tree diagrams, permutations, combinations)	3 1.3 Sampling and Distributions 1.4 Applications (Binomial theorem, poker hands, lotteries) *Last day for official add/drop*
6 2.1 Sets, Sample Spaces, Events 2.2 Venn Diagrams, Rules of Probability	7 2.3 Conditional Probability and Tree Diagrams 2.4 Independence	8 2.5 Bayes' Theorem 2.6 Credibility	9 3.1 Discrete Random Variables 3.2 Cumulative Probability Distribution	10 3.3 Measures of Central Tendency (mean, median, mode, percentiles)
13 3.4 Measures of Dispersion (variance) 3.5 Conditional Expectation	14 3.6 Jointly Distributed Random Variables	15 4.1 Discrete Uniform Distribution 4.2 Binomial Distribution	16 4.3 Geometric Distribution 4.4 Negative Binomial Distribution 4.5 Hypergeometric Distribution	17 4.6 The Poisson Random Variable Student assessment #1: names/characteristics Review for Exam 1
20 **EXAMINATION 1 – Probability and Discrete Distributions**	21 5.1 Cumulative Distribution Functions 5.2 Density Functions	22 5.3 Expectations of Continuous Random Variables	23 5.4 Mixed Distributions 5.5 Deductibles and Caps	24 5.6 Moment Generating Functions
27 6.1 Uniform Random Variable 6.2 Exponential Distribution	28 6.3 The Normal Distribution 6.4 The Central Limit Theorem	29 7.1 Joint Discrete Distributions 7.2 Conditional Distributions 7.3 Independence	30 7.4 Covariance and Correlation 7.5 Joint Continuous Distributions	31 7.6 Conditional Distributions 7.7 Independence
4 	5 8.1 Transformations	6 8.2 Moment Generating Function Method Student assessment #2 Review for Exam 2	7 **EXAMINATION 2 – Continuous and Multivariate Distributions**	8
11 *Second – term classes*	12	13	14	15
18	19	20	21	22
25	26	27	28	29
August 1	2	3	4	5
8	9	10 STORRS 8/10 – 8/13	11 STORRS 8/10 – 8/13	12 STORRS 8/10 – 8/13
15	16	17 *Orientation for new undergraduates*	18 *Registration for fall*	19
22 *Registration for fall*	23 *Registration for fall*	24 Fall 2011 Semester Begins	25	26