
Probabilistic Methods in Engineering and Science EE 3384 Syllabus – Fall 2015

R. von Borries

Department of Electrical & Computer Engineering
The University of Texas at El Paso, El Paso, Texas 79968, USA
rvonborries@utep.edu

1 General Information

- **Course ID:** Probabilistic Methods in Engineering and Science, EE 3384-001, CRN-15092
- **Time:** Monday and Wednesday, 9:00 am – 10:20 am
- **Required Textbook:** [1, Textbook]
- **Lecture Room:** Quinn Hall 206
- **Prerequisites:** MATH 2313 and EE 2353 each with a grade *C* or better
- **Instructor:** von Borries – rvonborries@utep.edu
- **Office:** Engineering Building 313
- **Office Hours:** Monday 3:00 to 4:30 pm and Wednesday 11:00 am to 12:30 pm
- **Version:** August 24, 2015

2 Catalog Description

Problems involving discrete and continuous random variables, distribution functions, moments, statistical dependence, and an introduction to statistical methods. Emphasis to be on formulation of physical problems.

Prerequisites: MATH 2313 Calculus III and EE 2353 Continuous-Time Signals and Systems, each with a grade of *C* or better.

3 Textbook

The required textbook for Probabilistic Methods EE 3384 is Intuitive Probability and Random Processes Using Matlab by Steven Kay [1, Textbook]. Reading the textbook is important for full understanding of the material.

Matlab and Mathematica software will be used by the instructor to illustrate basic concepts in probability and its applications [6, Matlab] [7, Mathematica]. Students will be required to use Matlab to solve homework problems. In addition to using Matlab for the homework, students are advised to use Matlab to work on the numerical solution to problems, instead of using a pocket calculator.

4 Student Outcomes

- Solve basic counting problems involving permutations and combination of equally-likely events (Critical).
- Use elements of set theory and axioms of probability to determine the probability of complex events and apply Bayes' theorem to the solution of conditional probability (Critical).
- Solve problems involving independent events and independent random variables (Critical).
- Determine marginal and Joint cumulative distribution functions, probability density functions and use them to compute various expected values of discrete and continuous random variables (Critical).
- Solve problems involving Gaussian, uniform, exponential, binomial and Poisson random variables (Critical).
- Compute probability density functions and cumulative density functions of a random variable (Critical).
- Compute expected values of sums of random variables and the covariance and correlation of pairs of random variables (Critical).

5 Contents

1. Introduction

- What is probability?

2. Computer Simulation

- Why use computer simulation?
-

- Introduction to Matlab (You should have access to MATLAB).

3. Basic Probability

- Review of set theory.
- Properties of the probability function.
- Combinatorics.

4. Conditional Probability

- Joint events and the conditional probability.
- Statistically independent events.
- Bayes' theorem.

5. Discrete Random Variables

- Definition of discrete random variable.
- Probability of discrete random variables.
- Probability mass function.
- Cumulative distribution function.

6. Expected Values for Discrete Random Variables

- Determining averages from the probability mass function.
- Expected values.
- Variance of a random variable.
- Estimating mean and variance.

7. Multiple Discrete Random Variables

- Jointly distributed random variables.
- Marginal probability mass functions and cumulative distribution functions.
- Independence of multiple random variables.
- Expected Values.

8. Conditional Probability Mass Functions

- Joint, conditional and marginal probability mass functions.
- Mean of the conditional probability mass function.

9. Continuous Random Variables

- Definition of continuous random variable.
-

- Probability density function.
- Cumulative distribution function.

10. Expected Values for Continuous Random Variables

- Determining the expected value.
- Expected values for important probability density functions.
- Variance of a random variable.
- Estimating mean and variance.

11. Multiple Continuous Random Variables

- Jointly distributed random variables.
- Marginal probability density functions and cumulative distribution functions.
- Independence of multiple random variables.
- Expected Values.

12. Conditional Probability Density Functions

- Joint, conditional and marginal probability density functions.
- Mean of the conditional probability density function.

13. Introduction to Statistical Methods

6 Evaluation

Activity	%
Homework	10
Participation	5
Exam I	20
Exam II	20
Exam III	20
Comprehensive Final	25

Exams I, II, III and the Comprehensive Final will be taken in the classroom.

7 Grading

$A = 100 - 90\%$, $B = 90 - 80\%$, $C = 80 - 70\%$, $D = 70 - 60\%$ and $F = 60 - 0\%$.

8 Attendance

Class attendance is mandatory and will be monitored. Any student who has more than two unexcused absences will be dropped out of the EE 3384. It is student's responsibility to sign the attendance sheet provided by the instructor for each class.

9 UTEP E-mail Account

Student's UTEP e-mail address is required for the instructor to communicate with the student and vice-versa. It is student's responsibility to have a UTEP e-mail account working properly. By the end of the first week of classes, every student should have received at least one e-mail message from the instructor. If an e-mail problem is detected (no e-mail message received by the end of the first week of classes), the student should request assistance from UTEP's help desk to fix the problem with his e-mail account.

10 Accommodations and Support Services

If you have a disability and need classroom accommodations, please contact *The Center for Accommodations and Support Services (CASS)* at 747-5148, or by email to cassutep.edu, or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at www.sa.utep.edu/cass.

11 Related Reading

You will enjoy reading the following books related to probability and its applications: history [4, Reading], chance [3, Reading], prediction [5, Reading] and brain (multitasking) [2, Reading].

References

- [1] S. M. Kay. *Intuitive Probability and Random Processes Using Matlab*. Springer, New York, NY, 2005.
 - [2] J. Medina. *Brain Rules (Updated and Expanded): 12 Principles for Surviving and Thriving at Work, Home, and School*. Pear Press, Seattle, WA, second edition, 2014.
 - [3] L. Mlodinow. *The Drunkard's Walk: How Randomness Rules Our Lives*. Vintage, New York, NY, 2008.
 - [4] D. Salsburg. *The Lady Tasting Tea: How Statistics Revolutionized Science in the Twentieth Century*. Henry Holt and Co., New York, NY, 2002.
-

- [5] N. Silver. *The Signal and the Noise: Why So Many Predictions Fail - but Some Don't*. Penguin Group USA, New York, NY, 2012.
 - [6] <https://www.youtube.com/user/MATLAB?feature=watch>. MathWorks. Matlab videos. Introductory and advanced Matlab tutorials.
 - [7] <http://wolfram.com/>. Mathematica. Wolfram.
-

12 Calendar

August						
M	T	W	R	F	S	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

2015

September						
M	T	W	R	F	S	S
	1	2	3	4	5	6
	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

2015

October						
M	T	W	R	F	S	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

2015

November						
M	T	W	R	F	S	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25			28	29
30						

2015

December						
M	T	W	R	F	S	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

2015

Exam I: September 28

Chapters 1, 2, 3 and 4

Exam II: November 2

Chapters 5, 6 and 7

Exam III: December 2

Chapters 10, 11, 12 and 13

Comprehensive Final: December 9

10 am to 12:45 pm

All the material for Exams I, II and III

University Closed:

September 7, November 26 and 27

13 Reading Assignment I

13.1 Chapter 1

- Sections 1.1, 1.2, 1.3, 1.4 and 1.5.
- Problems 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.12, 1.13, 1.14 and 1.15.
- Binomial distribution

13.2 Chapter 2

- Sections 2.1, 2.2, 2.3, 2.4, 2.5, 2.6 and Appendix 2A.
- Problems 2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.15.
- Matlab: `vector`, `stem`, `plot`, `axis`, `xlabel`, `ylabel`, `hist`
- Matlab: `rand`, `randn`

13.3 Chapter 3

- Sections 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7 and 3.8.
- Problems 3.1, 3.3, 3.4, 3.5, 3.6, 3.10, 3.11, 3.12, 3.16, 3.18, 3.19, 3.20, 3.23, 3.24, 3.26, 3.27, 3.30, 3.32, 3.34, 3.41, 3.45 and 3.46.

13.4 Chapter 4

- Sections 4.1 to 4.7.
- Problems 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, 4.13, 4.14, 4.15, 4.19, 4.22, 4.24, 4.27, 4.32, 4.34, 4.35, and 4.42

14 Reading Assignment II

14.1 Chapter 5

- Sections 5.1 to 5.10.
- Problems 5, 8, 12, 19 to 21, 23 to 29 and 31.

14.2 Chapter 6

- Sections 6.1 to 6.6, (6.7), 6.8 and 6.9 (we will not study Section 6.7 in detail).
 - Problems 1 to 8, 10, 13, 16 to 18, 21, 22, 25 and 27.
-

14.3 Chapter 7

- Sections 7.1 to 7.5 (7.6 and 7.7 concentrate on the material seen in the lectures).
- Problems 2, 3, 7, 8, 12, 14, 18, 22, 27, 28, 29 and 32.

15 Reading Assignment III

15.1 Chapter 10

- Sections 10.1 to 10.6, 10.7 (concentrate on the material seen in the lecture), 10.8 to 10.10.
- Problems 1, 2, 4 to 6, 10 to 13, 20, 21, 28, 33, 41, 45, 48 to 51.

15.2 Chapter 11

- Sections 11.1 to 11.6, 11.8 to 11.10.
- Problems 1, 2, 10, 11, 17, 20, 23, 24, 27, 30, 31, 33, 35, 36.

15.3 Chapter 12

- Sections 12.1 to 12.7, 12.9 and 12.11.
 - Problems 6 to 9, 11, 14, 15, 18, 19, 22, 25, 26, 28, 30, 52, 56.
-