
Probabilistic Methods in Engineering and Science

EE3384

Syllabus – Spring 2015

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1 General Information

- **Course ID:** Probabilistic Methods in Engineering and Science, EE3384-001, CRN-21575
- **Time:** Monday and Wednesday, 4:30 pm – 5:50 pm
- **Textbook:** [Kay05] and [Mat]
- **Lecture Room:** CRBL C205
- **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 and Wednesday 12:00 pm to 1:00 pm and 6:00 pm to 7:00 pm
- **Version:** January 26, 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 and EE 2353 each with a grade “C” or better.

3 Student Outcomes

- Solve basic counting problems involving permutations and combination of equally-likely events (I).
 - 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 (C).
 - Solve problems involving independent events and independent random variables (C).
 - Determine marginal and Joint cumulative distribution functions, probability density functions and use them to compute various expected values of discrete and continuous random variables (C).
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- Solve problems involving Gaussian, uniform, exponential, binomial and Poisson random variables (C).
- Compute probability density functions and cumulative density functions of a random variable (I).
- Compute expected values of sums of random variables and the covariance and correlation of pairs of random variables (C).

4 Syllabus

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

5 Evaluation

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|-----------------|----|
| • Homework | 10 |
| • Participation | 5 |
| • Exam I | 20 |
| • Exam II | 20 |
| • Exam III | 20 |
| • Comprehensive | 25 |

All exams in the classroom.

6 Grading

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

7 Attendance

Class attendance is mandatory and will be monitored. Any student who has more than two unexcused absences will be dropped out of the EE3384.

8 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.

9 Related Reading

You will enjoy reading the following books related to probability and its applications: history [Sal02], chance [Mlo08], prediction [Sil12] and brain (multitasking) [Med14].

References

- [Kay05] S. M. Kay. *Intuitive Probability and Random Processes Using Matlab*. Springer, New York, NY, 2005.
 - [Mat] MathWorks. Matlab videos. <http://www.youtube.com/user/MATLAB?feature=watch>. Introductory and advanced Matlab tutorials.
 - [Med14] 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.
 - [Mlo08] L. Mlodinow. *The Drunkard's Walk: How Randomness Rules Our Lives*. Vintage, New York, NY, 2008.
 - [Sal02] D. Salsburg. *The Lady Tasting Tea: How Statistics Revolutionized Science in the Twentieth Century*. Henry Holt and Co., New York, NY, 2002.
 - [Sil12] N. Silver. *The Signal and the Noise: Why So Many Predictions Fail - but Some Don't*. Penguin Group USA, New York, NY, 2012.
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10 Calendar

January						
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

February						
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	

2015

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

2015

April						
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			

2015

May						
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 1: Chapters 1, 2, 3 and 4
February 23

Exam 2: Chapters 5, 6 and 7
April 6

Exam 3: Chapters 10, 11, 12 and 13
May 6

Exam Final: Comprehensive
May 11, 4:00 pm to 6:45 pm

Spring Break: No classes
March 9–13

11 Reading Assignment I

11.1 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

11.2 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`

11.3 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.

11.4 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

12 Reading Assignment II

12.1 Chapter 5

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

12.2 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.
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12.3 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.

13 Reading Assignment III

13.1 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.

13.2 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.

13.3 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.
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