Middle East Technical University
Department of Electrical and Electronics Engineering

EE 230
PROBABILITY AND RANDOM VARIABLES
Spring 2020-2021

Instructors

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Assistants

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Textbook
- *Introduction to Probability, 2nd edition*, Dimitri Bertsekas, John N. Tsitsiklis, Athena Scientific, 2008.

References
- *A First Course in Probability, 9th ed.*, S.Ross, Pearson, 2012.
- *Probability Random Variables and Stochastic Processes*, A.Papoulis, McGraw Hill.
- *MATLAB Programming for Engineers*. Stephen J. Chapman. Nelson Education, 2015.

Course Outline

1. Sample Space and Probability (~9 lectures)
   a. Sets
   b. Probabilistic Models
   c. Conditional Probability
   d. Total Probability and Bayes' Theorem
   e. Independence & Independent Trials
   f. Counting
2. Discrete Random Variables (~11 lectures)
   a. Basic Concepts
   b. Probability Mass Function
   c. Functions of Random Variables
   d. Expectation, Mean and Variance
   e. Joint PMFs of multiple random variables
   f. Conditioning
   g. Independence
3. General Random Variables (~14 lectures)
   a. Continuous Random Variables and PDFs
   b. Cumulative Distribution Functions
   c. Normal Random Variables
   d. Joint PDFs of Multiple Random Variables
   e. Conditioning
   f. The Continuous Bayes' Rule
4. Further Topics on Random Variables (~6 lectures)
   a. Derived Distributions
   b. Covariance and Correlation
   c. Conditional Expectation
   d. Transforms
   e. Sums of Independent Random Variables
5. Limit Theorems (~2 lectures)
   a. The Markov and Chebychev Inequalities
   b. The Weak Law of Large Numbers
   c. The Central Limit Theorem

Course Objectives
Objective 1: The students will be able to understand the fundamental concepts related with probability theory.
Objective 2: The students will be able to understand discrete random variable concept with its extensions.
Objective 3: The students will be able to understand continuous random variables with its extensions.
Objective 4: Students will be able to interpret more advanced topics about random variables.

Course Learning Outcomes

1.1. Construct sample space of a probabilistic experiment and interpret the axioms of probability.
1.2. Compute probabilities and conditional probabilities from an underlying experiment.
1.3. Solve problems related to Total Probability and Bayes' Theorems.
1.4. Discriminate independent events and compute their probabilities
1.5. Compute probabilities of repeated experiments by using binomial law.

2.1. Determine probability mass function (PMF) & conditional PMF of a discrete random variable (r.v.) from an experiment.
2.2. Compute expected value, and variance of a discrete r.v. from its PMF.
2.3. Calculate the PMF of a discrete r.v. defined as a function of another r.v.
2.4. Obtain the joint PMF of two discrete r.v.'s. and compute marginal PMF's from the joint PMF.
2.5. Determine independence between discrete r.v's.

3.1 Identify continuous r.v.'s through their probability density (PDF) & cumulative distribution (CDF) functions.
3.2. Compute PDF and CDF for well-known continuous distributions.
3.3. Solve problems using the conditional and joint PDF and CDF.
3.4. Calculate expectation and variance for continuous r.v.'s

4.1. Solve problems of practical interest through functions of r.v.'s.
4.2. Relate two r.v.'s based on their correlation.
4.3. Utilize transforms of r.v.s in solving particular classes of probability problems.
4.4. Use limit theorems to estimate probabilities and calculate bounds on some probabilities.

Tentative Grading Policy

Online midterm examination 1: 25 %	Homework & attendance: 10 %
Online midterm examination 2: 25 %	Online Quizzes: 10 %
Online final examination: 30 %	~~Project: 3 %~~

- ❖ All the course material will be available in ODTUClass under [EE230 All Sections].
- ❖ There will be online quizzes with visual connection in the scheduled weeks, as indicated in the table below.
- ❖ There will be midterm and final examinations (pen&paper) with visual connection in the scheduled weeks.

Homework ~~and Project~~

- There will be **4** homework (HW) assignments, including MATLAB exercises. There should be a single HW submission for each group consisting of **2** (not 1, not 3 or more) students. In each HW, we expect every student to work on each question including MATLAB part. HW submission must be uploaded to ODTUClass system. Handwritten solutions with legible scans might also be uploaded as a single PDF file. Illegible scans cannot be graded. Mobile scanner apps are strongly recommended.
- ~~There will be a single course project. The project will be relevant to the practical applications of probability theory in electrical and electronics engineering.~~

Tentative Course Schedule

Week #	Chapter	Dates	Online Quiz	HW due	Midterm	~~Project~~
1	1	Mar. 15-19				
2	1	Mar. 22-6	X (Ch1)			
3	1	Mar. 29 – Apr.2		X (Ch1)		~~Distribute~~
4	2	Apr. 5-9				
5	2	Apr. 12-16	X (Ch2)			
6	2	Apr. 19-**23**				
7	2-3	Apr.26-30		X (Ch2)		
8	3	May 3-7			X	
		May 10-14	**SPRING BREAK**			
9	3	May 17-21	X (Ch3)			
10	3	May 24-28				~~Submit~~
11	3	May 31- June 4		X (Ch3)		
12	3-4	June 7-11			X	
13	4	June 14-18	X (Ch4)			
14	4-5	June 21-25		X (Ch4)		

Weeks with a holiday are shown in bold (April **23**rd)