ECE302H1F 2022 - Probability and Applications
FALL 2022

Description: Engineers and scientists deal with systems, devices, and environments that contain unavoidable elements of randomness. Probability theory is a mathematical tool that allows logical ways to reason about knowledge and uncertainty. This course introduces 3rd- and 4th-year electrical and computer engineering students to basic concepts in probability theory.

ECE302 2020 Learning Outcomes

- **Understand the basic concepts of probability, random variables, probability distribution, and joint probability distribution.**
- **Acquire basic knowledge of discrete and continuous, univariate, and multi-variate probability distribution functions.**
- **Have an appreciation for probabilistic analysis techniques.**

Textbook: A. Leon-Garcia**, *Probability and Random Processes for Electrical Engineering***, Third Edition, Addison Wesley, ISBN-13: 978-0-13-147122-1.

Instructors: Parham Aarabi; Email: p (AT) arh.am
http://p.arh.am/
Ervin Sejdić; Email: ervin.sejdic (AT) utoronto.ca
https://www.ece.utoronto.ca/people/sejdic-e/

Course Website: The course will be administered via Quercus. Communications with the instructor and Teaching Assistants, announcements, on-line course notes, detailed course notes, assigned homework, homework solutions, evaluations (midterms and finals), and grades, and will be posted here. Please ensure that you always have access to the Quercus based ECE302 page. **There is only one ECE302 web page**.

Evaluation: There will **be two midterms and a final examination**. The composition of the final ECE302 mark is as follows:

Final Examination	50%
Midterm Test 1 (Sep. 29th)	25%
Midterm Test 2 (Nov. 3rd)	25%
Total	100%

Note:

1. Petitions related to any evaluation must be submitted online through the Term-Work Petition system: http://uoft.me/termworkpetition
2. **Midterm tests will be 60 minutes long.**
3. **The final examination will be a 2 ½ hours long (150 minutes long) exam.**

Coverage

Week	**First Nominal Lecture**	**Second Nominal Lecture**	**Third Nominal Lecture**
WK 0			Course Introduction, Random Experiments, Relative Frequency (ch 1.3, 2.1)
WK1 12/09-16/09	Events, Axiomatic Definition of Probability, Properties of Probability (ch 2.2)	Properties of Probability, Specifying Probability: Discrete and Continuous (ch 2.2)	Computing Probability by Counting (ch 2.3)
WK2 19/09 – 23/09	Conditional Probability (ch 2.4)	Total Probability, Bayes' Rule (ch. 2.4)	Independence of Events (ch. 2.5)
WK3 26/09-30/09	Sequential Experiments, Independent Bernoulli Trials, Binomial, Geometric Probability Laws (ch 2.6)	Random Variables, DiscreteRVs, PMF (ch 3.1, 3.2)	Expected Value: Discrete, Expected Value of g(X) (ch3.3)
Midterm 1 Coverage: Chapter 2; Sections: 2.1, 2.2., 2.3, 2.4, 2.5, 2.6 Sep. 29th, 2022			
WK4 02/10 07/10	Variance, Conditional PMF and Expectation (ch 3.3, 3.4)	Important Discrete RVs: Uniform, Bernoulli, Binomial (ch. 3.5)	Important Discrete RVs: Geometric, Poisson (ch 3.5)
WK5 10/10 – 14/10	**10/10 Thanksgiving holiday**	Cumulative distribution Function CDF (ch 4.1)	Types of RVs, PDF, (ch 4.1, 4.2)
WK6 17/10-21/10	Conditional CDF and PDF (ch4.2)	Expected Values (ch 4.3)	Important Continuous RVs: Uniform, Exponential, Gaussian (ch 4.4)
Wk7 24/10-28/10	Gaussian, Gamma, Cauchy (ch 4.4), Function of RV (ch 4.5)	Function of RV (ch 4.5)	Function of RV, Markov and Chebyshev Inequalities (ch 4.5, 4.6)

Midterm 2 **Coverage: Chapter 3; Sections: 3.1, 3.2, 3.4, 3.5** **Chapter 4; Sections: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6** **Nov. 3rd, 2022**			
WK8 31/10 – 04/11	Characteristic Function (ch 4.7)	Two RVs, Joint PMF (ch 5.1, 5.2)	Marginal PMF, Joint CDF, Marginal CDF (ch. 5.3)
Fall Semester Break **07/11-11/11**			
WK9 14/11 – 18/11	Joint PDF, Marginal PDF (ch 5.4)	Joint CDF/PDF, Two Mixed RVs (ch. 5.3, 5.4)	Independence of Two RVs (ch. 5.5)
WK10 21/11-25/11	Expected Value of a Function of Two RVs, Correlation, Covariance (ch. 5.6)	Conditional Probability and Density with Two RVs (ch. 5.7)	Total Probability, Conditional Expectation (ch. 5.7)
WK11 28/11-02/12	One Function of Two RVs (ch 5.8)	Transformation of Two RVs (ch 5.8)	Two Jointly Gaussian RVs (ch 5.9)
WK12 05/12-07/12	Sum of RVs, Sample Mean, Law of Large Numbers (ch 7.1, 7.2)	Central Limit Theorem (ch 7.3)	
Final Examination **Coverage: Chapter 2,3,4,5, 7 ALL pertinent Sections**			

Note: The lecturing schedule is provided for **information purposes only.** All specific details are **subject to change (with notice).**

Homework Problems / Readings

While ECE302 is one of the most interesting and useful courses in electrical and computer engineering, it is also a challenging upper-year course. **To do well in this course you must *keep up to date with the class schedule***. The best way to accomplish this is to *practice*, through the assigned homeworkand other exercise problems. **In Fall 2021 homework problems have been pre-announced, and their solutions have been posted one week after the tutorial session**. Thus, homework solutions will not be collected, but you are required to work out the problems when the pertinent material is covered and before you consult the solutions.

ECE302 Fall 2022 Weekly Homework Assignments
Assignment #1:
1.1, 1.2, 1.5, 2.2, 2.4, 2.5, 2.9, 2.23, 2.24
Assignment #2:
2.36, 2.38, 2.49, 2.54, 2.63, 2.73, 2.74, 2.75, 2.76, 2.77

Assignment #3:
2.82, 2.85, 2.92, 2.95, 2.97, 2.99, 2.101, 2.104, 2.126, 2.128
Assignment #4:
3.8, 3.10, 3.12. ab, 3.13, 3.17, 3.25.b, 3.27, 3.31, 3.36.ab, 3.41, 3.43
Assignment #5:
3.44, 3.49, 3.52, 3.53, 3.56, 3.57, 3.63, 3.65, 3.66, 4.5, 4.6, 4.7
Assignment #6:
4.12, 4.16, 4.17, 4.19, 4.27.ab, 4.35, 4.38, 4.39, 4.41, 4.48, 4.54, 4.56
Assignment #7:
4.62, 4.63, 4.64, 4.67, 4.68, 4.69
Assignment #8:
4.77, 4.79, 4.82, 4.85, 4.88, 4.91, 4.99, 4.100, 4.102, 4.104, 4.105, 4.106
Assignment #9:
5.8 (a - e), 5.9, 5.11, 5.14, 5.17, 5.26, 5.31, 5.33
Assignment #10:
5.40, 5.41, 5.42, 5.45, 5.48, 5.56, 5.57, 5.58, 5.63 5.64, 5.68, 5.76, 5.79, 5.80
Assignment #11: (optional – will not be discussed in a tutorial session)
5.81(a, b), 5.84, 5.86, 5.88, 5.93, 5.95, 5.96, 5.98, 5.99, 5.102, 5.105, 5.111, 5.113.
Assignment #12: (optional – will not be discussed in a tutorial session)
7.1, 7.5, 7.8, 7.9, 7.16, 7.17, 7.23, 7.26, 7.29