CONCORDIA UNIVERSITY
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Syllabus and General Information

ENGR 371 W **Probability and Statistics** Jan. 2022

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Course Objective
This is an introductory course in probability and statistics. It aims at teaching engineering students the fundamentals of the probability and statistics theory with applications to various engineering disciplines. Many examples related to real life engineering (probabilistic) problems will be addressed.

Instructor:

Course Instructor: Professor Hassan Rivaz, Section W
Web: http://sonography.ai/

POD: Mr. Ali Tehrani alikafaei1991(AT)gmail.com
from week 5 (Feb 7) to week 13 (Apr 11)
Tuesdays 10:30AM to 12noon at **EV5.237**
Tuesdays 3:30PM to 5PM over https://concordia-ca.zoom.us/j/89274898259
Office Hours by Dr. Rivaz: Fridays 9AM to 10AM, at EV15.185 by appointment (only one student can enter the office at anytime)

Pre-req.: ENGR 213 and ENGR 233

Textbook
Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, 6th Edition, Wiley 2014.
The 5th edition is accessible for free on learning.oreilly.com via the Concordia Library web page.
The 7th edition (eBook) can be rented or purchased from the Concordia Bookstore or wiley.com.

References
Any text on probability and/or statistics can serve as a reference. There is a large number of them available at the Concordia University Library.

Topics:
- Introduction (Chapter 1)
- Probability (Chapter 2)
- Discrete random variables and probability distributions (Chapter 3)
- Continuous random variables and probability distributions (Chapter 4, excluding 4.9-4.12)
- Joint probability distributions (Chapters 5, excluding 5.5,5.6)
- Descriptive Statistics (Chapter 6, 6.1 and 6.7 only)
- Sampling distributions (Chapter 7, excluding 7.3.4, 7.4)
- Statistical Intervals (Chapter 8, excluding 8.4, 8.6)
- Tests of Hypotheses (Chapter 9, 9.1-9.4 only)

Extraordinary circumstances
In the event of extraordinary circumstances and pursuant to the Academic Regulations the University may modify the delivery, content, structure, forum, location and/or evaluation scheme. In the event of such extraordinary circumstances, students will be informed of the changes.

Course Schedule (Tentative)

Date	**Topic**	**Suggested Problems**
Week 1 (Jan 10) Ch. 2.1-2.4	Sample Spaces, Events, Counting, Axioms of Probability, Addition rules, conditional probability.	2.15, 2.27, 2.66, 2.70, 2.87, 2.89, 2.92, 2.103, 2.107, 2.114
Week 2 (Jan 17) Ch. 2.5-2.8	Multiplication rule, Total Probability Rule, Independence of events, Bayes Theorem, Random Variables.	2.153, 2.156, 2.169, 2.171, 2.175, 2.182, 2.221, 2.227
Week 3 (Jan 24 20) Ch. 3.1-3.6	Discrete Random Variables, pmf's, cdf's, Mean and Variance for discrete random variables, discrete uniform distribution, binomial distribution.	**Quiz 1 (Chapter 2) in TA session** 3.10, 3.27, 3.32, 3.47, 3.52, 3.66, 3.68, 3.86, 3.91, 3.92, 3.110
Week 4 (Jan 31) Ch. 3.7-3.9, 4.1-4.2	Geometric distribution, negative binomial distribution, hypergeometric distribution, Poisson Distribution, Continuous Random Variables, pdf's.	3.125, 3.131, 3.149, 3.165, 3.185, 3.187, 3.201, 3.202, 4.4, 4.7
Week 5 (Feb 7) Ch. 4.3-4.8	cdf's, Mean and Variance of Continuous random variables, continuous uniform distribution, normal distribution, normal approximation for binomial and Poisson distributions, exponential distribution.	**Quiz 2 (Chapter 3) in TA session** 4.18, 4.26, 4.49, 4.55, 4.67, 4.73, 4.100, 4.124
Week 6 (Feb 21) Ch 5.1-5.2	Bivariate and multivariate distributions, Joint distributions, marginal distributions, conditional distributions, independence of two random variables, covariance and correlation.	5.1, 5.3, 5.9, 5.14, 5.16, 5.20, 5.23, 5.27, 5.34, 5.42
Week 7 Midterm	**Midterm, Wed Feb. 23, in class, chapters 2 and 3**	
Week 8 (Mar 7) Ch 5.3-5.4	Common Joint Distributions: multinomial distribution, bivariate normal distribution. Linear functions of random variables.	**Quiz 3 (Chapter 4) in TA session** 5.48, 5.49, 5.52, 5.54, 5.55, 5.62, 5.67, 5.70, 5.71, 5.78
Week 9 (Mar 14) Ch 6.1, 7.1-7.3 (excluding 7.3.4)	Numerical summaries of data, Probability plots. Point estimation, Sampling distributions, Central Limit Theorem, Unbiased estimators, variance of a point estimator, mean squared error.	6.12, 6.16, 7.4, 7.11, 7.12, 7.13, 7.14, 7.24, 7.29, 7.34
Week 10 (Mar 21) Ch 8.1-8.3,8.5	Confidence Intervals on the mean of a normal distribution both with variance known and unknown. Confidence intervals on the variance and on the standard deviation. Guidelines for confidence intervals.	**Quiz 4 (Chs 5, 6, 7) in TA session** 8.1, 8.8, 8.10, 8.14, 8.17, 8.21, 8.31, 8.38, 8.52
Week 11 (Mar 28) Ch 8.7, 9.1	Tolerance and prediction intervals. Hypothesis Testing.	9.1, 9.3, 9.10, 9.15, 9.17, 9.20, 9.21, 9.25
Week 12 (Apr 4) Ch 9.2-9.4	Tests on the mean of a normal distribution both with variance known and unknown. Tests on the variance and standard deviation of a normal distribution.	9.36, 9.40, 9.43, 9.48, 9.52, 9.58, 9.62, 9.65, 9.80, 9.83
Week 13 (Apr 11)	Review	

Skills and attributes: All engineers must be able to analyze data and draw valid conclusions from it. Many of the tools that you learn in this course will be aimed toward that. This course emphasizes and develops the following CEAB (Canadian Engineering Accreditation Board) graduate attributes and indicators:

Attribute	Indicator	Level of knowledge	Evaluation method
INV Investigation An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions	ECE INV 1. Background and Hypothesis Formulation	Introductory	Group project
	ECE INV 2. Designing Experiments	Introductory	Group project
	ECE INV 3. Conducting Experiments and Collection of Data	Intermediate	Group project
	ECE INV 4. Analysis and Interpretation of Data	Intermediate	Group project
KB A knowledge base for engineering Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program	KB 1. Knowledge-base of mathematics	Advanced	Quizzes/project/exams 30%+10%+60%
	KB 3. Knowledge base in a specific domain	Advanced	Quizzes/project/exams 30%+10%+60%

Exams: One midterm and one final exam will be given. All exams will be closed book. If you miss the midterm exam for any reason, the weight on the midterm will be added to that of the final exam. Crib sheets will be provided.
The grading for the course will be based on the student performance in Assignments, and Quiz and Exam exercises. The proportion that each exercise contributes to the total grade is shown below. Note that there is no fixed number to letter conversion for the final grade.

Quizzes
Four quizzes will be given and the best 3 will be counted. The questions on the quizzes will be related to the suggested problems. Your best 3 quizzes will be used for 10% of your grade. The quizzes will take **place during the tutorials**.

Project
The project will be a team project.

Grading

	Scheme A	*Scheme B*
Project	15%	15%
Quizzes:	15%	15%
Midterm:	**20%**	**0%**
Final exam:	**50%**	**70%**

Whichever is better. If you miss the midterm for any reason scheme B will be used.

Academic Code of Conduct
- All students are expected to fully respect the academic honor system and abide by the Code of Academic Conduct set by Concordia University.
- Any reasonable suspicion of an honor violation will be reported.

Course Learning Outcomes:
Upon successful completion of ENGR371, the students will be able to:
- Select, apply, and adapt a wide array of probability and statistics techniques aiming to solve general

- engineering problems
- Understand and apply probability and statistics knowledge to practical engineering problems
- Develop the ability to use this base knowledge in analysis of engineering problems
- Gain advanced mathematical knowledge base for application in probability and statistics fundamentals
- Develop the ability to use this base knowledge in investigation of engineering problems, to formulate, to
- solve problems, and to reach concrete conclusions.

Course Learning Outcomes mapping to Graduate Attributes:

Course Learning Outcome	Graduate Attribute
Selection, application, and adaptation of a wide array of probability and statistics techniques aiming to solve general engineering problems, e. g, discrete and continuous probability distributions, joint distributions, Bayes' Theorem, Central Limit Theorem, Confidence Intervals and Hypothesis testing	**A knowledge base for engineering** • Learning university level mathematics in a specialized domain
Understanding and application of probability and statistics knowledge to practical engineering problems	**A knowledge base for engineering** • Learning some engineering fundamentals and specialized engineering knowledge **Investigation** • Background and Hypothesis Formulation • Designing Experiments • Conducting Experiments and Collection of Data • Analysis and Interpretation of Data
Development of ability to use this base knowledge in analysis of engineering problems	**Investigation** • Background and Hypothesis Formulation • Designing Experiments • Conducting Experiments and Collection of Data • Analysis and Interpretation of Data
Gaining advanced mathematical knowledge base for application in probability and statistics fundamentals, e.g., learning and using double/triple integrations, sigma notation, reading the z-, t-, chi-squared tables, etc.	**A knowledge base for engineering** • Developing advanced mathematical ability to use appropriate knowledge
Development of the ability to use this base knowledge in investigation of engineering problems - to formulate, solve problems and to reach concrete conclusions, e. g., collecting data for team project, calculating measures of central tendency and dispersion, calculating confidence, prediction and tolerance intervals, formulating and testing hypotheses about population parameters, etc.	**A knowledge base for engineering** • Learning and using specific equations **Investigation** • Background and Hypothesis Formulation • Designing Experiments • Conducting Experiments and Collection of • Data • Analysis and Interpretation of Data