**CONCORDIA UNIVERSITY**
**DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING**

Syllabus and General Information

ENGR 371 **Probability and Statistics, section W** January 2015

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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:**

Dr. Hassan Rivaz, **Section W**
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Office Hours: Thursday 9:30AM-11:30AM

**Section:**

Section W, FG B060
Wednesdays and Fridays, 10:15-11:30

**Pre-req.:** ENGR 213 (Ordinary Differential Equations) and ENGR 233 (Advanced calculus)

**Textbook**

Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, 6th Edition, Wiley 2014.

**References**

Any text on probability and/or statistics can serve as a reference. There are 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)

**Tutorial Sessions**
Tut WA: Wednesdays, 8:45-9:35am in Room FG-B080 (TA: Khodadadi, Hossein)
Tut WB: Fridays, 8:45-9:35am in Room FG-B055 (TA: Zhou, Hang)
Marker: Wednesdays & Fridays, 10:15~11:30 Azami, Aria

**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. **The graduate attributes are trained with**

1) Background and hypothesis
2) Designing experiments
3) Conducting experiments and collect of data
4) Analysis and interpretation of data

**Course Schedule (Tentative)**

| *Date* | **Topic** | **Suggested Problems** |
|---|---|---|
| Week 1<br>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<br>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<br>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**<br>3.10, 3.27, 3.32, 3.47, 3.52, 3.66, 3.68, 3.86, 3.91, 3.92, 3.110 |
| Week 4<br>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<br>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**<br>4.18, 4.26, 4.49, 4.55, 4.67, 4.73, 4.100, 4.124 |
| Week 6 Midterm | **Midterm Wed. Feb. 18, 2015, 8:30pm-10.00pm** | |
| Week 7 Ch 5.1-5.2 | Bivariate and multivariate distributions, Joint distributions, marginal distributions, conditional distributions, independence of two random variables, covariance and correlation**.** | **Quiz 3**<br>5.1, 5.3, 5.9, 5.14, 5.16, 5.20, 5.23, 5.27, 5.34, 5.42 |
| Week 8<br>Ch 5.3-5.4 | Common Joint Distributions: multinomial distribution, bivariate normal distribution. Linear functions of random variables. | **Quiz 4**<br>5.48, 5.49, 5.52, 5.54, 5.55, 5.62, 5.67, 5.70, 5.71, 5.78 |
| Week 9<br>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. | **Quiz 5**<br>6.12, 6.16, 7.4, 7.11, 7.12, 7.13, 7.14, 7.24, 7.29, 7.34 |
| Week 10<br>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 6**<br>8.1, 8.8, 8.10, 8.14, 8.17, 8.21, 8.31, 8.38, 8.52, 8.54 |
| Week 11<br>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<br>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 | Review | |

**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. The crib sheets will be provided.

**Assignments:** One of the most important skills that you can have as an engineer is the ability to read a technical document and get something out of it. One of the best techniques to get more out of what you read is to make notes and formulate questions and hypothesis as you read. This takes often passive activity of reading and makes it active.

Before the first class of each week you should have read the sections in the textbook for the upcoming week.

After lectures**, DO all suggested problems for each chapter. But you are NOT required to hand in.**

**Quizzes**
Six quizzes will be given and the best five will be counted. The questions on the quizzes will be related to the suggested problems. Your best five quizzes will be used for 15% of your grade. The quizzes will take place in the tutorials.

**Project**
The project will be a team project. This will count for 15% of your grade.
Group: up to three students.

**Grading**

*Scheme A*

| | |
|---|---|
| Quizzes: | 15% |
| Midterm: | 20% |
| Project | 15% |
| Final exam: | 50% |

Or

*Scheme B*

| | |
|---|---|
| Quizzes: | 15% |
| Project | 15% |
| Final exam: | 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.

**ENGR 371 project**
Winter 2015

As engineers it is important that you know how to analyze data and draw conclusions from it. In the Statistics section of this course you learn many tools for doing this. With these tools you can say something about a large pool of objects/numbers (the "population") by looking at only a few of them (the "sample"). Even with all of the tools that you will learn in this course, engineers and other users of statistics will sometimes end up with invalid conclusions because they have not selected the few they will look at wisely.

In this course the few that you select should form a "random sample". We will define this term later in the course, but the essence of it is that they are unrelated and reflect the overall population. This is not always so easy. Sometimes the way you select the sample will bias it one way or another.

Here are two examples where the sampling methodology resulted in non-random samples of the population.

A. In 1936 there was a presidential election in the US. Prior to election day a telephone survey was done and it was predicted that the Republican leader would win. On election day the democratic candidate Franklin Roosevelt won by a landslide. What went wrong? Answer: In 1936 not everyone had a telephone. Those that did tended to be richer who tended to vote republican. Thus the overall sample was biased and did not represent the overall population.

B. In a plant you want certain parts tested to see if they meet spec. You give the operators of the machines that make these parts a list of the parts you want them to set aside for testing. Your tests indicate that the parts are well in spec. But many complaints come from the field that that parts are out of spec. What is happening? Answer: Your operators try hard to please you by doing a very good job on the parts that they know you will be testing. This sample ends up not representing the entire population.

The procedures for the project are given as follows.
1. Groups of up to three will be formed by yourselves.
2. **Proposal**: Each group will write a proposal for the project. The proposal is typically one page in length. It should clearly state the population it is trying to get information on, and the way that a sample will be obtained. In the proposal, you are required to carefully write 1) Background and hypothesis and 2) Designing experiments. All the members sign the proposal and submit it to the Marker **for approval**.
**The deadline for submitting the proposal is one week before the mid-term exam.**
3. Approval by the Marker
After the submission of the proposal, the Marker will read your proposal and give you a decision of whether or not your proposal is satisfied. If not, you need to revise the proposal and submit it again.
4. **Conducting experiments and collect of data**: Based on your approved proposal, now you can conduct the experiment. Your sample size must be at least 50.
5. **Analysis and interpretation of data**
Based on the experiments, now you can use some tools and your own calculation to analyze the experiments. You are required to calculate the sample mean, sample median, sample variance, sample standard deviation.
6. **Comments**
After the analysis, you are required to comment on the results. In particular you should comment on whether your sample was a random sample, things that may have made it not a random sample and any measures that could be taken to address the things that made it not a random sample. This is a vital part of this project and you should spend some time doing a good job on this part.

The project is evaluated by four indicators with equal weight:
1) Background and hypothesis
2) Designing experiments
3) Conducting experiments and collect of data
4) Analysis and interpretation of data

Note:
a) First page of the report is the originality form and signed by all the members
c) You should include the proposal that was approved by the Marker (second page).
d) Your report should clearly state the details of the above four indicators.

**Deadline for the submission of the report is the day of the last tutorial.**