ELEG 310
Random Signals and Noise

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Feb 11, 2020

Random Signals and Noise
$\approx$
Probability Theory

Agenda

- What is probability theory and why is it important?

- What can we expect to learn from this course?

- Logistics

What is probability theory and why is it important?

Probability

From Wikipedia:

"Probability is a numerical description of how likely an event is to occur or how likely it is that a proposition is true. Probability is a number between 0 and 1, where, roughly speaking, 0 indicates impossibility and 1 indicates certainty. The higher the probability of an event, the more likely it is that the event will occur."

Probability: An Example

A communication system consists of four antennas. Assume that this system will be functional if no two consecutive antennas are defective.
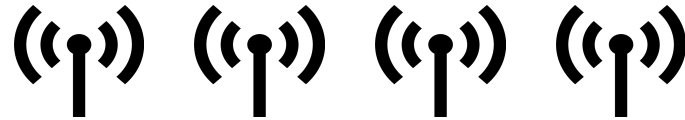
Question: If there are exactly two antennas defective, what is the probability that the resulting system will be functional?

Thinking process:

   1) List all the possiblities: 0110, 0101, 1010, 0011, 1001, 1100
   2) If all the cases are equally likely, then the desired probability is $\frac{3}{6} = \frac{1}{2}$.

This course is about how to formalize the above thinking process and how to systemize and generalize the idea!
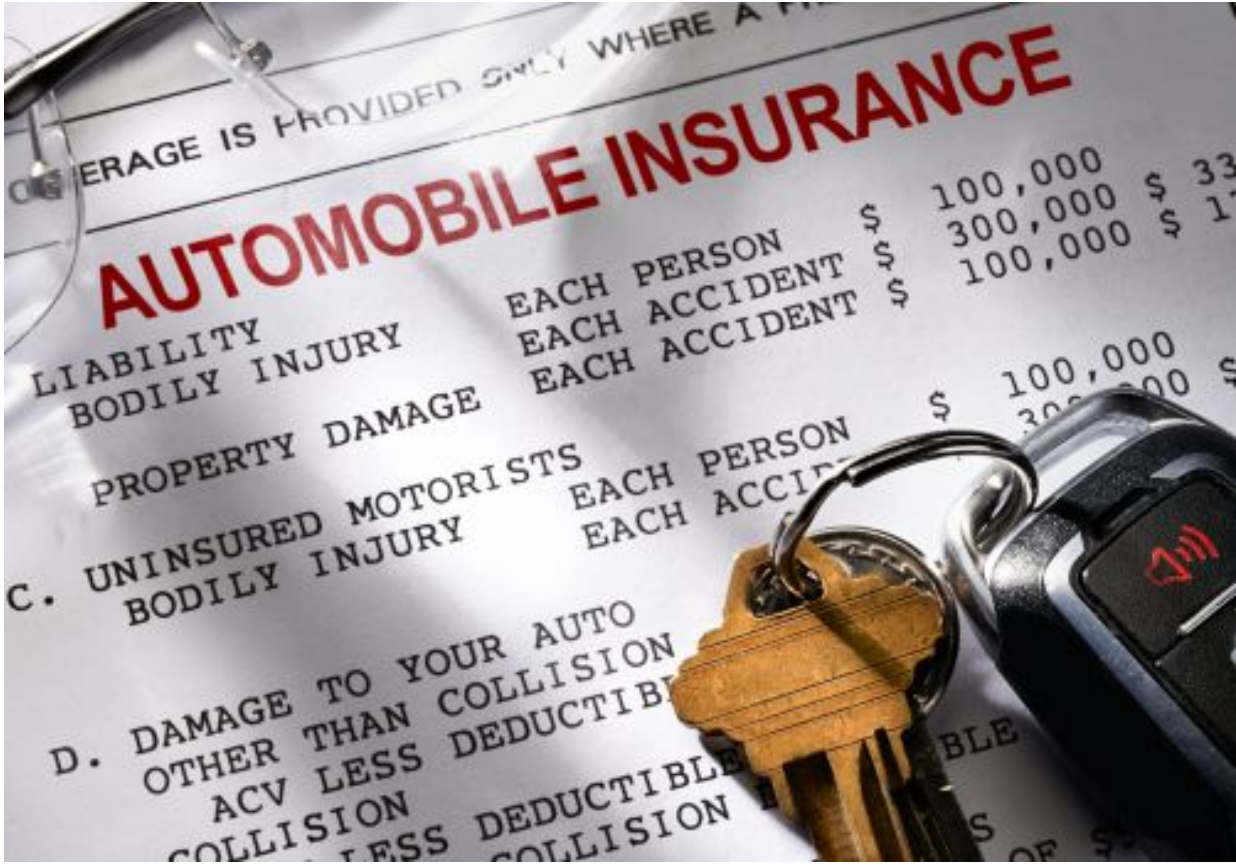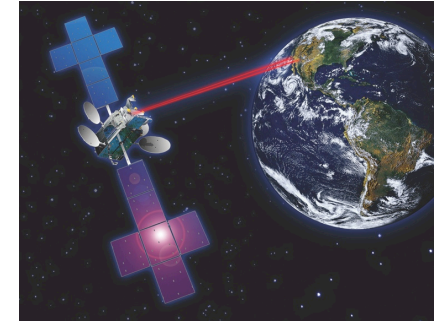
Applications: Gambling

Applications: Finance

Applications: Insurance

Applications: Communication

The Bell System Technical Journal

Vol. XXVII   July, 1948   No. 3

A Mathematical Theory of Communication

By C. E. SHANNON

INTRODUCTION

THE recent development of various methods of modulation such as PCM and PPM which exchange bandwidth for signal-to-noise ratio has intensified the interest in a general theory of communication. A basis for such a theory is contained in the important papers of Nyquist[1] and Hartley[2] on this subject. In the present paper we will extend the theory to include a

Applications: Statistics/Machine Learning/AI
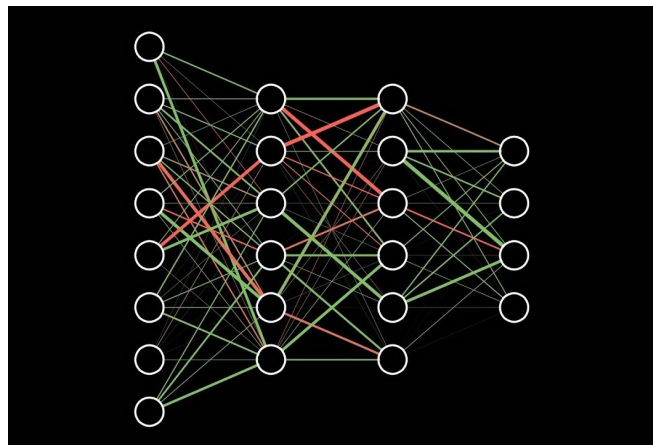
What can we expect to learn from this course?

Before Midterm

Involve working knowledge of

- Combinatorial analysis, set theory

Topics include (Chapters 1-4):

- Combinatorial analysis
- Axioms of probability
- Conditional probability and independence
- Discrete (integer-valued) random variables

After Midterm

Involve working knowledge of

- Calculus (derivative, integral, limit)

Topics include (Chapters 5-8):

- Continuous (real-valued) random variables
- Joint distributed random variables
- Properties of expectations
- Limit theorems

Logistics

Lecture and Office Hour

- Lecture

  - TR 9:30−10:45 AM

  - Kirkbride Hall 004

- Office hour

  - TR 11:00-12:00 AM
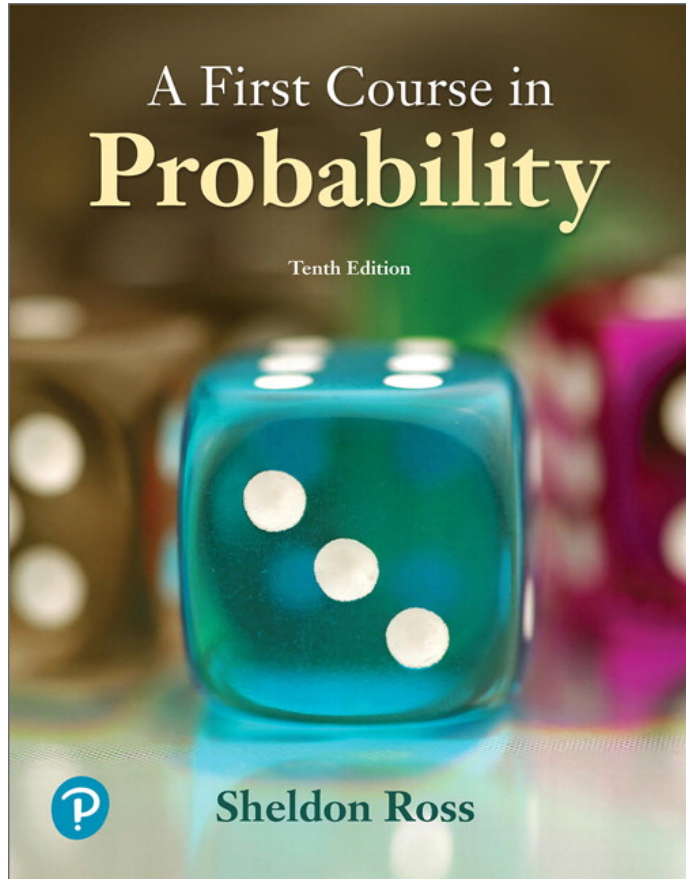
  - Evans 314

- Course website

  https://www.eecis.udel.edu/~xwu/class/ELEG310/

TA

- ## Yikun Bai (Primary)

  - Email: bai@udel.edu
  - Office Hour: WF 10:00-11:00 AM, Evans Hall

- ## Bin Zhu (Secondary)

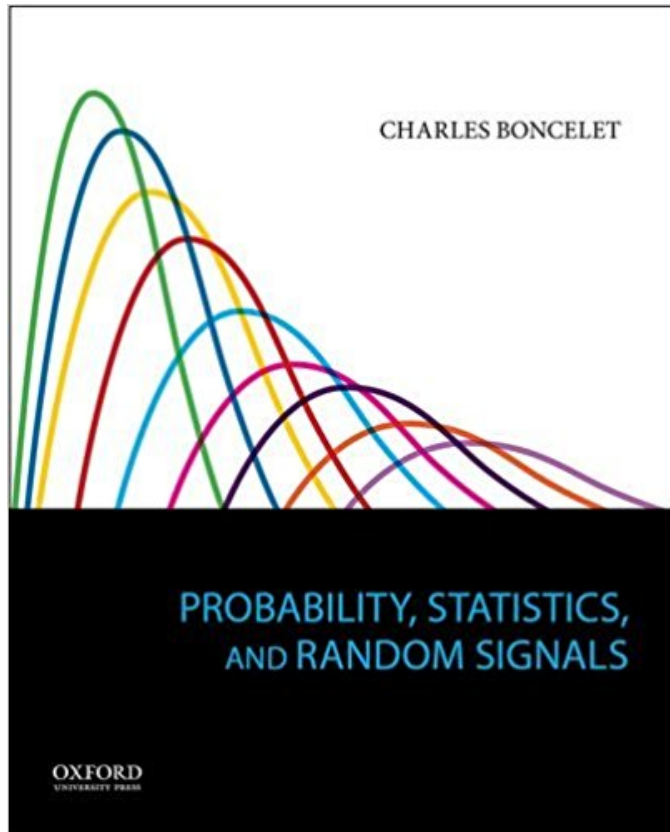 - Email: zhubin@udel.edu
  - Office Hour: TBD

Prerequisite

- Not much; except for a basic understanding of combinatorial analysis, set theory and calculus

Textbook

- Lots of examples and exercises

- Lecture notes on course website

Reference

- Written by Prof. Charles Boncelet

- Features engineering applications

Grading

- **Homework: 30 points**

    - 4 homework assignments in total, each covering two chapters

    - Assignment will be updated each week

- **In-Class Midterm: 30 points**

    - 3/26/2020, Thursday, 9:30-10:45 AM; Kirkbride Hall 004

    - Closed book (with one letter-size aid-sheet allowed)

- **Final: 40 points**

    - 5/26/2020, Tuesday, 1:00-3:00 PM; Kirkbride Hall 004

    - Closed book (with one letter-size aid-sheet allowed)

Questions?