LECTURE 1

- **Readings:** Sections 1.1, 1.2

Lecture outline

- Purpose of the course
- What do we mean by probability?
- Course mechanics and administration

Purpose of the course

- What is probability?
- One interpretation: "incidence" of an event
- Let us look at some instances in which we use probability:
  - Toss a coin and decide that probability of a head is one half
  - Take a poll to figure what percentage of people have cable - say 60 %
  - What is the effectiveness of a medical test- say 95 %
  - What is the probability of a failure in a nuclear facility?
  - What is the probability that a customer will have to wait in line more than 5 minutes for a transaction? How many packets may get lost because of congestion at a router?
- What do these mean?

What does this incidence mean?

- If I toss a coin twice, do I always get one head and one tail - NO!
  - I have 1/4 probability of getting two heads
  - 1/8 probability of getting three heads, etc
  - We will consider how to characterize these kinds of processes (**independence, Bernoulli**)
- But should I not get the same number of heads and tails in the long run?
  - I am just as likely to get HT as TT!
  - We will look at the way long runs tend to the average at the end of the course when we consider **law of large numbers**

What does this incidence mean?

- How reliable is our poll?
  - How did we get our measurement?
  - How many measurements do we need?
  - We will study these issues when we consider **mean, variance, central limit theorem**
- How reliable is the medical test?
  - What is the probability that the patient is sick or healthy?
  - What is the probability that the measurement is actually wrong?
  - How does this depend on previous information about the patient?
  - It can be wrong by giving a false positive or a false negative - we will consider this in the context of **hypothesis testing**

What does this incidence mean?

- What is the probability of failure in a nuclear facility?
  - We cannot make measurements, because the experiment is highly undesirable
  - We may know the physics of the processes (some of the processes may be better described by continuous rather than discrete random variables), the characteristics of the components
  - We need to create distributions that are *derived* from the information we have at hand (**Continuous random variables, derived distributions, iterated expectations, prediction**)

What does this incidence mean?

- What is the probability that a customer will have to wait in line more than 5 minutes for a transaction? How many packets may get lost because of congestion at a router?
  - Given the current state of the system, how does it evolve?
  - This requires characterizing the arrival process of customers or packets (**Poisson process**)
  - What is the long term behavior of these systems - when can we characterize their steady-state behavior (**Markov chains**)?

Mechanics

- Lectures, recitations, tutorials, homework, tests
- Expectations from the course
- Tips for surviving and even thriving