MATH 320: Probability

Lecture 0: Course Overview

Big picture

Relationship between Probability and Statistics

- In a probability problem, the properties of the population are assumed known, and we use these to infer properties of the sample.

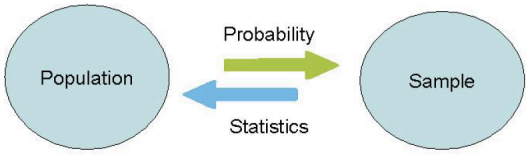

Figure: The reverse actions of Probability and Statistics

- Whereas statistics is concerned with learning (inferring) population properties from sample information (which is the opposite of probability).
- Example:
  - Suppose we know 75% of batteries last longer than 1500 hours. $\rightarrow$

    We want to know the chance all 10 batteries in a pack last 1500 hours. $\rightarrow$

  - Suppose that out of 10 batteries, 6 are found to last more than 1500 hours. $\rightarrow$

    We want to know if that is enough evidence to conclude that the proportion of all batteries that last more than 1500 hours is less than 75%. $\rightarrow$

- In spite of this difference, statistical inference itself would not be possible without probability because it is based on probability calculations.

Courses you will take

- MATH 320 Probability (Fall)
  - This deals with the building blocks of inferential statistics, which is probability.
  - Calculating probabilities: Set theory, counting, probabilities of events, random variables
  - Univariate distributions: Random variables / distributions, probabilities of events, summaries of random variables, applications
  - Multivariate distributions: Repeat above, now with more than one random variable.

- MATH 321 Mathematical Statistics (Spring)
  - This deals with theory and practice of statistics → We have data, now what do we do with it?
  - Descriptive statistics: Summarizing a whole data set with a single or a few measures (e.g. mean, standard deviation, minimum) and visualizing datasets (e.g. histograms, boxplot).
  - Inferential statistics: Collecting data, analyzing it, and making inferences on parameters using probability concepts.

Exam P syllabus

1. **Topic: General Probability (23-30%)**
Learning Objectives
The Candidate will understand basic probability concepts, combinatorics, and discrete mathematics.

2. **Topic: Univariate Random Variables (44-50%)**
Learning Objectives
The Candidate will understand key concepts concerning discrete and continuous univariate random variables (including binomial, negative binomial, geometric, hypergeometric, Poisson, uniform, exponential, gamma, normal, lognormal, and beta) and their applications.

3. **Topic: Multivariate Random Variables (23-30%)**
Learning Objectives
The Candidate will understand key concepts concerning multivariate discrete random variables, the distribution of order statistics, and linear combinations of independent random variables, along with associated applications.