Math 5411 – Mathematical Statistics I– Fall 2024
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Terms & Symbols:

X is the set values that can be attained by some random variable x.

Sample Space Ω the values that are attained by the random variable.

Discrete Random Variable a data point that can take specific list of values. That is, there is a one-to-one correspondence between elements of X and $\mathbb{N}$ and it is finite.

Continuous Random Variable a data point that comes from a range of values.

Probability, p**,** of a random variable x is $p : X \to [0, 1]$ and indicates the likelihood of x appearing in X. In the discrete case:

$$p(X = x) = \frac{|\{y \in X : y = x\}|}{|\Omega|}$$

Probability Mass Function, PMF a function $p : X \to [0, 1]$ indicating the values of the probabilities by element for a discrete random variable.

Cumulative Mass Function, CMF, $F(x) = p(X \leq x)$ for a discrete random variable.

Probability Density Function, PDF $f : (-\infty, \infty) \to [0, 1]$ whose area under the graph is the probability by range for a continuous random variable.

$$p(a < x < b) = \int_a^b f(x)dx$$

Cumulative Density Function, CDF $F : (-\infty, \infty) \to [0, 1]$ which the cumulative probability up to the point x for a continuous random variable. That is

$$F(x) = p(X < x) = \int_{-\infty}^{x} f(t)dt$$

A ***Permutation*** of a discrete set, X, is a one-to-one correspondence of all elements in X. If n is the index of the elements in X then the permutation $P(n)$ is a different complete ordering of X (i.e., no replacement).

A ***Combination*** is a subset of the elements of X in a specific order (i.e., no replacement).

Random Variable Types:

Bernouli: $p : \{0, 1\} \to [0, 1]$, $p(x) = \begin{cases} 1 & x = 1 \\ 0 & x = 0 \end{cases}$

Uniform: $p : [a, b] \to [0, 1]$, $p(x) = \begin{cases} \frac{1}{b-a} & a \leq x \leq b \\ 0 & \text{otherwise} \end{cases}$

Binomial(n, p) indicates n trials with each probability of success for each trial of p. Thus, the probability of k success in n trials is

$$p(X = k) = \binom{n}{k} p^k (1 - p)^{n-k}$$

Hypergeometric

Poisson

Distributions: