Expected Values, Variance, and Standard Deviation

Expected Value

For a measure of center for data you would use a mean. A probability distribution has a measure of center called an **Expected Value**. The expected value can be thought of as the value you expect the mean to be for data drawn from that distribution.

The expected value of a discrete random variable is a weighted average of all possible values the variable can take

$$E(X) = \sum x_i P(x_i)$$

Variance and Standard Deviation

Variance and standard deviation provide a measure of the spread or dispersion of the distribution. Similarly, these are about what you would expect to find for standard deviation and variance of observed data that follows this probability distribution

$$\text{Variance: } Var(X) = \sum (x_i - E(X))^2 P(x_i)$$

$$\text{Standard Deviation: } SD(X) = \sqrt{Var(X)}$$

Binomial Distribution

The binomial distribution is a discrete probability distribution of the number of successes in a sequence of n independent experiments.

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

Expected value and variance:

$$E(Y) = np$$

$$Var(Y) = np(1-p)$$

Geometric Distribution

The geometric distribution represents the number of trials required for the first success in repeated independent Bernoulli trials.

$$P(Z = k) = (1 - p)^{k-1} p$$

Expected value and variance:

$$E(Z) = \frac{1}{p}$$

$$Var(Z) = \frac{1 - p}{p^2}$$