Formula Sheet

Definition 1.1: Mean p9

The mean of a sample of n measured responses $y_1, y_2, \ldots, y_n$ is given by

$$\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$$

The corresponding population mean is denoted μ.

Definition 1.2: Variance p10

The variance of a sample of measurements $y_1, y_2, \ldots, y_n$ is the sum of the square of the differences between the measurements and their mean, divided by $n - 1$. Symbolically, the sample variance is

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(y_i - \bar{y})$$

The corresponding population variance is denoted by the symbol σ^2.

Definition 1.3: Standard Deviation p10

The standard deviation of a sample of measurements is the positive square root of the variance; that is,

$$s = \sqrt{s^2}$$

The corresponding population standard deviation is denoted by $\sigma = \sqrt{\sigma^2}$.

Definition 2.7: Permutation p43

An ordered arrangement of *r* distinct objects is called a permutation. The number of ways of ordering n distinct objects taken *r* at a time will be designated by the symbol $P^{n}{}_{r}$.

$$nPr = n(n-1)(n-2)\ldots(n-r+1)\frac{(n-r)!}{(n-r)!} = \frac{n!}{(n-r)!}$$

Theorem 2.3: Permutation Partitions p44

The number of ways of partitioning n distinct objects into *k* distinct groups containing n_1, n_2, ..., n_k objects, respectively, where each object appears in exactly one group and $\sum_{i=1}^{k} n_i = n$, is

$$N = \binom{n}{n_1 n_2 \ldots n_k} = \frac{n!}{n_1!\, n_2! \ldots n_k!}$$

Theorem 2.4: Combination p46

The number of unordered subsets of size *r* chosen (without replacement) from *n* available objects is

$$\binom{n}{r} = nCr = \frac{nPr}{r!} = \frac{n!}{r!\,(n-r)!}$$

Definition 2.9: Conditional Probability p52

The conditional probability of an event *A*, given that an event *B* has occurred, is equal to

$$P(A|B) = \frac{P(A \cup B)}{P(B)}$$

provided *P(B)* > 0.

Definition 2.10: Independent Events p53

Two events *A* and *B* are said to be independent if any one of the following holds:

$$P(A|B) = P(A),$$

$$P(B|A) = P(B),$$

$$P(A \cap B) = P(A)P(B).$$

Otherwise, the events are said to be dependent.

Definition 3.4: Expected Value p91

Let *Y* be a discrete random variable with the probability function p(y). Then the expected value of *Y*, *E(Y)*, is defined to be

$$E(Y) = \sum_{\mathrm{y}} yp(y)$$

Theorem 3.6: Variance of Random Variable p96

Let Y be a discrete random variable with probability function p(y) and mean E(Y) = μ; then

$$V(Y) = \sigma^2 = E[(Y - \mu)^2] = E(Y^2) - \mu^2$$

Definition 3.7: Binomial Distribution p103

A random variable *Y* is said to have a binomial distribution based on *n* trials with success probability *p* if and only if

$$p(y) = \binom{n}{y} p^y q^{(n-y)}, \qquad y = 0, 1, 2, \dots, n, \qquad 0 \leq p \leq 1$$

Definition 3.8: Geometric Distribution p115

A random variable *Y* is said to have a geometric probability distribution if and only if

$$p(y) = q^{y-1}p, \quad y = 1, 2, 3, \dots, \quad 0 \leq p \leq 1$$

Bayes' Theorem p(N/A)

$$P(A|B) = \frac{P(B|A)\,P(A)}{P(B)}$$