## **Formula Sheet**

## **Chapter 1**

### **Mean**

The mean of a sample of n measured responses is given by

The corresponding population mean is denoted µ

### **Variance**

The variance of a sample of measurements is the sum of the square of the differences between the measurements and their mean, divided by n − 1. Symbolically, the sample variance is

## **Chapter 2**

### **Permutation**

An ordered arrangement for 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 nPr =

### **Combinations**

The number of combinations of *n* objects taken *r* at a time is the number of subsets, each of size *r*, that can be formed from the *n* objects. This number will be denoted by or

() =

### **Conditional Probability of an Event**

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

provided P(B) > 0.

### Independent Cases

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

Otherwise, the events are dependent.

### **The Multiplicative Law of Probability**

The Multiplicative Law of Probability The probability of the intersection of two events A and B is

If A and B are independent, then

### **The Additive Law of Probability**

The probability of the union of two events A and B is

If A and B are mutually exclusive events, P(A ∩ B) = 0 and

### Mutual Exclusive Events

If A is an event, then

### **Bayes’ Rule**

Bayes’ Rule Assume that (B1, B2,..., Bk) is a partition of S such that P(Bi) > 0, for i = 1, 2,..., k. Then

## **Chapter 3**

### **Expected Value**

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

### **Random Variable Mean and Variance**

If Y is a random variable with mean E(Y) = µ, the variance of a random variable Y is defined to be the expected value of (Y − µ)2. That is,

The standard deviation of Y is the positive square root of V(Y).

### **Binomial Distribution**

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

, and

### **Geometric Probability**

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

If Y is a random variable with a geometric distribution

and

### **Negative Binomial Probability Distribution**

A random variable Y is said to have a negative binomial probability distribution if and only if

,

If Y is a random variable with a negative binomial distribution,

and

### **Hypergeometric Probability Distribution** A random variable Y is said to have a hypergeometric probability distribution if and only if

where y is an integer 0, 1, 2,..., n, subject to the restrictions y ≤ r and n − y ≤ N − r.

If Y is a random variable with a hypergeometric distribution,

and .

### **Poisson Probability Distribution**

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

, .

If Y is a random variable possessing a Poisson distribution with parameter λ, then

and

### **Probability-Generating Function**

Let Y be an integer-valued random variable for which , where i = 0, 1, 2, . . . . The probability-generating function P(t) for Y is defined to be

for all values of t such that P(t) is finite.

## **Chapter 4**

### **Probability Density Function**

Let F(y) be the distribution function for a continuous random variable Y. Then f (y), given by

wherever the derivative exists, is called the probability density function for the random variable Y.

### **Expected Value of a Continuous Random Variable**

The expected value of a continuous random variable Y is

provided that the integral exists.

### **Continuous Uniform Probability Distribution**

If , a random variable Y is said to have a continuous uniform probability distribution on the interval () if and only if the density function of Y is

If and Y is a random variable uniformly distributed on the interval (, then

and .

### **Normal Probability Distribution**

A random variable Y is said to have a normal probability distribution if and only if, for and, the density function of Y is

, .

If Y is a normally distributed random variable with parameters and , then

and

### **Gamma Distribution**

A random variable Y is said to have a gamma distribution with parameters α > 0 and β > 0 if and only if the density function of Y is

where.

If Y has a gamma distribution with parameters α and β, then

and

### **Chi-Square Distribution**

0 Let ν be a positive integer. A random variable Y is said to have a chi-square distribution with ν degrees of freedom if and only if Y is a gamma-distributed random variable with parameters α = ν/2 and β = 2.

If Y is a chi-square random variable with ν degrees of freedom, then

and

### **Exponential Distribution with Parameters**

A random variable Y is said to have an exponential distribution with parameter β > 0 if and only if the density function of Y is.

If Y is an exponential random variable with parameter β, then

and

### **Beta Probability Distribution**

A random variable Y is said to have a beta probability distribution with parameters α > 0 and β > 0 if and only if the density function of Y is.

If Y is a beta-distributed random variable with parameters α > 0 and β > 0, then

and .

## **Chapter 5**

### **Join Probability Function**

Let Y1 and Y2 be discrete random variables. The joint (or bivariate) probability function for Y1 and Y2 is given by

For any random variables Y1 and Y2, the joint (bivariate) distribution function F(y1, y2) is

Let Y1 and Y2 be continuous random variables with joint distribution function F(y1, y2). If there exists a nonnegative function f(y1, y2), such that

for all then Y1 and Y2 are said to be jointly continuous random variables. The function f(y1, y2) is called the joint probability density function.

### **Conditional Discrete Probability Function of Y**

If Y1 and Y2 are jointly discrete random variables with joint probability function p(y1, y2) and marginal probability functions p1(y1) and p2(y2), respectively, then the conditional discrete probability function of Y1 given Y2 is

provided that

### **Conditional Distribution Function of Y**

If Y1 and Y2 are jointly continuous random variables with joint density function f(y1, y2), then the conditional distribution function of Y2 given Y2 = y2 is

### **Jointly Continuous Random Variables with Joint Density**

Let Y1 and Y2 be jointly continuous random variables with joint density f(y1, y2) and marginal densities f1(y1) and f2(y2), respectively. For any y2 such that f2(y2) > 0, the conditional density of Y1 given Y2 = y2 is given by

and, for any y1 such that f1(y1) > 0, the conditional density of Y2 given Y1 = y1 is given by