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**Formula Sheet**

**2nd Half of Semester**

**Definition 3.11 – Poisson Distribution**

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

Equation:

**Theorem 3.11 – Expected and Variance of Poisson Distribution**

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

Expected:

Variance:

**Theorem 3.14 – Tchebysheff’s Theorem**

Let Y be a random variable with mean μ and finite variance σ 2 . Then, for any constant ,

Equation:

**Definition 4.1 – Distribution function**

Let Y denote any random variable. The distribution function of Y , denoted by F(y), is such that:

Equation:

**Theorem 4.1 – Properties of a Distribution Function**

1.

2. .

3. F(y) is a nondecreasing function of y. [If and are any values such that , then

**Definition 4.2**

A random variable Y with distribution function F(y) is said to be continuous if F(y) is continuous, for

**Definition 4.3 – Density function**

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

Equation:

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

**Theorem 4.2 – Properties of a Density Function**

If f (y)is a density function for a continuous random variable, then:

1.

2. .

**Theorem 4.3**

If the random variable Y has density function f (y) and a < b, then the probability that Y falls

in the interval [a, b] is

Equation:

**Definition 4.5 – Expected Value of random variable Y**

Equation: ,

provided integral exists

**Theorem 4.4**

Let g(Y ) be a function of Y ; then the expected value of g(Y ) is given by

Equation:

Provide integral exists

**Theorem 4.5**

Let c be a constant and let g(Y ), (Y ), g2(Y ), . . . , (Y ) be functions of a continuous random

variable Y . Then the following results hold:

**Definition 4.6 – Uniform 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:

Equation:

**Theorem 4.6 – Expected and Variance of Uniform Distribution**

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

Expected:

Variance:

**Definition 4.9 – 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

Equation:

Where :

Equation:

**Theorem 4.8 – Expected and Variance of Gamma Distribution**

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

Equation for Expected:

Equation for Variance:

**Definition 4.11 – Exponential Distribution**

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

Equation:

**Theorem 4.10 – Expected and Variance of Exponential Distribution**

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

Equation for Expected:

Equation for Variance:

**Definition 5.1 – bivariate probability function**

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

Equation:

**Theorem 5.1**

If and are discrete random variables with joint probability function p(, ), then

1.

2. where the sum is over all values (, ) that are assigned nonzero probabilities.

**Definition 5.2 – Bivariate distribution function**

For any random variables and , the joint (bivariate) distribution function is

Function:

**Definition 5.3:**

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

Equation:

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

**Theorem 5.2**

If and are random variables with joint distribution function , then

1. .

2. .

3.

**Theorem 5.2**

**(Repeat Theorem in Textbook?)**

If and are jointly continuous random variables with a joint density function given by , then

1.

2.

**Definition 5.4:**

**Definition 5.5:**

If and are jointly discrete random variables with joint probability function and marginal probability functions () and (), respectively, then the conditional discrete probability function of and is

provided that

**Definition 5.6:**

If and are jointly continuous random variables with joint density function then the conditional distribution function of given = is

**Definition 5.7:**

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

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

**Definition 5.8:**

Let have distribution function (), have distribution function (), and and have joint distribution function F(). Then and are said to be independent if and only if

for every pair of real numbers (). If and are not independent, they are said to be dependent.

**Theorem 5.4:**

If and are discrete random variables with joint probability function and marginal probability functions () and (), respectively, then and are independent if and only if

for all pairs of real numbers ().

**Theorem 5.5:**

Let and have a joint density that is positive if and only if a ≤ ≤ b and c ≤ ≤ d, for constants a, b, c, and d; and = 0 otherwise. Then and are independent random variables if and only if

where g() is a nonnegative function of alone and h() is a nonnegative function of alone.