**Formula Sheet 2**

**Chapter 3.7-> Chapter 5.6**

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# Chapter 3

**Definition 3.7:**

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

**Theorem 3.7:**

Let Y be a binomial random variable based on n trials and success probability p. Then:

**Definition 3.8:**

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

**Theorem 3.8:**

If Y is a random variable with a geometric distribution.

Theorem 3.11

Chebyshev’s Theorem Let Y be a random variable with mean µ and finite variance σ2. Then, for any constant k > 0,

# Chapter 4

Definition 4.1

Let Y denote any random variable. The distribution function of Y, denoted by F(y), is such that F(y) = P (Y ≤ y) for −∞ < y < ∞.

Theorem 4.1

Properties of a Distribution function:

F(y)is a distribution function, then 1. F (−∞) ≡ Lim y→−∞F(y) = 0.

2. F (∞) ≡ Lim y→∞ F(y) = 1.

3. F(y) is a nondecreasing function of y. [If y1 and y2 are any values such that y1 < y2, then F(y1) ≤ F(y2).

Definition 4.2

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

Definition 4.3

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.

Theorem 4.2

Properties of a Density Function If f (y)is a density function for a continuous random variable, then.

1. f (y) ≥ 0 for all y, −∞ < y < ∞.

2. # ∞ −∞ f (y) dy = 1

Definition 4.4

Let Y denote any random variable. If 0 < p < 1, the pth quantile of Y, denoted by φp, is the smallest value such that P (Y ≤ φq) = F(φp) ≥ p. If Y is continuous, φp is the smallest value such that F(φp) = P (Y ≤ φp) = p. Some prefer to call φp the 100pth percentile of Y.

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.

Definition 4.5

The expected value of a continuous random variable Y is.

provided that the integral exists.

Theorem 4.4

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

provided that the integral exists.

Theorem 4.5

Let c be a constant and let g (Y), g1(Y), g2(Y), . . ., gk (Y) be functions of a continuous random variable Y. Then the following results hold:

1. E(c) = c.

2. E [cg (Y)] = cE [g (Y)].

3. E [g1(Y)+g2(Y)+· · ·+gk (Y)] = E [g1(Y)] +E [g2(Y)] +· · ·+E [gk (Y)]

Definition 4.6

If θ1 < θ2, a random variable Y is said to have a continuous uniform probability distribution on the interval (θ1, θ2) if and only if the density function of Y is.

Definition 4.7

The constants that determine the specific form of a density function are called parameters of the density function.

Theorem 4.6

If θ1 < θ2 and Y is a random variable uniformly distributed on the interval (θ1, θ2), then.

Definition 4.8

A random variable Y is said to have a normal probability distribution if and only if, for σ > 0 and −∞ <µ< ∞, the density function of Y is.

Theorem 4.7

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

# Chapter 5

Definition 5.1

Let Y1 and Y2 be discrete random variables. The joint (or bivariate) probability function for Y1 and Y2 is given by p (y1, y2) = P (Y1 = y1, Y2 = y2), −∞ < y1 < ∞, −∞ < y2 < ∞

Theorem 5.1

If Y1 and Y2 are discrete random variables with joint probability function p (y1, y2), then.

where the sum is over all values (y1, y2) that are assigned nonzero probabilities.

Definition 5.2

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

F ()) = P ( ≤ , ≤ ), − < < , − < < .

Definition 5.3

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

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 Y1 and Y2 are random variables with joint distribution function F (y1, y2), then.

1. F (−∞, −∞) = F (−∞, y2) = F (y1, −∞) = 0.

2. F (∞, ∞) = 1.

3. If y∗ 1 ≥ y1 and y∗ 2 ≥ y2, then F (y∗ 1, y∗ 2) − F(y∗ 1 , y2) − F(y1, y∗ 2 ) + F(y1, y2) ≥ 0.

Theorem 5.2

If Y1 and Y2 are jointly continuous random variables with a joint density function given by f (y1, y2), then 1. f (y1, y2) ≥ 0 for all y1, y2. 2. # ∞ −∞ # ∞ −∞ f (y1, y2) dy1 dy2 = 1

Definition 5.4

Definition 5.5

Definition 5.6

Definition 5.7