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Formula Sheet:

Chapter 1:

**Mean:**

**Variance:**

**Standard Deviation:**

Chapter 2:

**mn rule:**

**Permutation:**

**Theorem 2.3 Multinomial coefficients?**

**Combination:**

**Conditional Probability:**

Ex: Suppose N = n11+ n12 + n21 + n22

Where:

A B = n11 A = n21 n12 n22

P(A) = (n11+n21)/N

P(B) = (n11 + n12)/N

P(A|B) = n11/(n11+n12)

P(B|A) = n11/(n11+n21)

P(AB) = n11/N

**Definition 2.10:**

A and B are independent if any one is true:  
P(A|B) = P(A)

P(B|A) = P(B)

P(AB) = P(A)P(B)

Otherwise, the events are dependent

**Multiplicative Law of Probability:**

P(AB) = P(A)P(B|A)

= P(B)P(A|B)

If A and B are independent, then

P(AB) = P(A)P(B)

**Additive Law of Probability:**

P(A U B) = P(A) + P(B) – P(A B)

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

P(A U B) = P(A) + P(B)

**Theorem 2.7:**

If A is an event, then

P(A) = 1 –

**Theorem of Total probability:**

**Bayes Theorem:**Assuming that {B1, B2, B3, … Bk} is a partition of S, such that P(Bj) > 0, for I = 1, 2, 3, …, k. then

Ex:

B = {B1, B2, B3}

P(B2|A) =

Using Bayes Theorem when event B has not been observed, but event A has been observed. ORDER MATTERS

**Probability distribution: (IDK what to write for this so I’m just gonna write an example)**

I derived this formula from the example, it’s the hypergeometric distribution formula, so I’m guessing I won’t need to program this.

p(y) = P(Y = y) for all y

For any discrete probability distribution, the following must be true:

1. 0 ≤ p(y) ≤ 1 for all y
2. =1

Ex:3.1

A supervisor choosing 2 workers out of 6 (3 women and 3 men)

Randomly picked.

Must pick 2 workers.

= 15 ways of selecting 2 workers

Since random sampling is on,

P(Ei) = 1/15 for i =1, 2, 3, 4, 5, …, 15

y = 0, 1, 2 (the number of selected women)

if Y = 0; the number of ways of choosing is , since 0 out of 3 women is selected and 2 out of 3 men are selected.

Thus,

p(0) = P(Y = 0) = =

p(1) = P(Y = 1) = =

p(2) = P(Y = 2) = =

, y=0, 1, 2

**Expected value of a random variable:**

**Variance value of a random variable:**

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

**Standard deviation of Y is**

**Probability Mass Function (PMF):?**  
PMF could be defined pointwise:

PMF must satisfy 2 conditions:  
1. 0 ≤ p(y) ≤ 1 for all y  
2.

**Binomial Probability Distribution:**

Where (1-p) = q

y = 0, 1, 2, 3, …, n and 0 ≤ p ≤ 1

**Expected value and variance of Binomial:**

µ = E(Y) = np

σ2 = V(Y) = npq

**Geometric Distribution:**

p(y) = qy-1p y = 1, 2, 3,…, 0 ≤ p ≤ 1

**Expected value and variance of geometric distribution:**

Shortcuts formulas for geometric distribution:

A success occurs on or before the nth trial

P (X ≤ n) = 1 – (1-p)n

A success occurs before the nth trial

P (X < n) = 1 - (1-p)n-1

A success occurs on or after the nth trial

P (X ≥ n) = (1-p)n-1

A success occurs after the nth trial

P (X > n) = (1-p)n

**Hypergeometric probability distribution:**

**Expected value and variance of Hypergeometric distribution:**

**Negative Binomial Distribution:**

**Expected and variance of negative binomial distribution:**