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P&S - Project 1 Formula Sheet

**Set Operations**

Intersection :

and

Union :

and

Complement :

De Morgan’s Laws:

**Chapter 1**

Mean Formula:

Variance Formula:

Standard Deviation Formula:

*s used for sample, σ (sigma) used for population.*

**Chapter 2**

Axioms 1-3:

*S is the sample space. A is in S (subset). P(A) is the probability of A.*

Axiom 1:

Axiom 2:

Axiom 3 (summing up events):

*are pairwise mutually exclusive events. Can be written as a finite sequence.*

rule (extended rule for ):

m elements and n elements form pairs.

*Can apply rule to sets; extended rule for permutations:*

Permutations (order matters):

*ordering distinct objects taken at a time*

*Factorial Note: and*

Partition distinct objects into distinct groups:  
*Each object appears in exactly one group, rearrangement within a group doesn’t count*

Combinations (order doesn’t matter):

*number of combos objects taken at a time*

Conditional Probability (probability of A given B has occurred):

Rewritten (\*similar to Bayes’ Theorem):

Dependent vs. Independent:

*Two events A and B are independent if any one of the following holds. Otherwise, the events are dependent:*

The Multiplicative Law of Probability (can find the intersection of 3+ events):

*The probability of the intersection of two events A and B is*

*If A and B are independent, then*

The Additive Law of Probability (can find union of 3+ events):

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

*If A and B are mutually exclusive events,*

Solve the Odds of an Event Not Happening (Theorem 2.7):

*Hard to directly solve the probability ? Solve the odds of the event NOT happening .*

The Law of Total Probability:

*Note: Assume is a partition of S*

such that for always

Bayes’ Rule:

*Used to make probability statements when event B hasn’t been observed but event A has.*

*Assume that is a partition of S such that such that for always, then*

or

or

**Chapter 3**

Probability Mass Function (Probability Distribution or PMF):

*Sum of the probabilities of all sample points in S that are assigned the value y.*

*The following also mean PMF:*

*[ = number of ways of selecting y for a value, = number of sample points in S]*

For any PMF, the following has to be true:

1. , probability has to be between 0 and 1.
2. , all values of must add to 1 when summed up.

Discrete Random Variable:

*Think of this as the “average”, the sum of the random variables multiplied by the PMF.*

Mean and Variance of Random Variable Y:

Standard Deviation of Random Variable Y:

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

PMF for Binomial Distribution (success or fail):

*\*Probability of Failure in a Binomial Experiment:*

and

for all other

*Use combination ( means “n Choose y”):*

|  |  |
| --- | --- |
| p = probability of success | n = number of trials |
| q = probability of failure (sometimes given) | y = number of successes |

Binomial Distribution Mean and Variance:

Geometric Distribution (count how many fails carried out until success):

where

|  |  |
| --- | --- |
| q = 1 – p (failure) | y = # of total trials (including success) |
| p = success probability | Y = y ⬄ y – 1 mean failures minus success |

Geometric Distribution Expected (Mean) and Variance:

Geometric Distribution (spelled out):

A success occurs on/before the nth trial

A success occurs before the nth trial

A success occurs on/after the nth trial

A success occurs after the nth trial

Hypergeometric Distribution PMF (# of successes without replacement from a sample size):

\*When and is too large use binomial PMF

= # of ways of selecting the Type I items from available

= # of ways of selecting the Type II items from the available

= # of ways of selecting items (this is our sample space)

|  |  |  |
| --- | --- | --- |
| Total *cards* = N | Num of *red cards* = r | Total *cards* – *red cards* = N - r |
| Total *cards* selected = n | Num of *red cards we want* = y | Remaining choices = N - y |
|  |  |  |

Hypergeometric Distribution Expected Mean and Variance Formulas:

Poisson Distribution (successes that occur independently in a continuous time at a continuous rate):

where

Poisson Distribution Expected (Mean) and Variable and :

*= rate at which successes occur*

Tchebysheff’s (Chebyshev’s) Theorem (how much values are in the interval around the average):

random variable, mean , finite variance , then for any constant

or

for , at least of data values lie k standard deviations of the mean

where

**Chapter 4**

Cumulative Distribution Function of Random Variable Y:

\*Distribution function (CDF), big F

for

1. Starts at 0:
2. Ends at 1:

Probability Density Function of Random Variable Y:

\*Density function (PDF), little f (derivative of F)

1. Non-negative: for this follows as is nondecreasing
2. Integrates to 1: this follows as

Interval Probability of Random Variable Y (find the probability in the range):

1. for all
2. area under the graph (everything sums up to 1)

Expected Value (Mean) of Random Variable Y (provided integral exists):

Variance of Random Variable Y:

Expected Value of a Function (provided integral exists)

Theorem 4.5:

*is the expected of a constant*