Probability and Statistics Summary

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# Expected Value and Variance

Expected value is the average value of random variable.

Properties:

* (if and are independent)

Variance tells us of how spread out the random value is from its average.

Properties:

* (if and are independent)

# Discrete Random Variable

Uniform

Bernoulli

(Uniform with True/False Only)

Binomial

(Repeated Trials, Count Success)

Negative Binomial

(Given Count of Success, Count Trials Needed)

Hypergeometric

(Binomial without Replacement)

Geometric

(Success Once)

Poisson

(Event with constant rate, )

# Uniform Random Variable

Probability is the same for all element in the sample space, evenly distributed.

|  |  |
| --- | --- |
|  | is size of sample space. |

# Bernoulli Random Variable

Probability of random variable with two outcomes: *Success (1)* and *Failure (0)*.

|  |  |
| --- | --- |
|  | is constant probability of Success. |

# Binomial Random Variable

Probability of doing trials, with of those trials be successful.

Fixed count of trials; count of successful trials is the variable.

|  |  |
| --- | --- |
|  | is the count of trials done. |
|  | is constant probability of Trial Success. |
|  | Of the trials, choose successful trials. |
|  | Probability of successful trials,  and unsuccessful trials. |

# Negative Binomial Distribution

Distribution of the count of trials needed to produce successful trials.

Fixed count of successful trials; count of total trials is the variable.

|  |  |
| --- | --- |
|  | is the count of successful trials. |
|  | is constant probability of Trial Success. |
|  | Of the previous trials,  choose success. |
|  | Probability of successful trials,  and unsuccessful trials. |

* In the other version, the count is the number of unsuccessful trials instead.

Use to transform the distribution.

# Geometric Random Distribution

Do some trials until one is successful.

Special case of Negative Binomial Distribution where .

|  |  |
| --- | --- |
|  | is constant probability of Trial Success. |
|  | Successful on the *one* last trial. |
|  | Unsuccessful on the previous trials. |

* There are two versions: Counting the number of trials (1-indexed; shown above),

Counting the number of failures (0-indexed)

# Poisson Random Variable

Probability of count of events occurring in some period given a constant rate.

Special case of Negative Binomial Distribution where .

|  |  |
| --- | --- |
|  | is constant rate of the event. |
|  |  |
|  |  |

# Hypergeometric Distribution

Probability of doing trials, with of those trials be successful.

But the probability changes each trial as the sample space decrease.

|  |  |
| --- | --- |
|  | Given good objects, pick . |
|  | Given bad objects, pick . |
|  | Given total objects, pick objects. |