Distributions

The Basics

Definition

The way in which quantities are distributed among a sample space.

Random Variables

- Definition:
  - A variable whose value is subject to variations due to chance
- Types:
  - Discrete Random Variables
  - Continuous Random Variables

Probability Distribution Functions

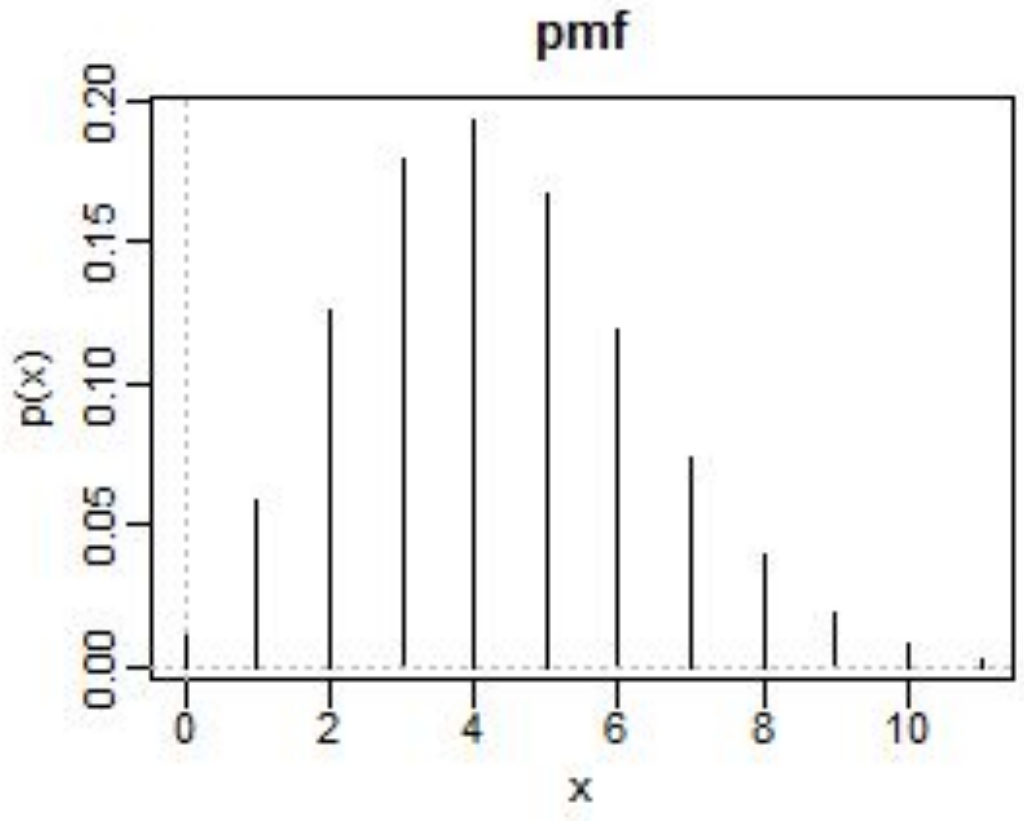
PMF vs PDF

CMF vs CDF

PMF vs. PDF

- PMF:
  - The Probability Mass Function (PMF) is a function that gives the probability that a DISCRETE random variable is exactly equal to some value.
  - Ex: p(x = 3) = 78%

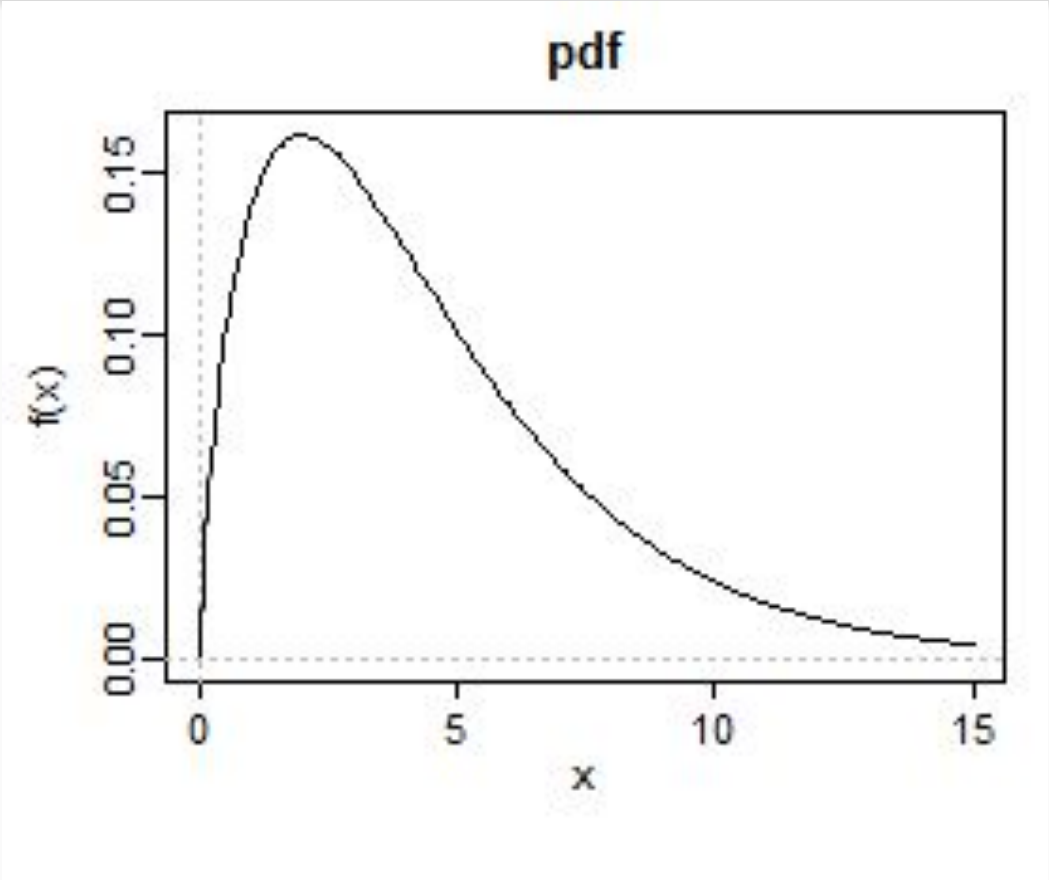
PMF



PMF vs. PDF

- PDF:
  - The Probability Density Function (PDF) is a function that gives the probability that a CONTINUOUS variable lies within a particular range. We cannot say anything about the probability of a variable equaling a single value in the space.
  - In other words: We must refer to probabilities in terms of intervals.
  - Ex: $p(1 < x < 3) = 43\%$

PDF



CMF vs. CDF

- CMF:
  - The Cumulative Mass Function (CMF) Is often represented as a series of probabilities on a table, that add up to 1.
  - Ex: Sum(p(X)) = 1; where X represents {x1, x2, x3, ..., xn}

CMF

CMF table

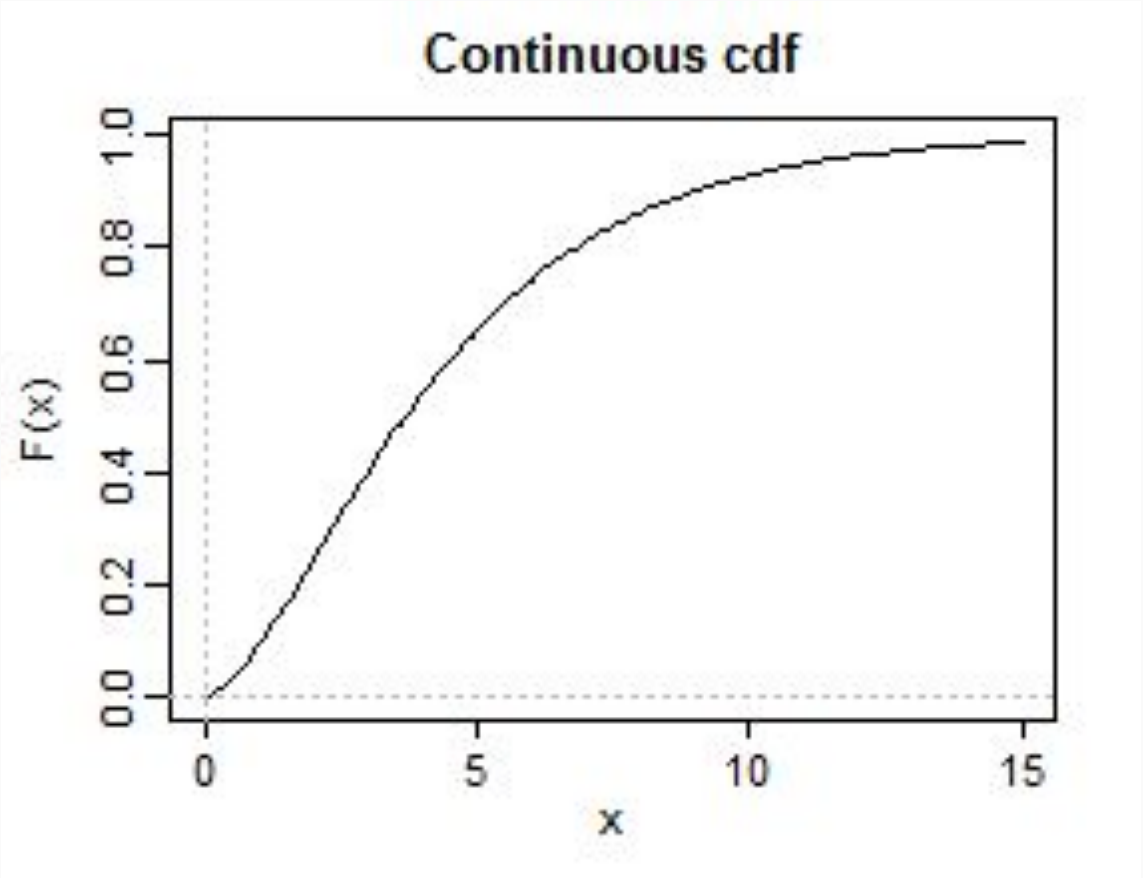
x	1	2	3	4
f(X = x)	0.5	0.1	0.2	0.2

Total (sum)	1

CMF vs. CDF

- CDF:
  - The Cumulative Density Function (CDF) is a probability distribution that is used to find the probability that the variable takes a value less than or equal to x. The probability that the variable is EXACTLY x will ALWAYS be 0.
  - Ex: p(x <= 3) = 72%
  - Ex: p(x = 3) = 0

CDF

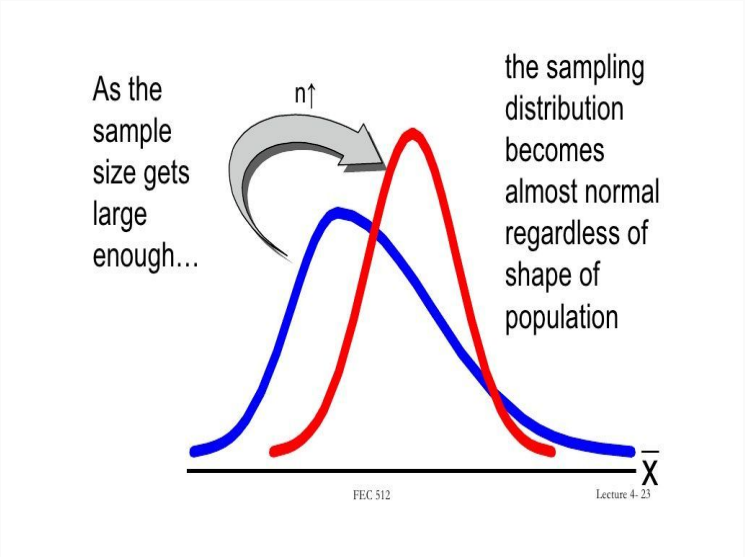


Properties of Distributions

Normal Distributions and more...

Central Limit Theorem

- Given certain conditions, the arithmetic mean of a sufficiently large enough set will be approximately normally distributed, regardless of the underlying distribution.
- This implies that methods that normally work for NORMAL distributions (bell curve), can be applied to many problems involving OTHER types of distributions.



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Binomial Distribution and Bernoulli

Bernoulli Trials are a series of binary experiments with each trial either being a success/ failure.

A Binomial distribution is the distribution of the number of successes in a series of n independent bernoulli trials.

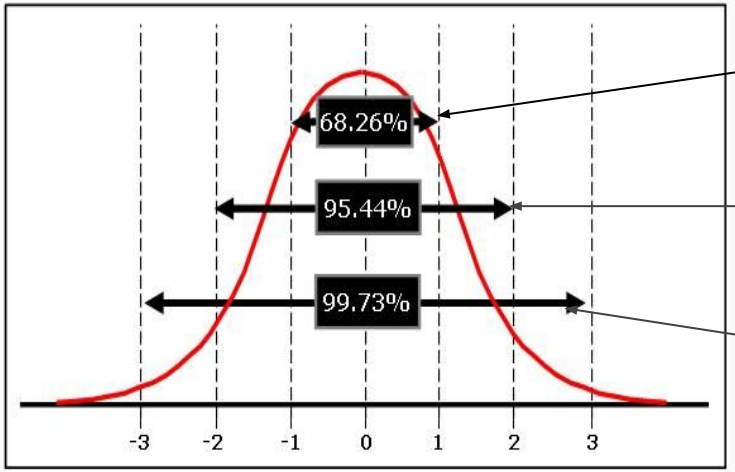
Ex: 100 coin tosses in a series are a Bernoulli Trial.

Ex: The resulting sample space = {H,H,T,T,T,H,T,T,H, … , H} is a Binomial Distribution.

6-Sigma: 68-95-99 Rule

The 6 Sigma rule:

Essentially, if you are able to represent your set as a normal distribution, normalized by standard deviation (Z-score) as such:



68% of all values lie within 1 std dev from the mean.

95% of all values lie within 2 std devs from the mean.

99% of all values lie within 3 std devs from the mean.

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Example Graphs

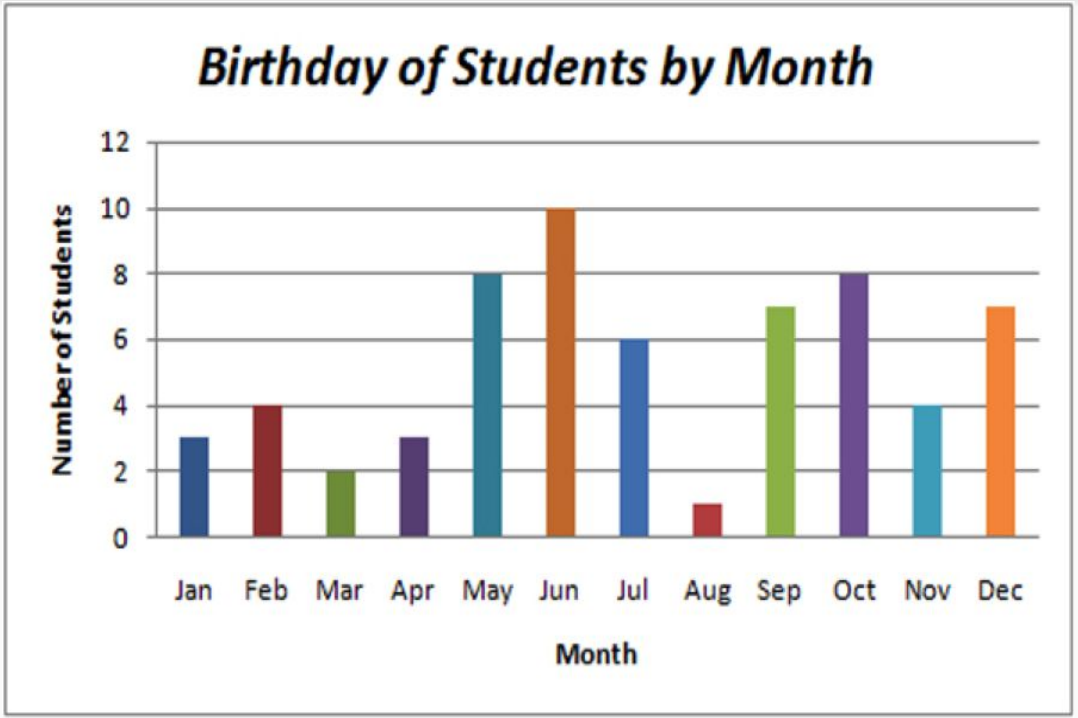
Histograms and Scatter Plots

Histogram

A Histogram is a diagram consisting of rectangles.

Each rectangle’s area is proportional to the frequency of a variable

Each rectangle’s width is equal to the class interval.



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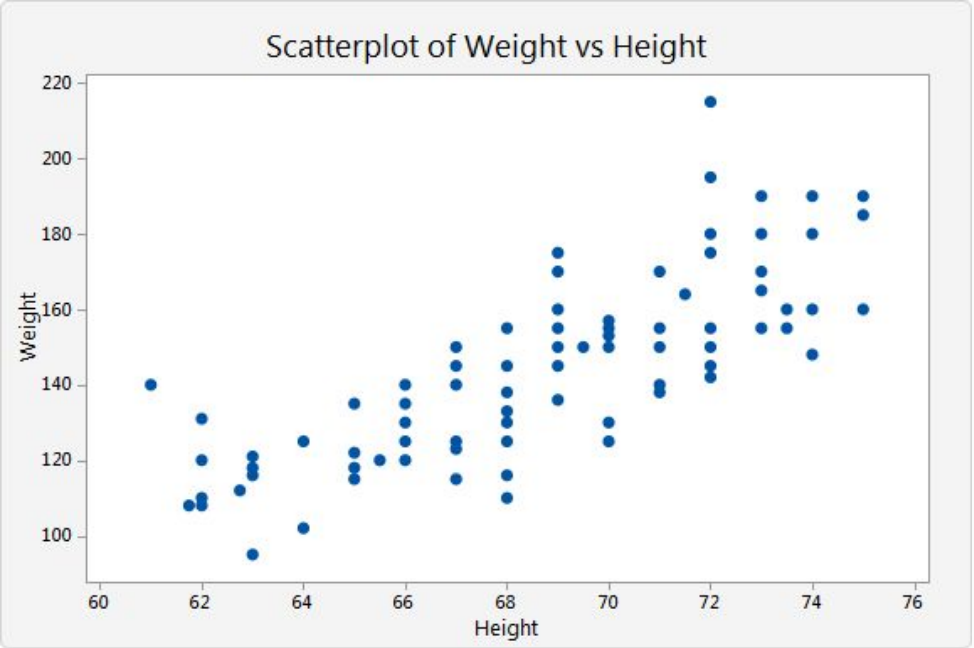
Scatter Plot

A Scatter Plot is a diagram consisting of 2 axes, and several points in an outcome space.

Each point represents a point in the outcome space

Great for finding trends in the data



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