What is the relationship between statistics and the normal distribution?

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Statistics and the normal distribution are closely related concepts in the field of mathematics and data analysis. The normal distribution, also known as the Gaussian distribution, is a probability distribution that is characterized by its symmetric bell-shaped curve. It is widely used in statistics to model the data and is often referred to as the "normal" or "bell curve" distribution.

The relationship between statistics and the normal distribution lies in the fact that many real-world phenomena can be approximated by the normal distribution. This makes it a useful tool for statisticians to analyze and interpret data. The properties of the normal distribution, such as its mean, median, and standard deviation, can provide valuable insights into the data and help researchers draw meaningful conclusions.

Furthermore, many statistical tests and methods are based on the assumption that the data follows a normal distribution. This allows statisticians to make accurate predictions and draw reliable conclusions from the data. In addition, the normal distribution also helps in determining the probability of events and calculating confidence intervals.

In summary, statistics and the normal distribution are closely intertwined, with the latter being a fundamental concept in the field of statistics. Its widespread use in data analysis and its ability to accurately represent many real-world phenomena make it an essential tool for statisticians.

Statistics - Normal Distribution

The normal distribution is an important probability distribution used in statistics.

Many real world examples of data are normally distributed.

Normal Distribution

The normal distribution is described by the mean ((mu)) and the standard deviation ((sigma)).

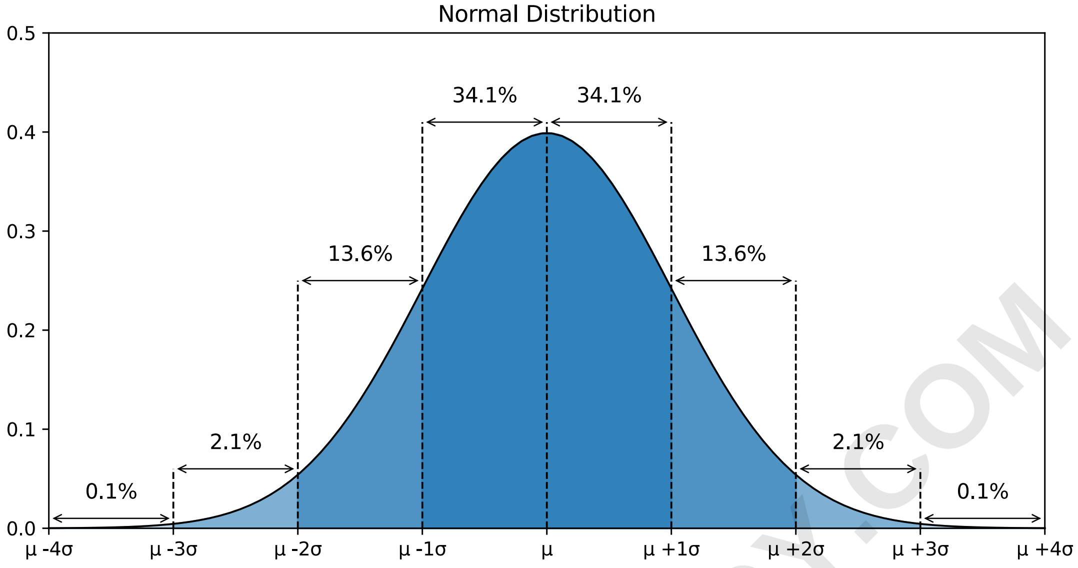
The normal distribution is often referred to as a 'bell curve' because of it's shape:

Most of the values are around the center ((mu))The median and mean are equalIt has only one modeIt is symmetric, meaning it decreases the same amount on the left and the right of the center

The area under the curve of the normal distribution represents probabilities for the data.

The area under the whole curve is equal to 1, or 100%

Here is a graph of a normal distribution with probabilities between standard deviations ((sigma)):



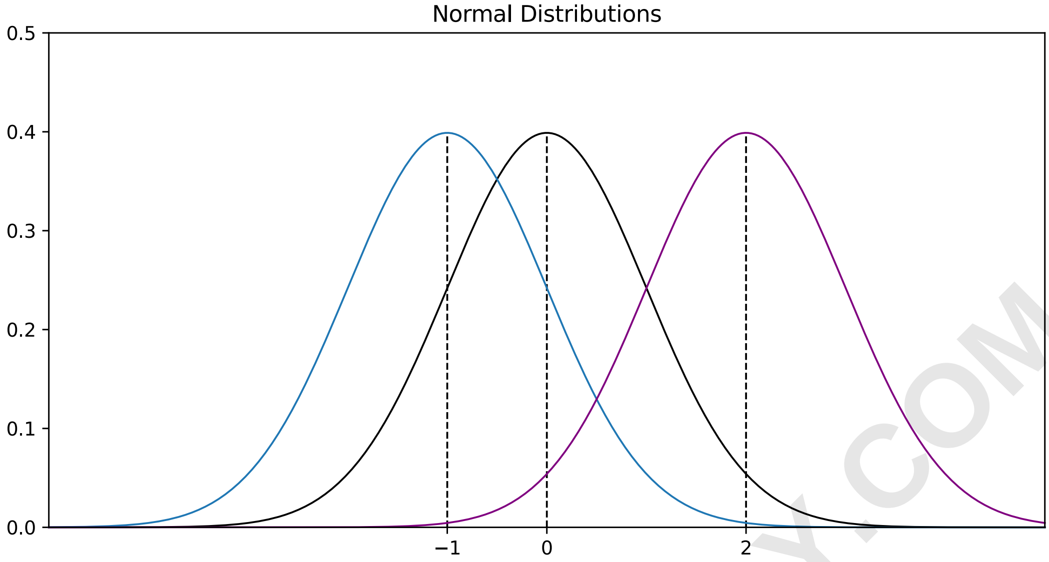
Roughly 68.3% of the data is within 1 standard deviation of the average (from μ-1σ to μ+1σ) Roughly 95.5% of the data is within 2 standard deviations of the average (from μ-2σ to μ+2σ) Roughly 99.7% of the data is within 3 standard deviations of the average (from μ-3σ to μ+3σ)

Note: Probabilities of the normal distribution can only be calculated for intervals (between two values).

Different Mean and Standard Deviations

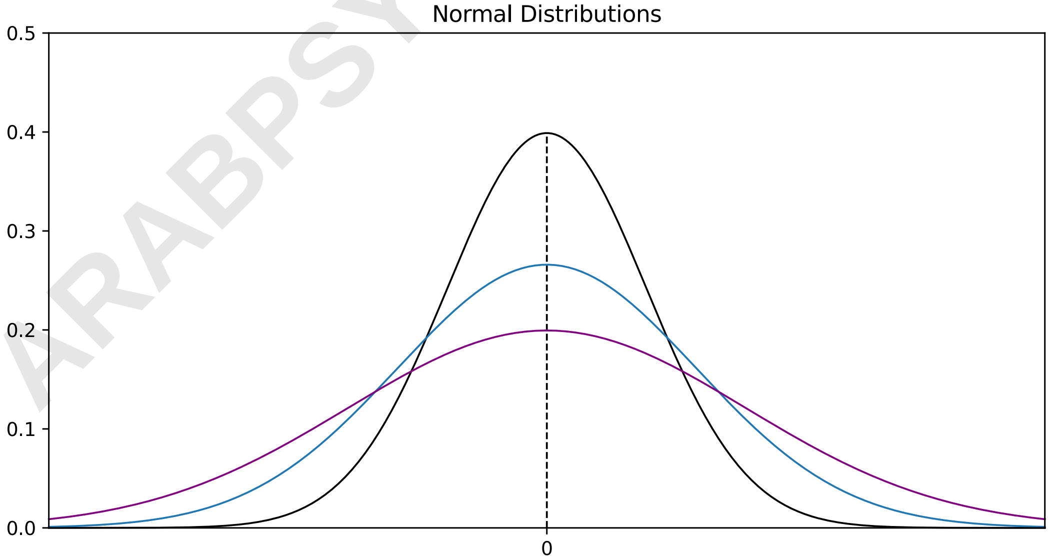
The mean describes where the center of the normal distribution is.

Here is a graph showing three different normal distributions with the **same** standard deviation but different means.



The standard deviation describes how spread out the normal distribution is.

Here is a graph showing three different normal distributions with the **same** mean but different standard deviations.



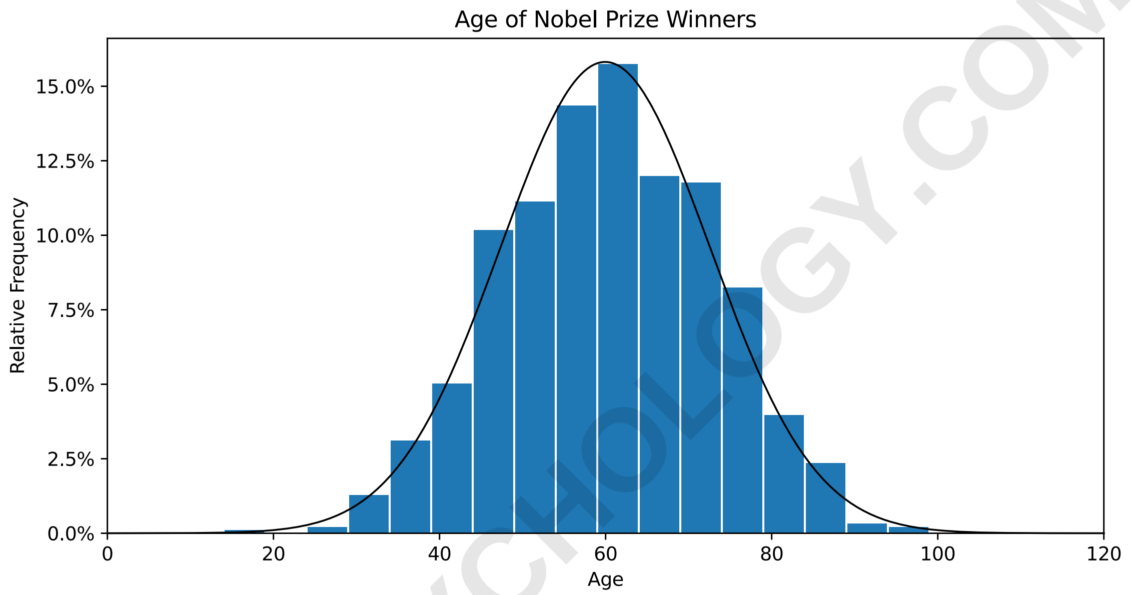
The purple curve has the biggest standard deviation and the black curve has the smallest standard deviation.

The area under each of the curves is still 1, or 100%.

A Real Data Example of Normally Distributed Data

Real world data is often normally distributed.

Here is a histogram of the age of Nobel Prize winners when they won the prize:



The normal distribution drawn on top of the histogram is based on the population mean ((mu)) and standard deviation ((sigma)) of the real data.

We can see that the histogram close to a normal distribution.

Examples of real world variables that can be normally distributed:

Test scoresHeightBirth weight

Probability Distributions

Probability distributions are functions that calculates the probabilities of the outcomes of random variables.

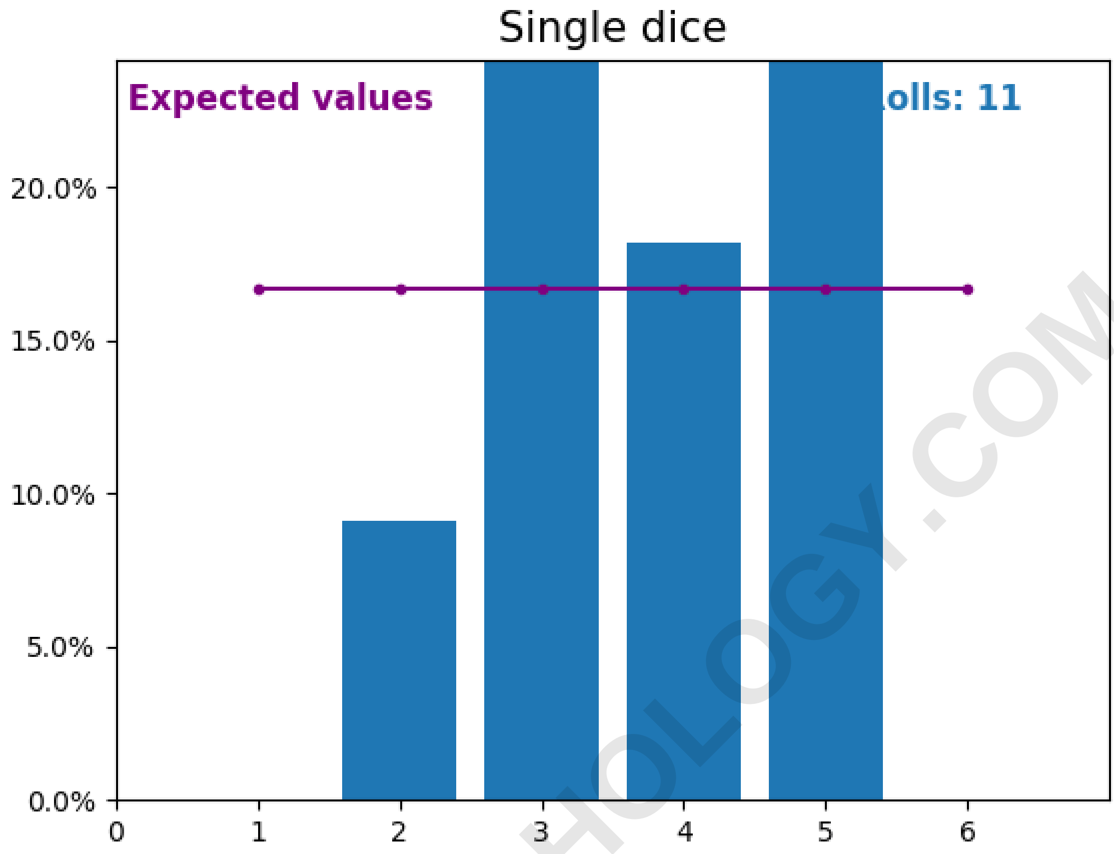
Typical examples of random variables are coin tosses and dice rolls.

Here is an graph showing the results of a growing number of coin tosses and the expected values of the results (heads or tails).

The expected values of the coin toss is the probability distribution of the coin toss.

Notice how the result of random coin tosses gets closer to the expected values (50%) as the number of tosses increases.

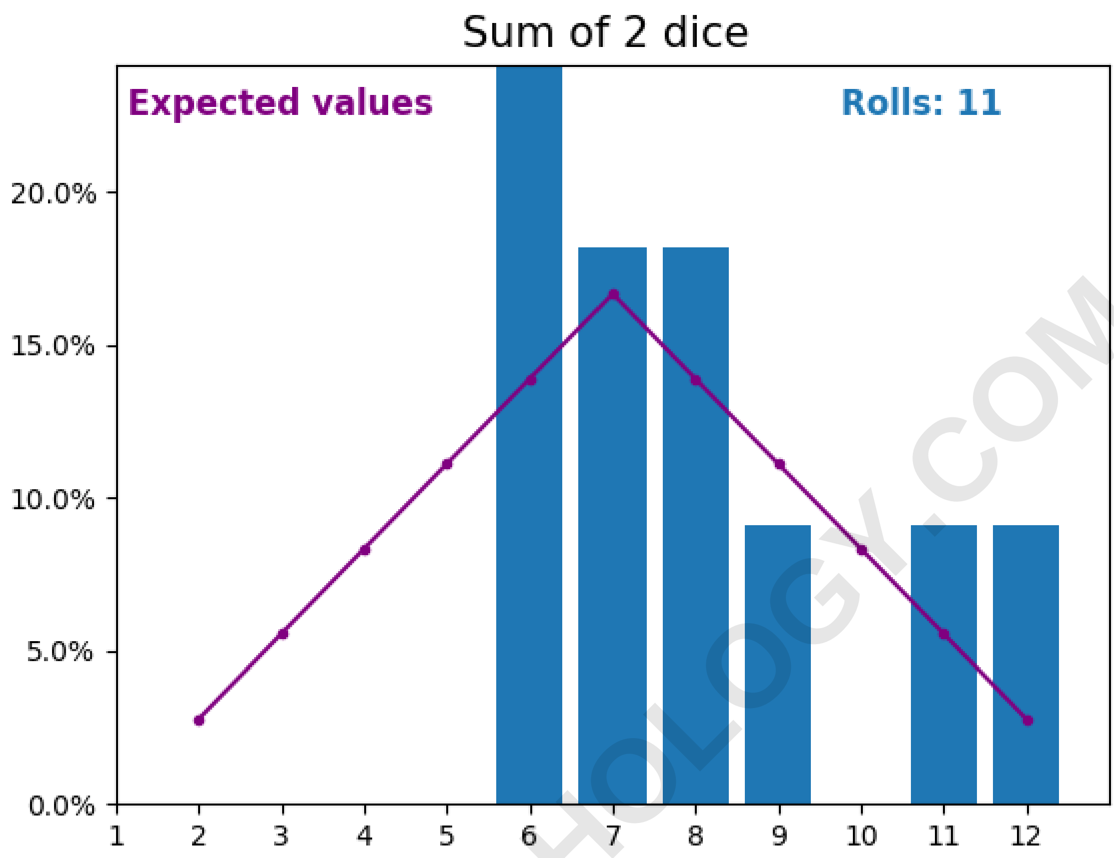
Similarly, here is a graph showing the results of a growing number of dice rolls and the expected values of the results (from 1 to 6).



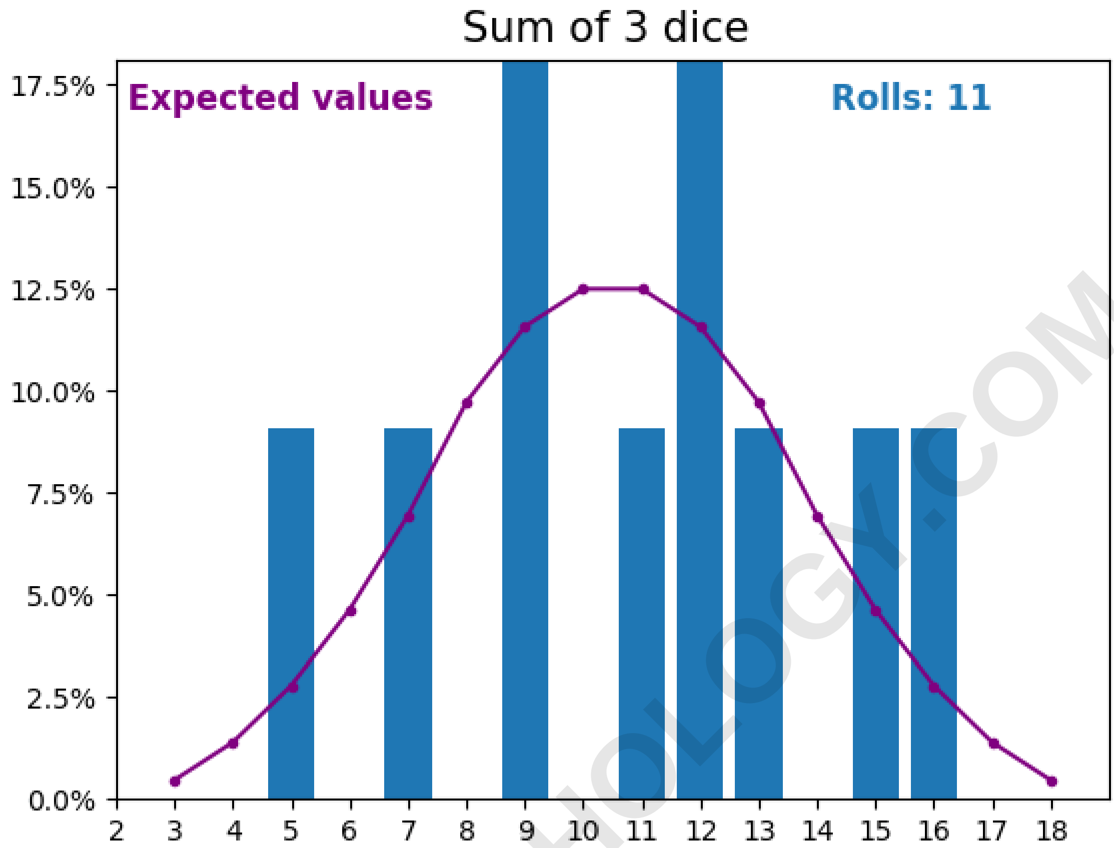
Notice again how the result of random dice rolls gets closer to the expected values (1/6, or 16.666%) as the number of rolls increases.

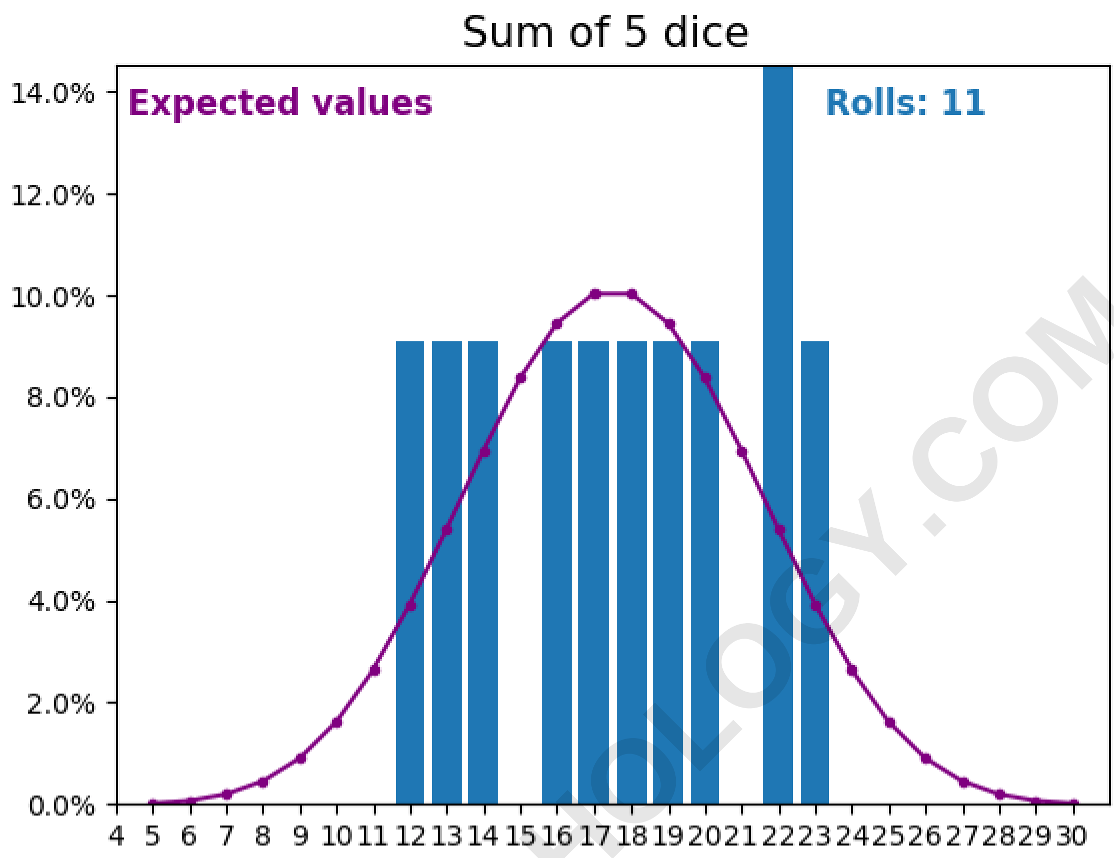
When the random variable is a **sum** of dice rolls the results and expected values take a different shape.

The different shape comes from there being more ways of getting a sum of near the middle, than a small or large sum.



As we keep increasing the number of dice for a sum the shape of the results and expected values look more and more like a normal distribution.


Sum of 3 dice
Expected values
Rolls: 11
17.5%
15.0%
12.5%
10.0%
7.5%
5.0%
2.5%
0.0%
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18



Many real world variables follow a similar pattern and naturally form normal distributions.

Normally distributed variables can be analyzed with well-known techniques.

You will learn about some of the most common and useful techniques in the following pages.

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