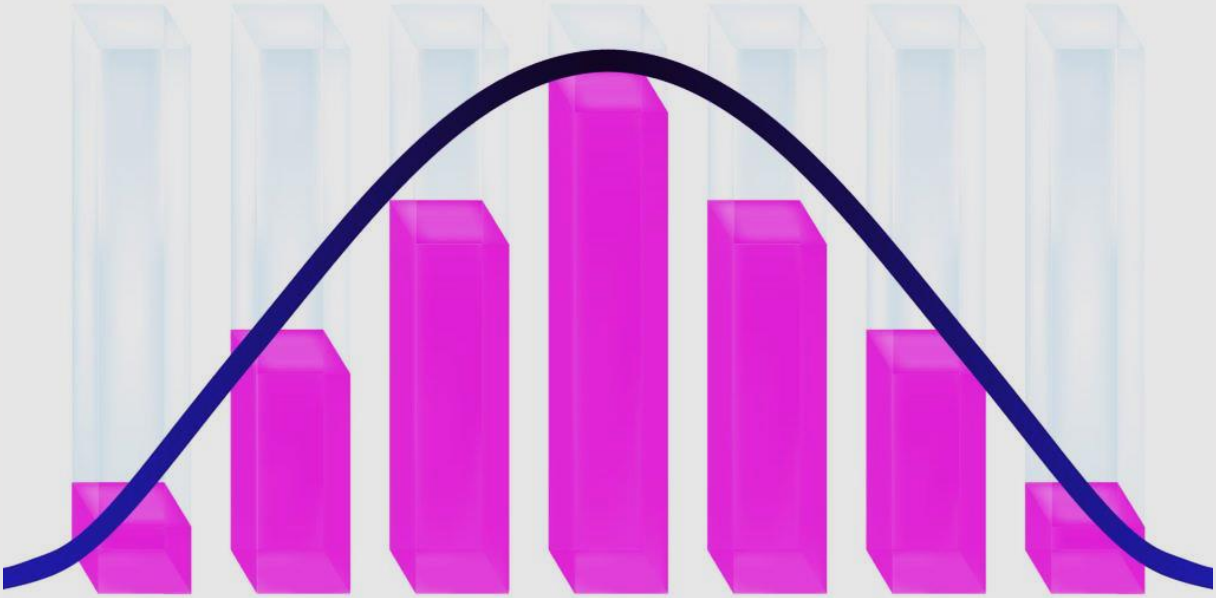
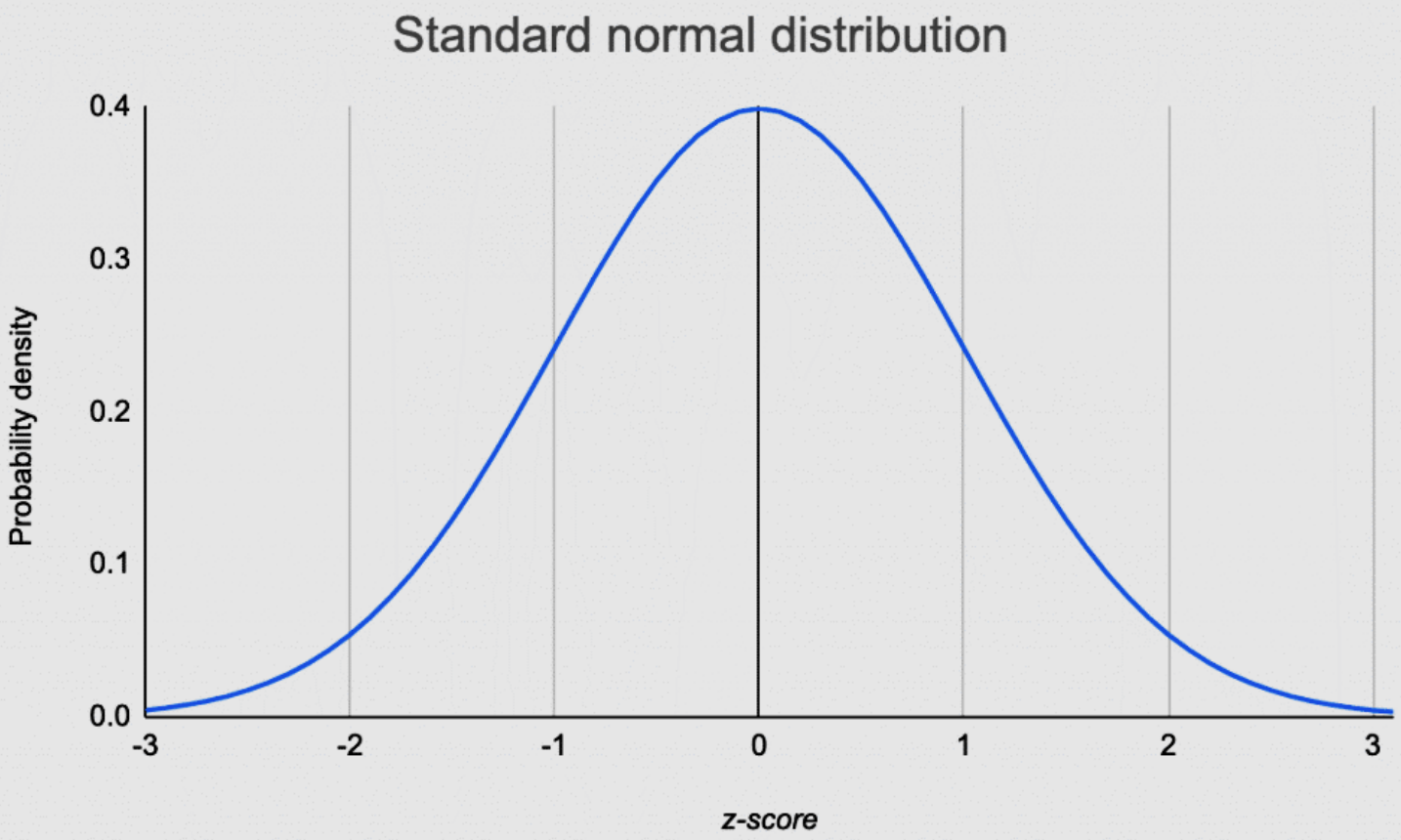
11 Important Probability Distributions Explained



1. Normal Distribution



Normal Distribution

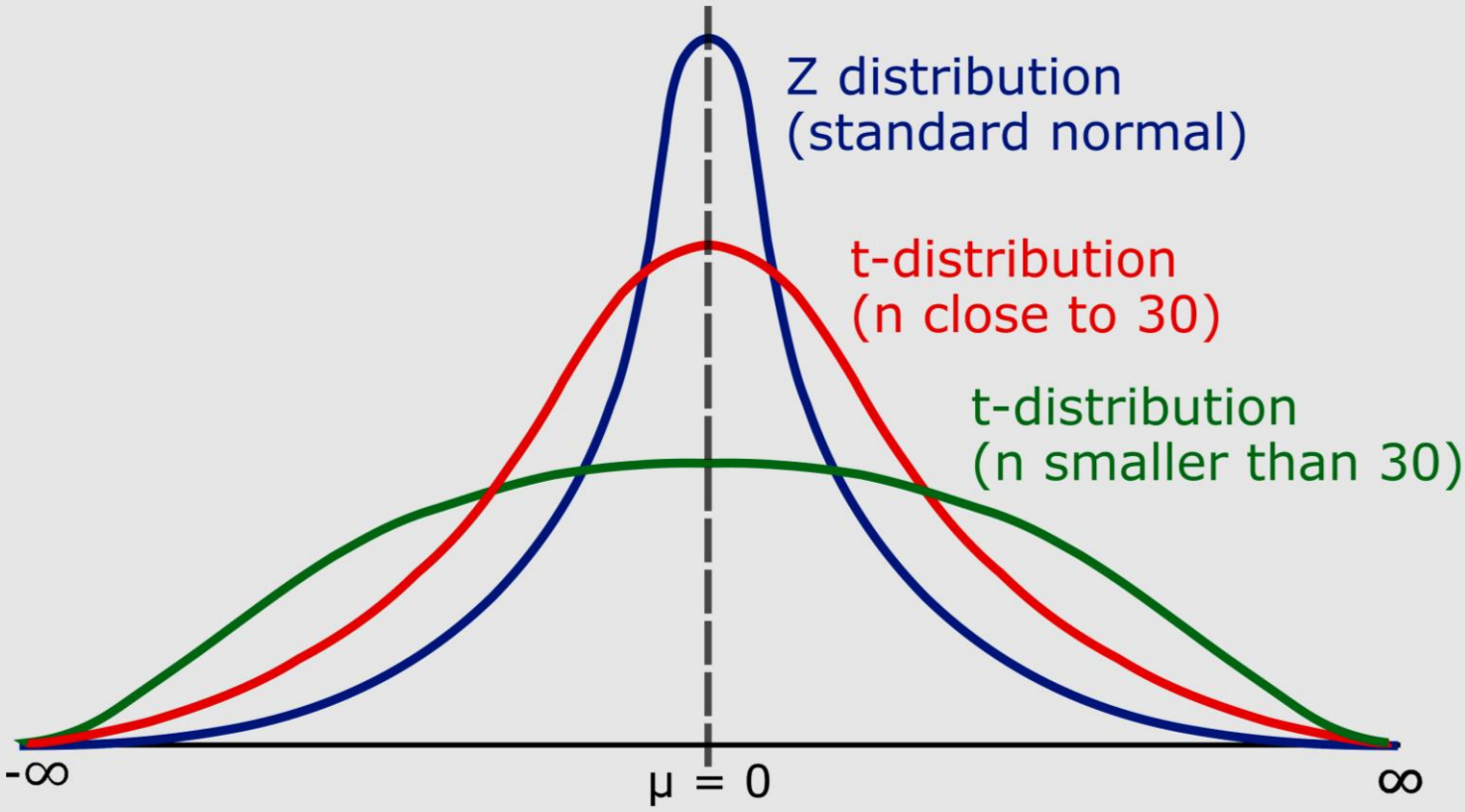
The normal distribution is arguably the most important distribution to know because many phenomena fit this distribution. IQs, heights of people, shoe size, birth weight are all examples that have a normal distribution.

The normal distribution has a bell-shaped curve and has the following properties:

- **It has a symmetric bell shape.**
- **The mean and median are equal and are both located at the center of the distribution.**
- **≈68% of the data falls within 1 standard deviation of the mean, ≈95% of the data falls within 2 standard deviations of the mean, and ≈99.7% of the data falls within 3 standard deviations of the mean.**

The normal distribution is also an integral part of statistics, as it is the basis of several statistical inference techniques, including linear regression, confidence intervals, and hypothesis testing.

2. T-distribution

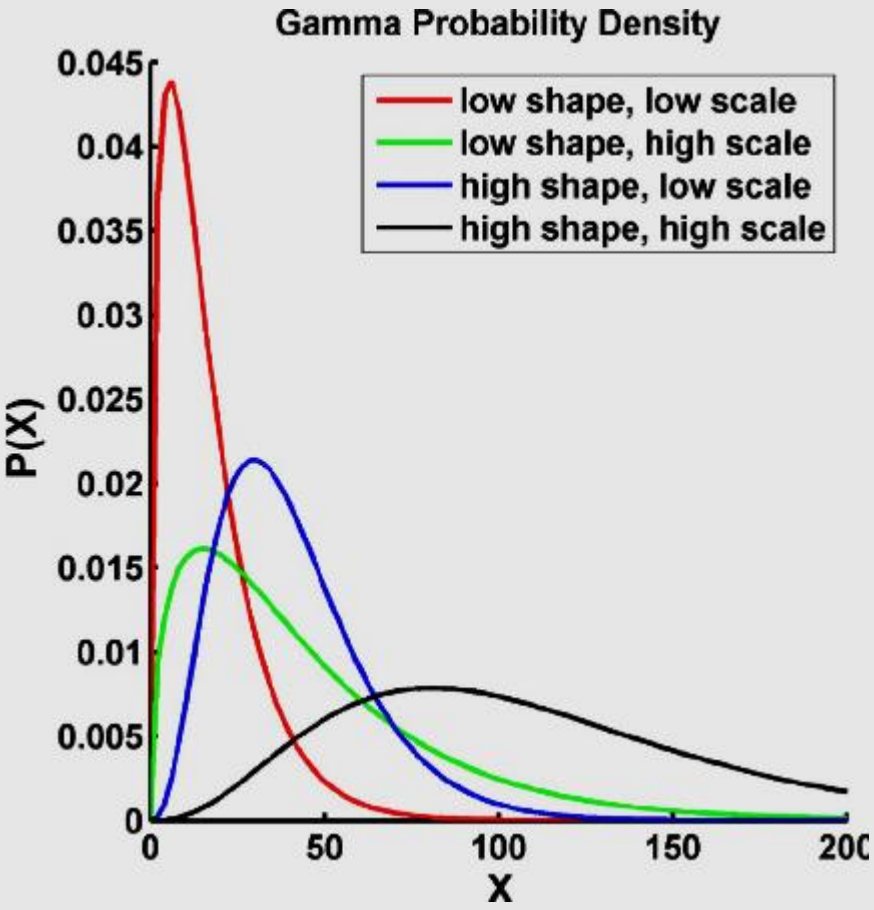


T-distribution

The t-distribution is similar to the normal distribution but is generally shorter and has fatter tails. It is used instead of the normal distribution when the sample sizes are small.

One thing to note is that as the sample size increases, the t-distribution converges to the normal distribution.

3. Gamma Distribution

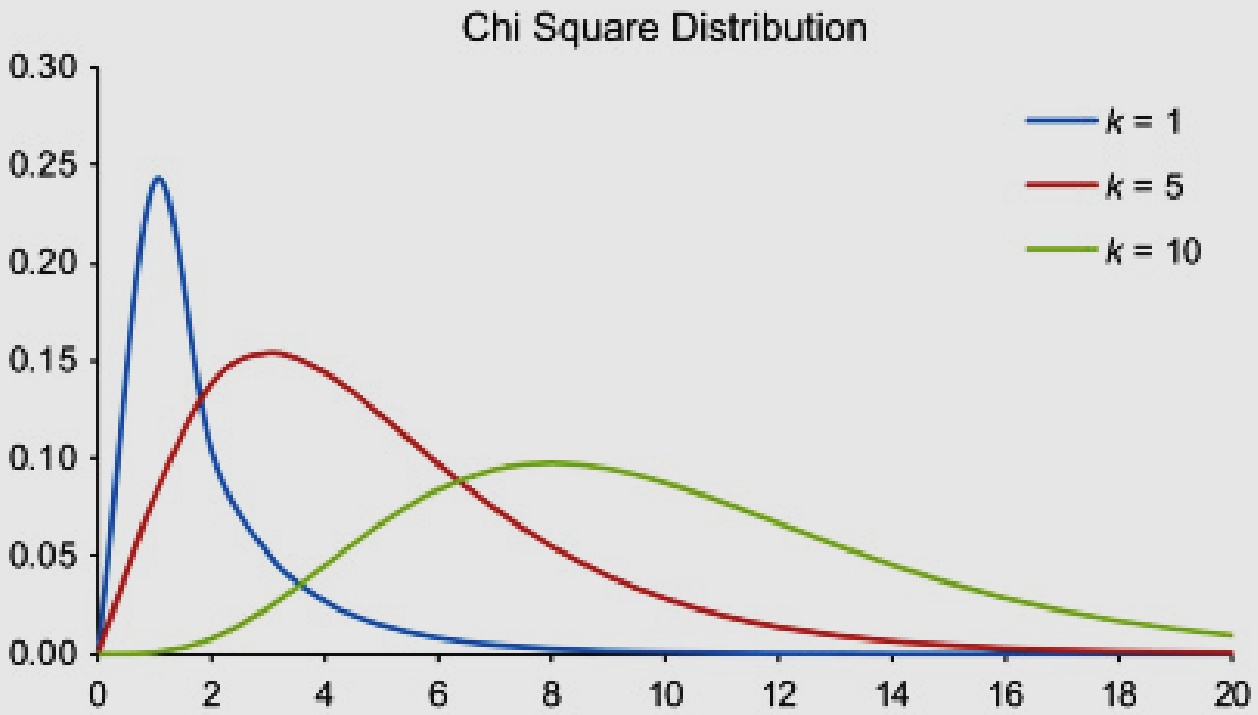


Gamma Distribution

The Gamma distribution is used to predict the wait time until a future event occurs. It is useful when something has a natural minimum of 0.

It's also generalized distribution of the chi-squared distribution and the exponential distribution (which we'll talk about later).

4. Chi-Squared Distribution

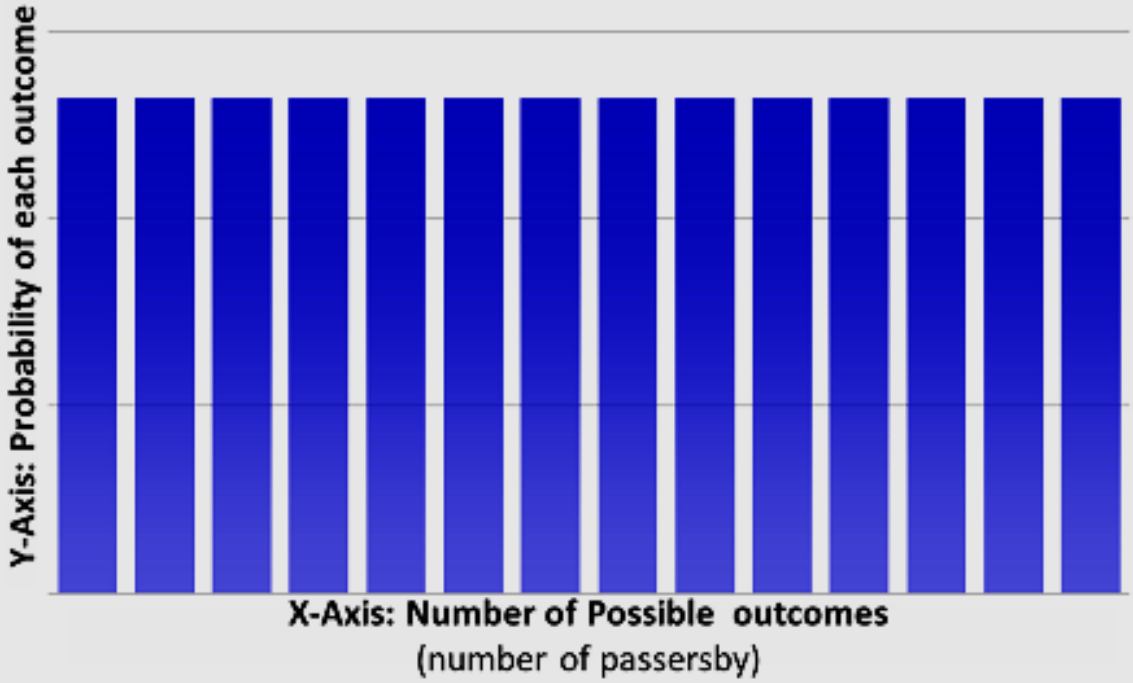


Chi-Squared Distribution

As said, the chi-squared distribution is a particular case of the gamma distribution. As there's a lot to the chi-squared distribution, I won't go into too much detail, but there are several uses for it:

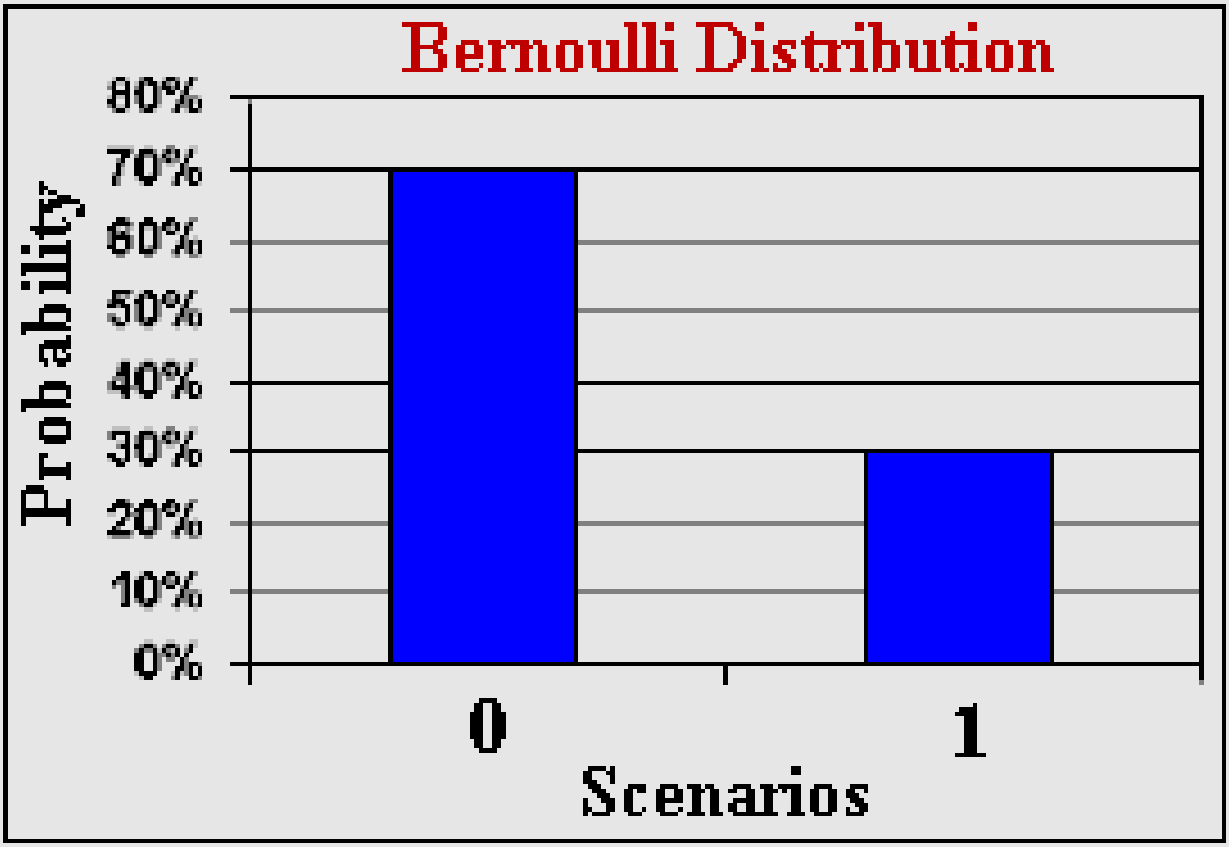
- It allows you to estimate confidence intervals for a population standard deviation.
- It is the distribution of sample variances when the underlying distribution is normal.
- You can test deviances of differences between expected and observed values.
- You can conduct a chi-squared test.

5. Uniform Distribution



The uniform distribution is really simple — each outcome has an equal probability. An example of this is rolling a dye.

6. Bernoulli Distribution



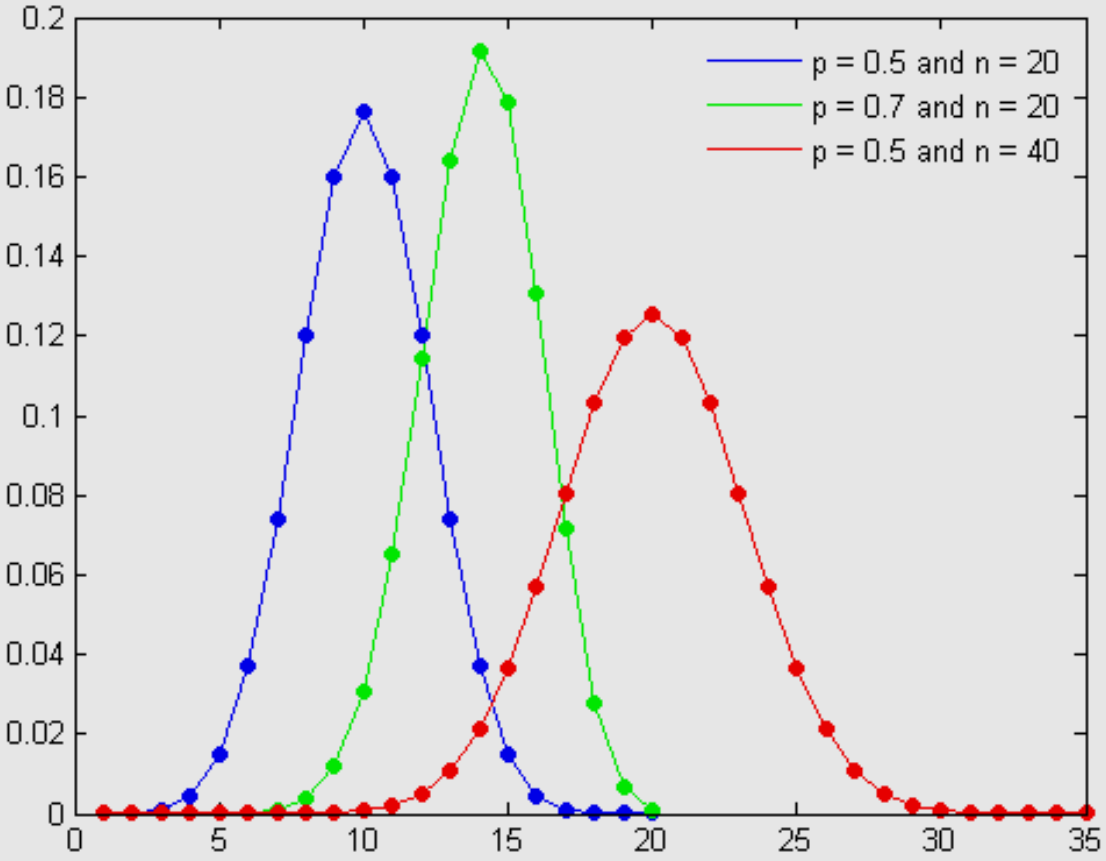
Bernoulli Distribution

In order to understand the Bernoulli Distribution, you first need to know what a Bernoulli trial is. A Bernoulli trial is a random experiment with only two possible outcomes, success or failure, where the probability of success is the same every time.

Therefore, the Bernoulli distribution is a discrete distribution for one Bernoulli trial.

For example, flipping a coin can be represented by a Bernoulli distribution, as well as rolling an odd number on a dye.

7. Binomial Distribution



Binomial Distribution

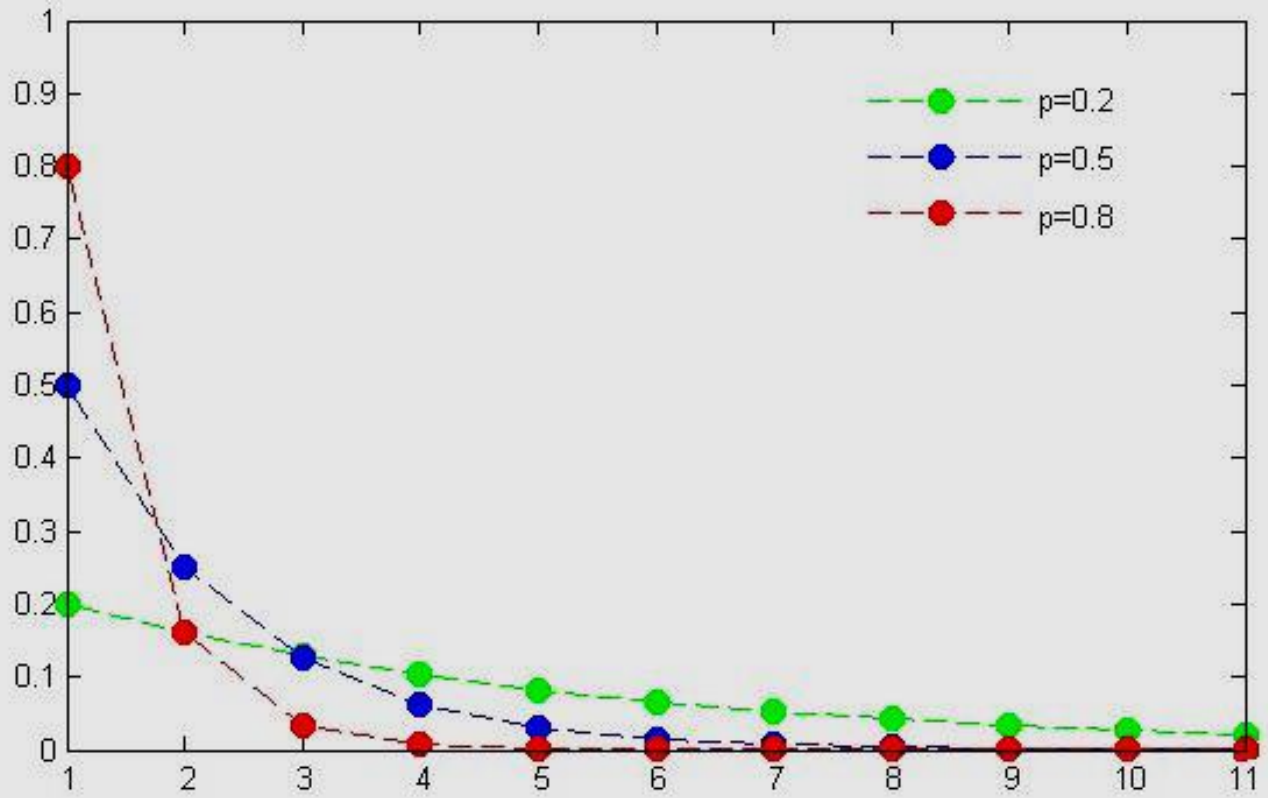
Now that you understand the Bernoulli distribution, the binomial distribution simply represents multiple Bernoulli trials. Specifically, the binomial distribution is a discrete distribution that represents the probability of getting x successes out of n independent Bernoulli trials.

Here are some examples that use the binomial distribution:

- What is the probability of getting 5 heads out of 10 coin flips?
- What is the probability of getting 10 conversions out of 100 emails (assuming the probability of converting is the same)?
- What is the probability of getting 20 responses from 500 customer feedback surveys (assuming the probability of getting a response is the same)?

One interesting thing about the binomial distribution is that it converges to a normal distribution as n (# of Bernoulli trials) gets large.

8. Geometric Distribution



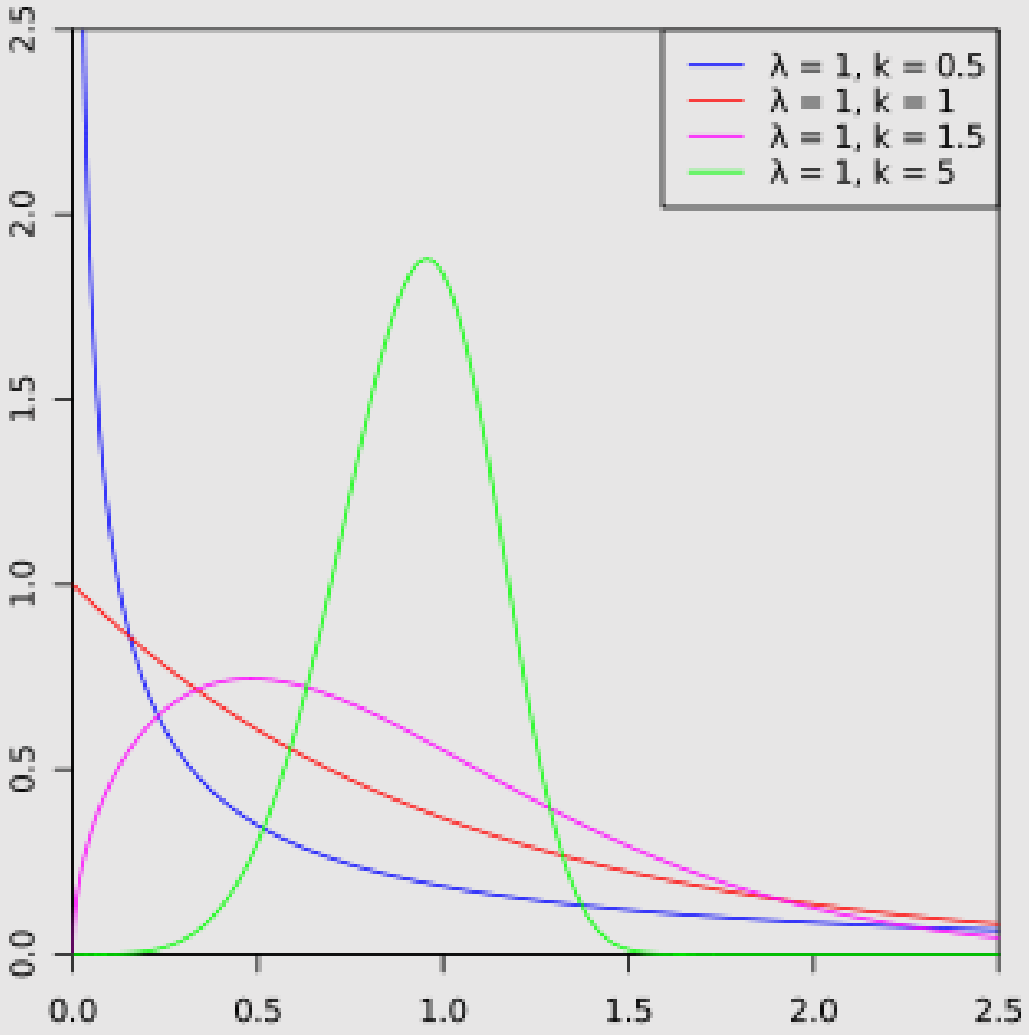
Geometric Distribution

The geometric distribution is also related to the Bernoulli distribution, like the binomial distribution, except that it answers a slightly different question. The geometric distribution represents the probability of having x Bernoulli (p) failures until first success? In other words, it answers, "how many trials are needed until your first success?"

An example of this is, "how many lottery tickets do I need to buy until I buy a winning ticket?"

You can also use the geometric distribution to find the probability of the number of Bernoulli (1-p) successes until failure. The geometric can also be used to check if an event is i.i.d if it fits the distribution.

9. Weibull Distribution



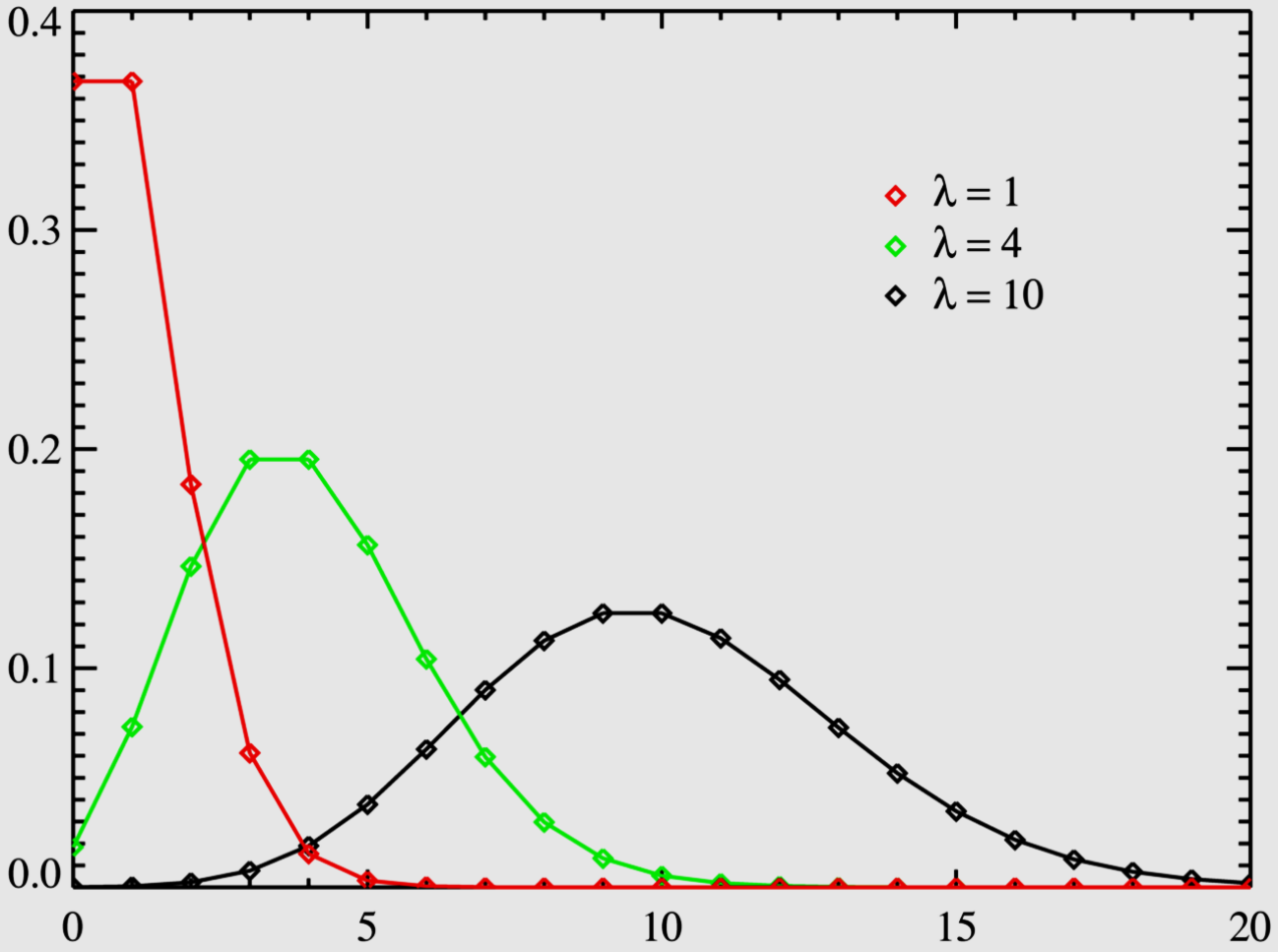
Weibull Distribution

The Weibull distribution is like the geometric distribution, except it is a continuous distribution. Therefore, the Weibull distribution models the amount of time it takes for something to fail or the time between failures.

The Weibull distribution can answer questions like:

- **How long until a particular lightbulb dies?**
- **How long until a customer churns?**

10. Poisson Distribution

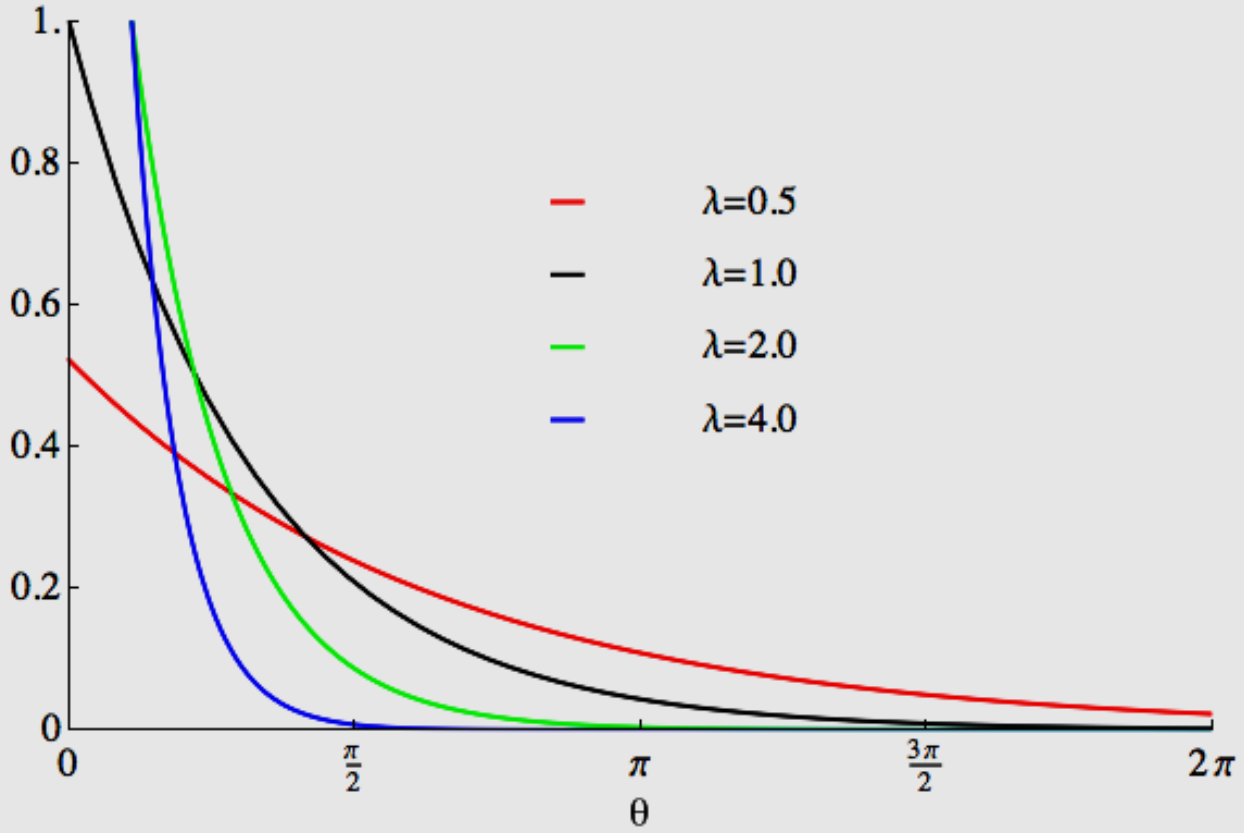


Poisson Distribution

The Poisson distribution is a discrete distribution that represents how many times an event is likely to occur within a specific time period.

The Poisson distribution is most commonly used in queuing theory, which answers questions along the lines of “how many customers are likely to come (queue) within a given period of time?”.

11. Exponential Distribution



Exponential Distribution

The exponential distribution is closely related to the Poisson distribution. If arrivals are distributed Poisson, then the time between arrivals (aka inter-arrival times) has the exponential distribution.

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