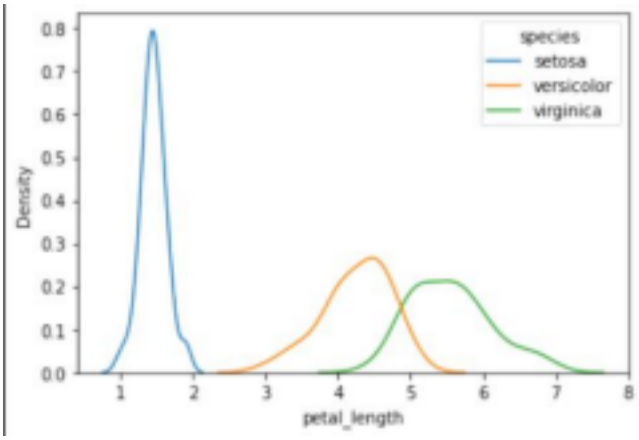
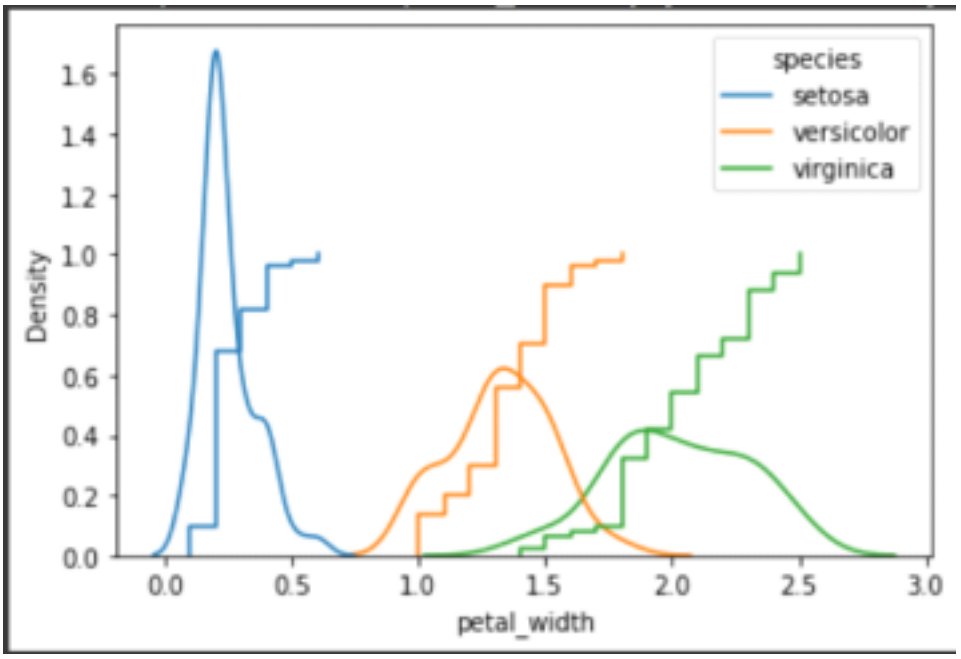
Recap

21 March 2023 14:50

How to use PDF in Data Science

20 March 2023 18:11





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2D Density Plots

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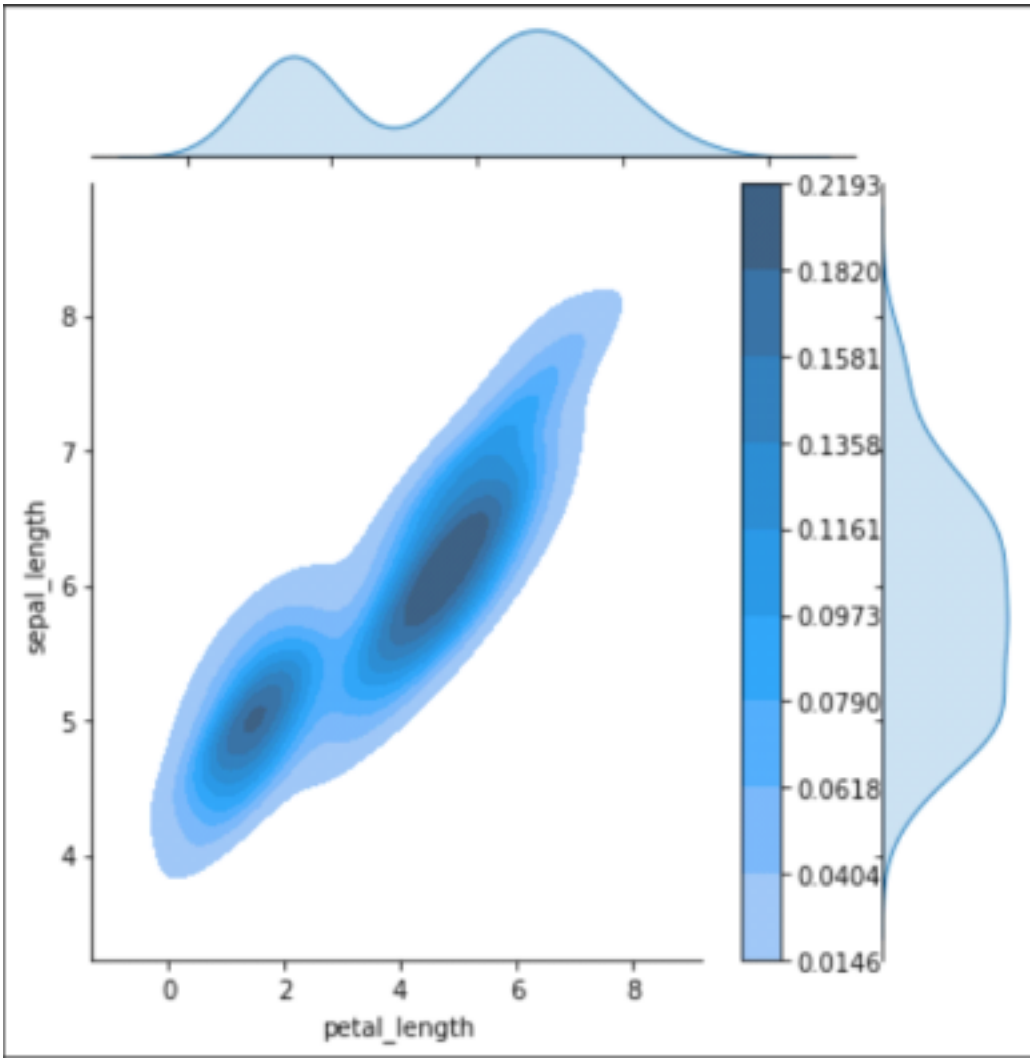

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Normal Distribution

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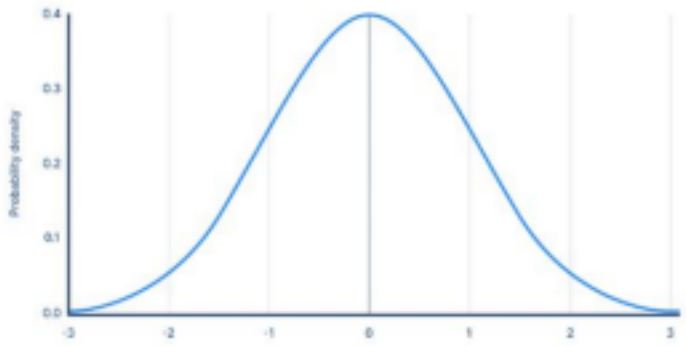
1. What is the normal distribution?

Normal distribution, also known as Gaussian distribution, is a probability distribution that is commonly used in statistical analysis. It is a

continuous probability distribution that is symmetrical around the mean, with a bell-shaped curve.



-> Tail
-> Asymptotic in nature
-> Lots of points near the mean and very few far away

The normal distribution is characterized by two parameters: the mean (μ) and the standard deviation (σ). The mean represents the centre of the distribution, while the standard deviation represents the spread of the distribution.

Denoted as:

Why is it so important?

Commonality in Nature: Many natural phenomena follow a normal distribution, such as the heights of people, the weights of objects, the IQ scores of a population, and many more. Thus, the normal distribution provides a convenient way to model and analyse such data.

PDF Equation of Normal Distribution

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$

Parameters in Normal Distribution

https://samp-suman-normal-dist-visualize-app-lkntug.streamlit.app/

Equation in detail:

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Standard Normal Variate
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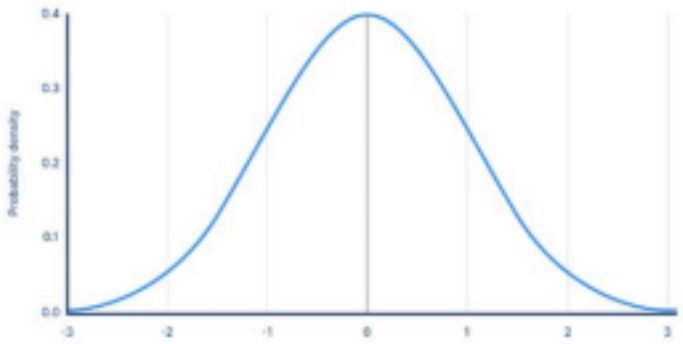
- What is Standard Normal Variate

A Standard Normal Variate(Z) is a standardized form of the normal distribution with mean = 0 and standard deviation = 1.



Standardizing a normal distribution allows us to compare different distributions with each other, and to calculate probabilities using standardized tables or software.

Equation:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$

- How to transform a normal distribution to Standard Normal Variate

Refer Python code

Kya Fayda Standardize karne ka?

Suppose the heights of adult males in a certain population follow a normal distribution with a mean of 68 inches and a standard deviation of 3 inches. What is the probability that a randomly selected adult male from this population is taller than 72 inches?

- What are Z-tables

A z-table tells you the area underneath a normal distribution curve, to the left of the z score

https://www.ztable.net/

For a Normal Distribution X~(u,std) what percent of population lie between mean and 1 standard deviation, 2 std and 3 std?

standard deviation, 2 std and 3 std?

Properties of Normal Distribution

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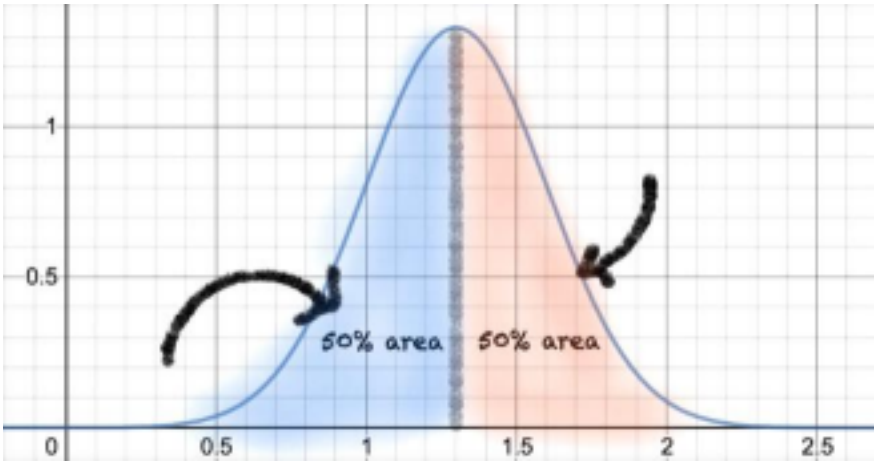
1. Symmetricity

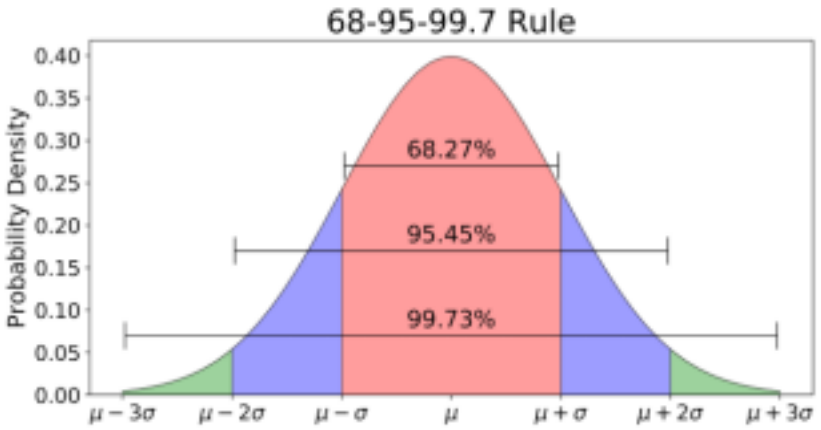
The normal distribution is symmetric about its mean, which means that the probability of observing a value above the mean is the same as the probability of observing a value below the mean. The bell-shaped curve of the normal distribution reflects this symmetry.



2. Measures of Central Tendencies are equal

3. Empirical Rule

The normal distribution has a well-known empirical rule, also called the 68-95-99.7 rule, which states that approximately 68% of the data falls within one standard deviation of the mean, about 95% of the data falls within two standard deviations of the mean, and about 99.7% of the data falls within three standard deviations of the mean.



4. The area under the curve

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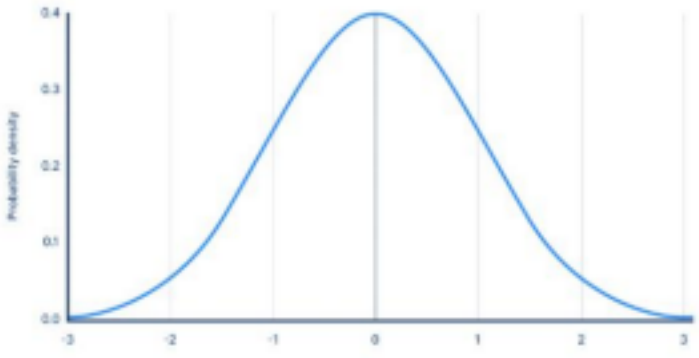

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Skewness

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- What is skewness?

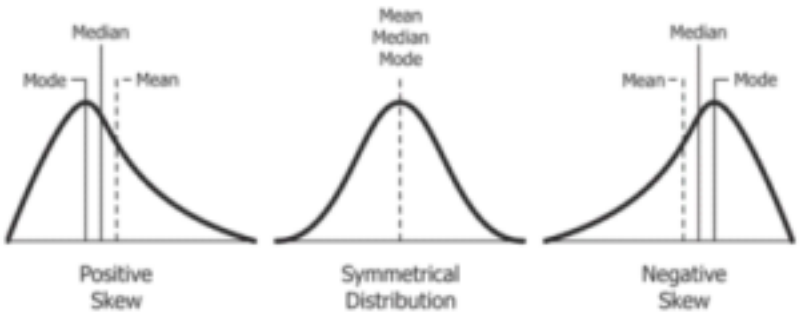
  A normal distribution is a bell-shaped, symmetrical

distribution with a specific mathematical formula that describes how the data is spread out. Skewness indicates that the data is not symmetrical, which means it is not normally distributed.

Skewness is a measure of the asymmetry of a probability distribution. It is a statistical measure that describes the degree to which a dataset deviates from the normal distribution.

In a symmetrical distribution, the mean, median, and mode are all equal. In contrast, in a skewed distribution, the mean, median, and mode are not equal, and the distribution tends to have a longer tail on one side than the other.

Skewness can be positive, negative, or zero. A positive skewness means that the tail of the distribution is longer on the right side, while a negative skewness means that the tail is longer on the left side. A zero skewness indicates a perfectly symmetrical distribution.

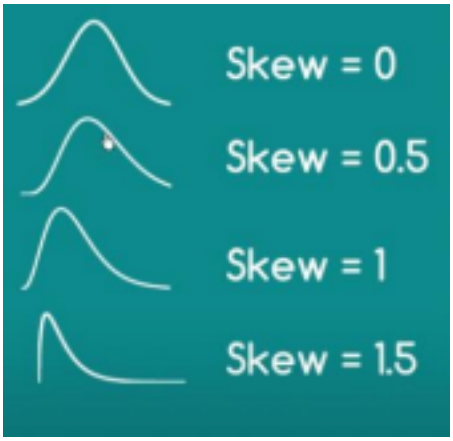


The greater the skew the greater the distance between mode, median and mode. • How skewness is calculated?

$$\frac{n}{(n-1)(n-2)}\sum\left(\frac{(x-\bar{x})}{s}\right)^3$$

• Python Example

• Interpretation



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CDF of Normal Distribution

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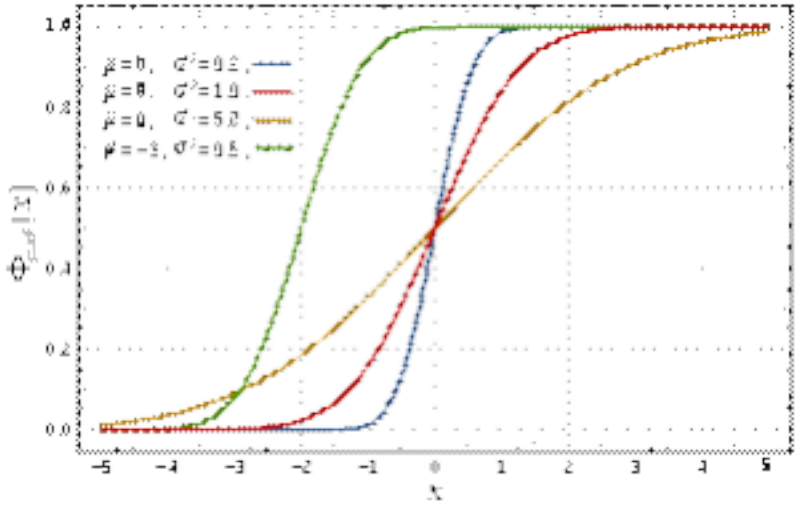
$$F(x) = p(X \le x) = \int_{-\infty}^{x} f(t)dt$$

$$= \frac{1}{\sigma\sqrt{2\pi}} \int_{-\infty}^{x} e^{-\frac{(t-\mu)^2}{2\sigma^2}} dt.$$



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Use in Data Science

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- Outlier detection
- Assumptions on data for ML algorithms -> Linear Regression and GMM
- Hypothesis Testing
- Central Limit Theorem