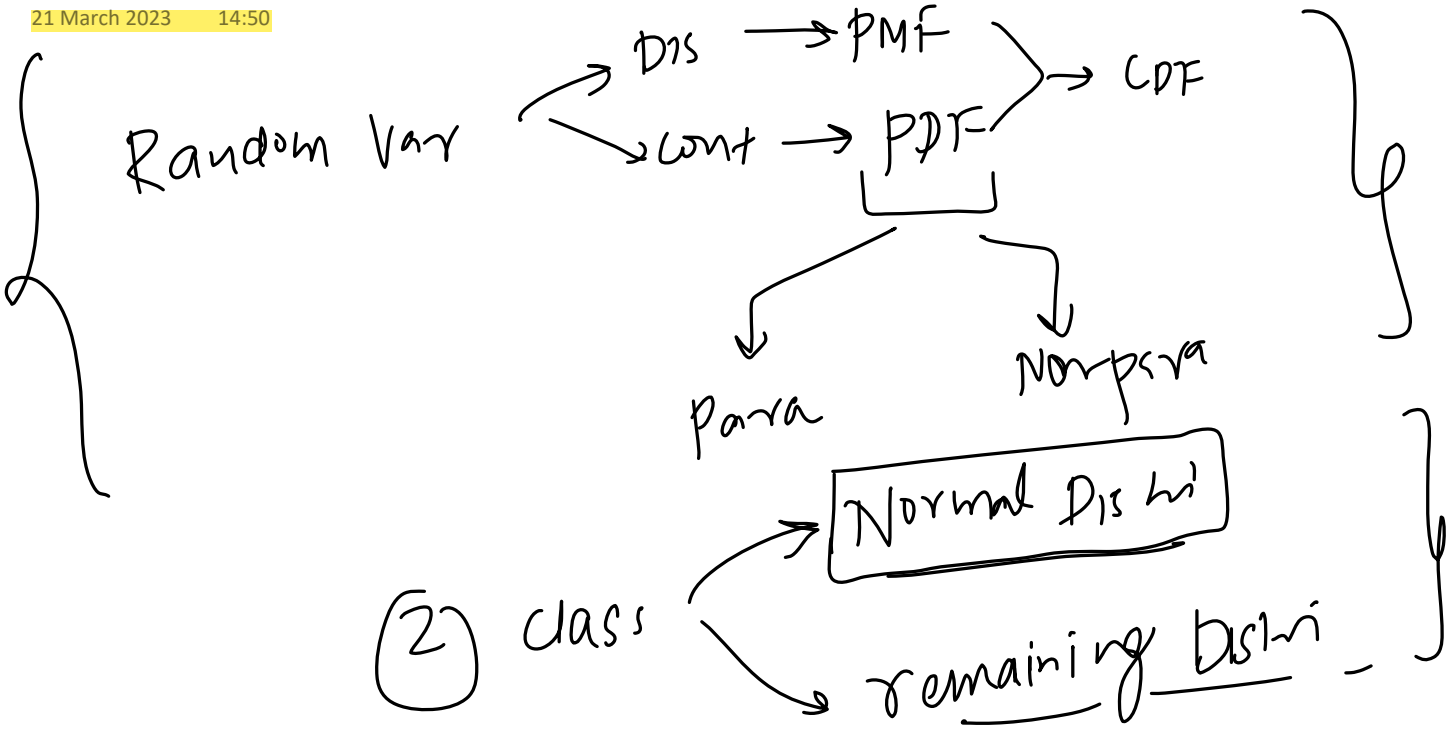
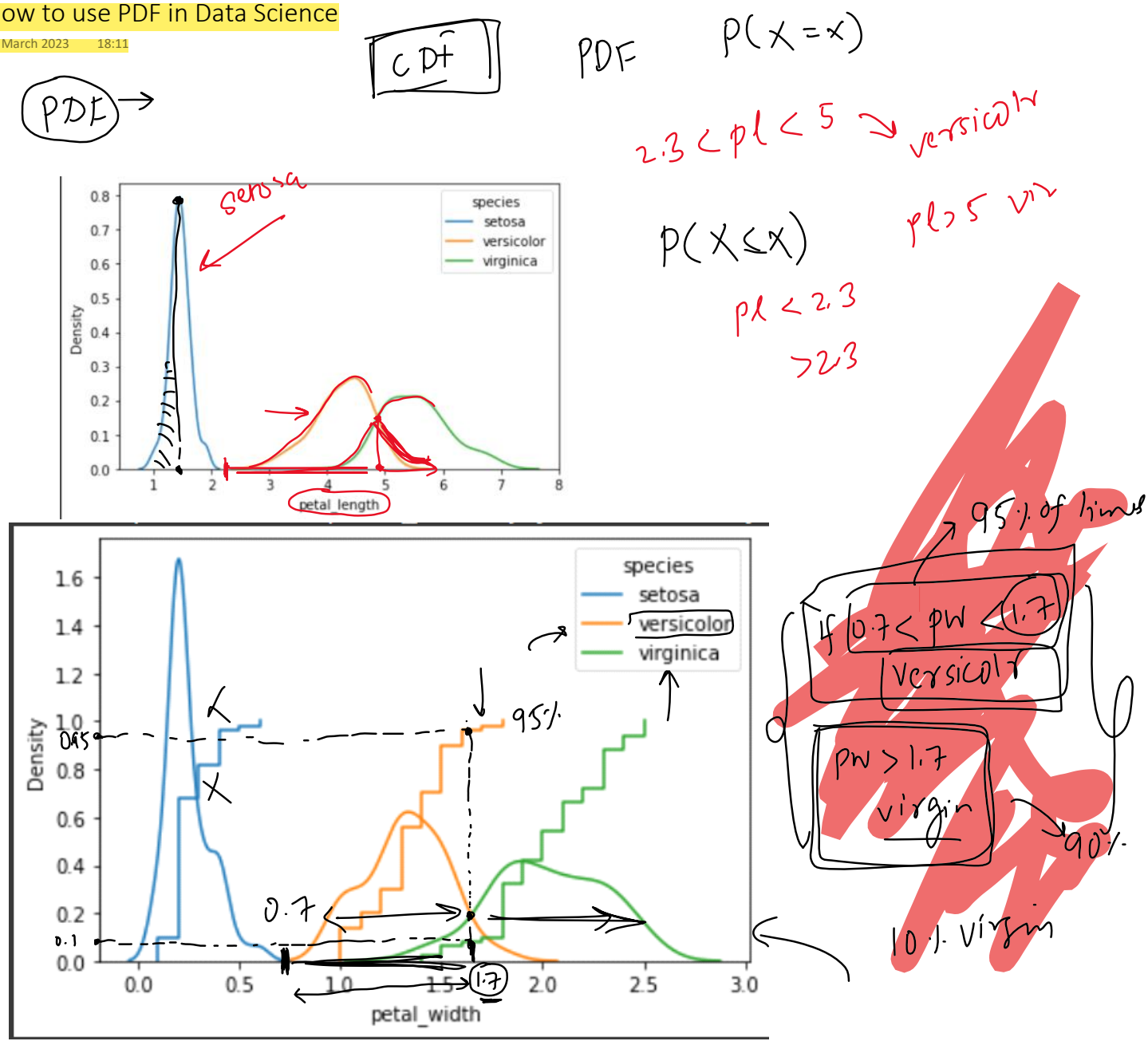
Recap

21 March 2023 14:50



How to use PDF in Data Science

20 March 2023 18:11



Benefit of using PDF

Pdf tells roughly probability at one point whereas cdf tell probability till particular point. So above we came with decision rule that if petal width is greater than 0.7 and less than 1.7 it will be versicolor because in the area of less than 1.7 versicolor pdf is more dominating but after 1.7 we can see virgin is more dominating hence pw>1.7 is virginica

Thats the benefit of using pdf

Benefit of using CDF

what if someone asks how sure you are about decision you made that's where CDF comes in it is used to quantify the decision making. Lets see how .

at point 1.7 we can see the cdf is 95 means if there are 100 virginica 95 will have petal width less than 1.7. at same point if we look at cdf of virginica it shows the cdf of 10 which means if there are out of 100 virginica only 10 will have the petal width less than 1.7 and 90 will have more than 1.7. Thats how you were able to quantify the decision making

2D Density Plots

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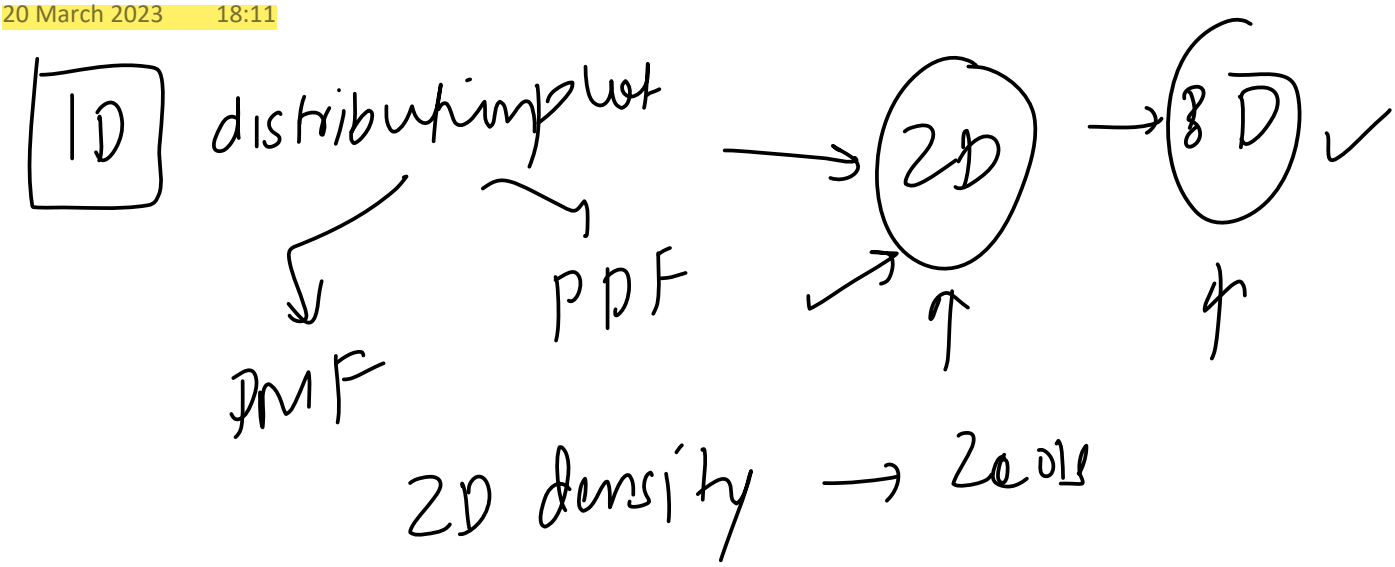
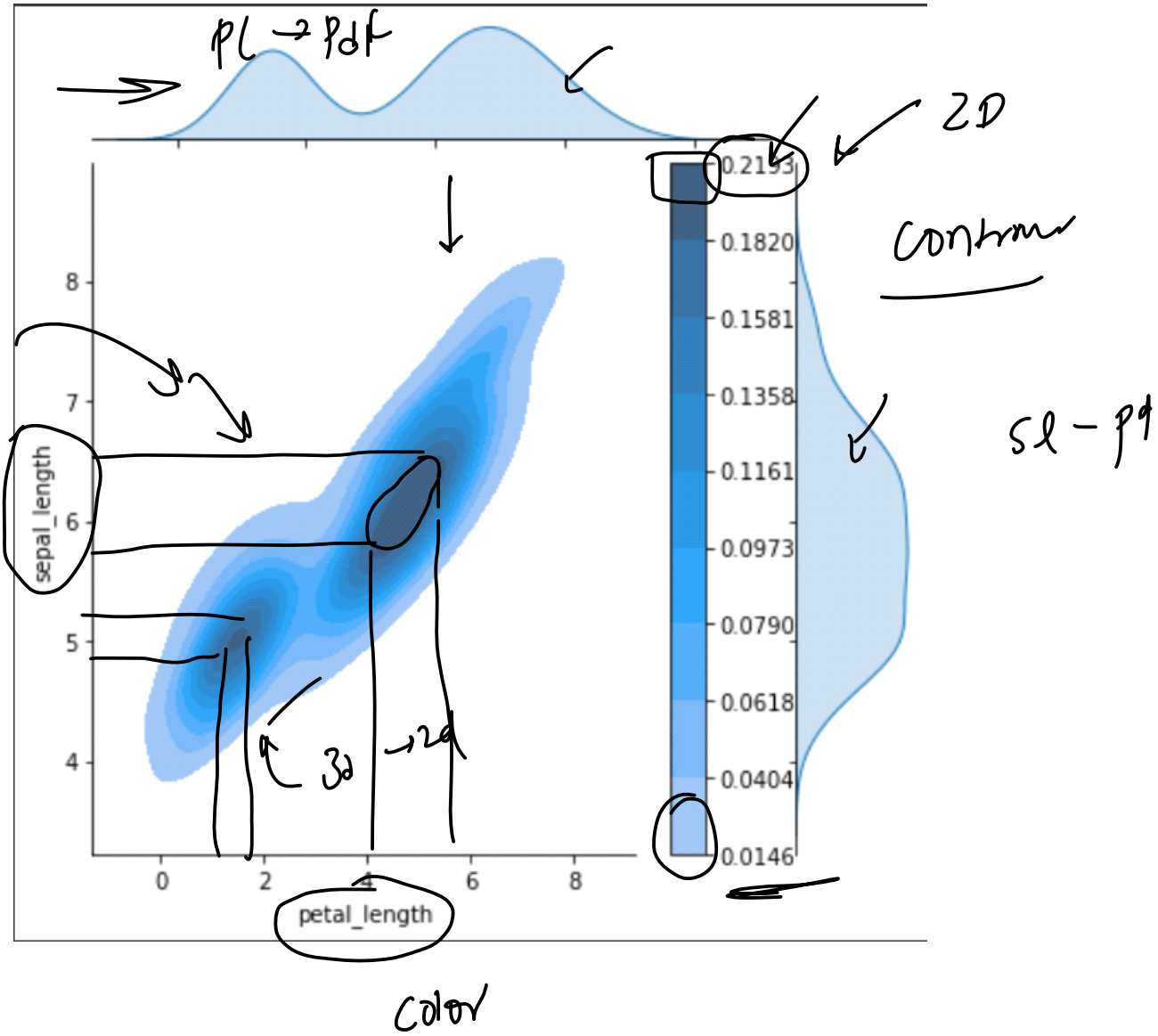




By these graph you will know the that which combination probability is highest.
if we try interpreting we can say that the probability/density of having petal_length greater than equal 4 and less than = 6 andhaving sepal length greater than 5.8 and less than = 6.5 is 21 percent which is the highest

Normal Distribution

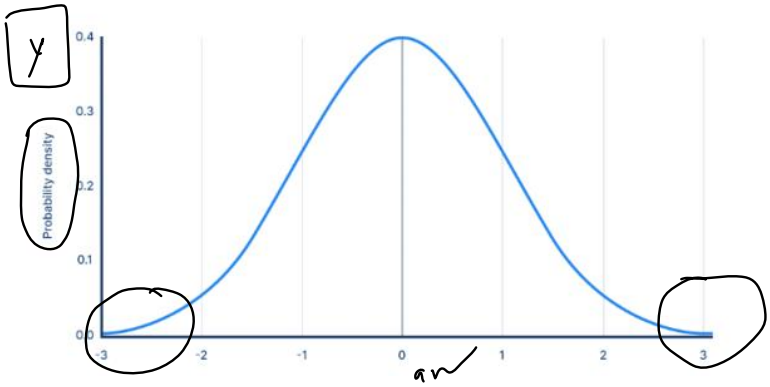
20 March 2023 18:06

1. What is normal distribution?

bell curve

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.

→ pdf

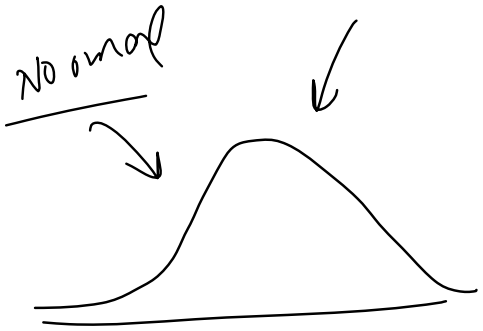


-> Tail
-> Asymptotic in nature
-> Lots of points near the mean and very few far away

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:

$X \sim N(\mu, \sigma)$ → μ → mean, σ → std



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

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

μ, σ

data → Normal → μ, σ

Parameters in Normal Distribution

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

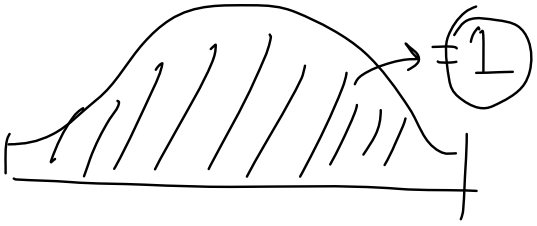
To check impact of mean and std on normal distribution pdf check out the link on left

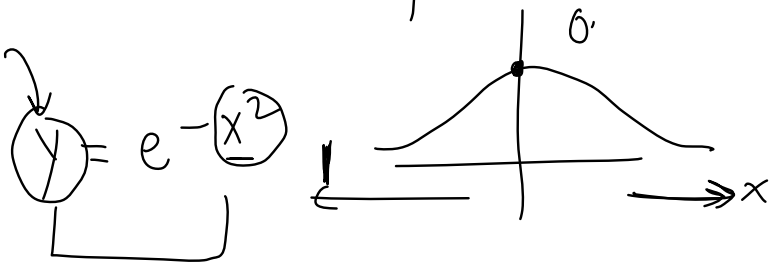
Equation in detail:

$$y = e^{\frac{-(x-\mu)^2}{2\sigma^2}} \div \sigma\sqrt{2\pi}$$

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

$\sigma\sqrt{2\pi}$





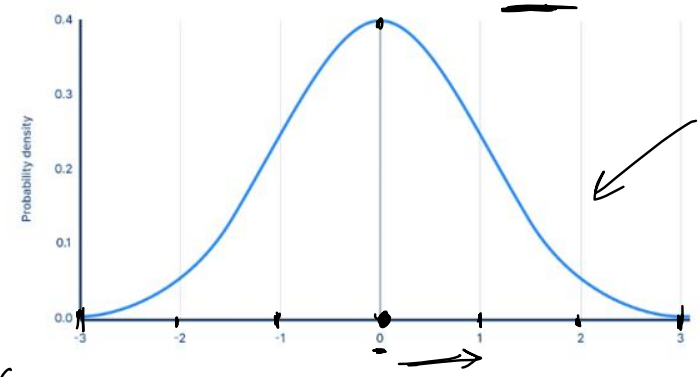
$$y = \frac{1}{e^{x^2}}$$

Standard Normal Variate

20 March 2023 18:08

- 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.



Z is the special case of normal distribution where mean is 0 and std is 1

importance of Standardization

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

Equation:

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

- 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

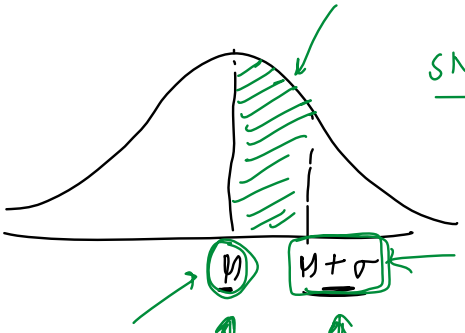
https://www.ztable.net/

Z table gives area under the curve till point , means cdf , means probability of less than or equal to for all standardize points

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.

$X \sim N(\mu, \sigma)$ %



SNV(z) →

$\mu \rightarrow$ ↓

$$z = \frac{x-\mu}{\sigma}$$

$$z = \frac{\mu-\mu}{\sigma} = 0$$

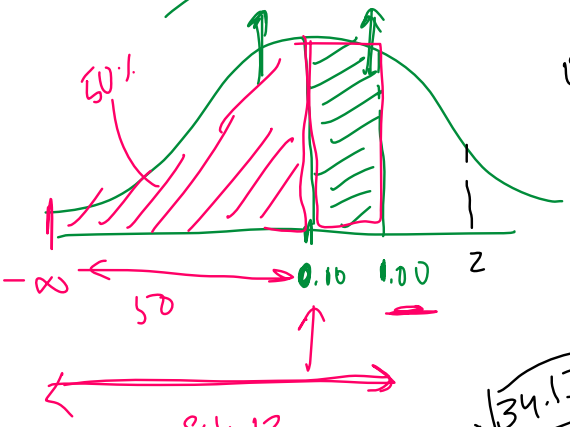
$$z = \frac{x-\mu}{\sigma} = \frac{\mu+\sigma-\mu}{\sigma}$$

$$\frac{\sigma}{\sigma} = 1$$

0.9772

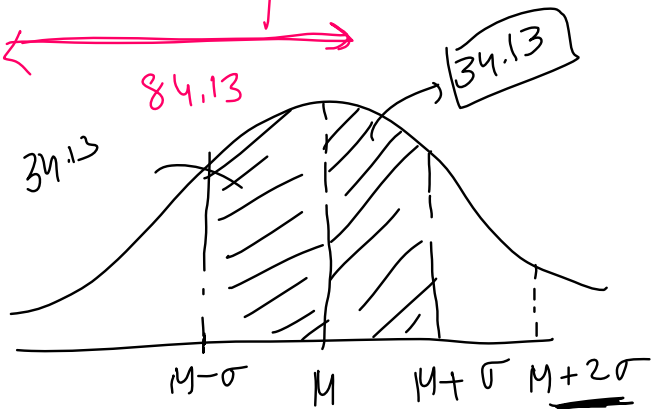
97%

84.13 − 50 = 34.13



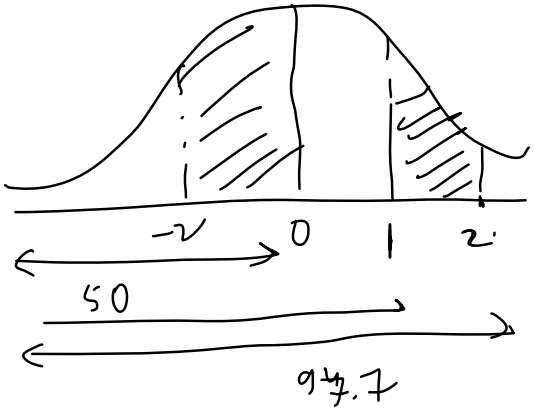
−1σ +1σ

64.28 %



$$z = \frac{\mu+2\sigma-\mu}{\sigma} = 2$$

69.



Properties of Normal Distribution

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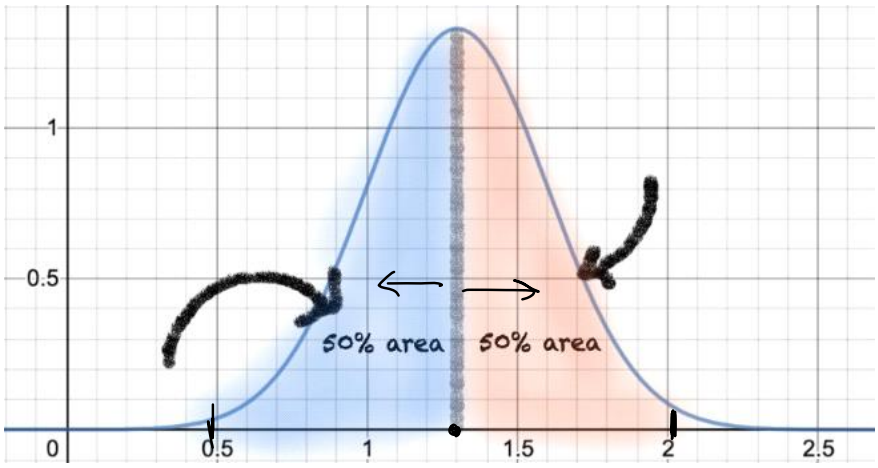
1. Symmetricity

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.



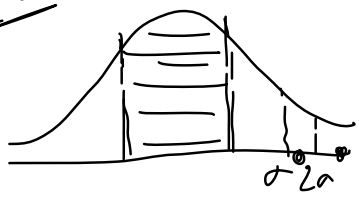
2. Measures of Central Tendencies are equal → mean → median → mode

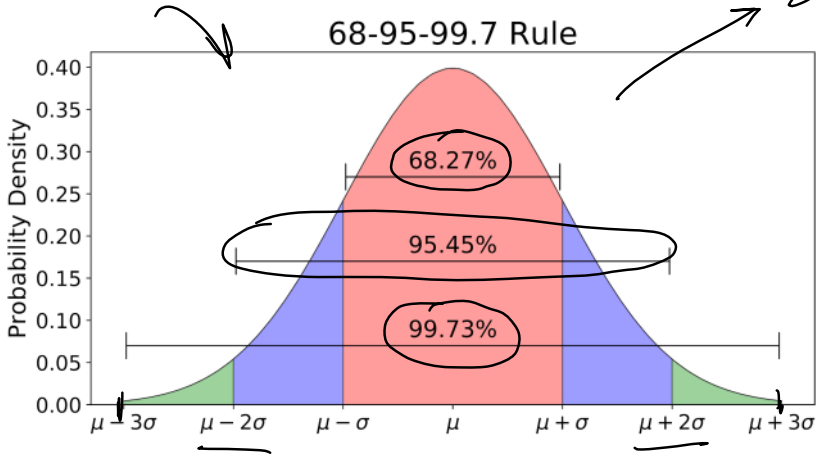
3. Empirical Rule

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.

Standard normal variate

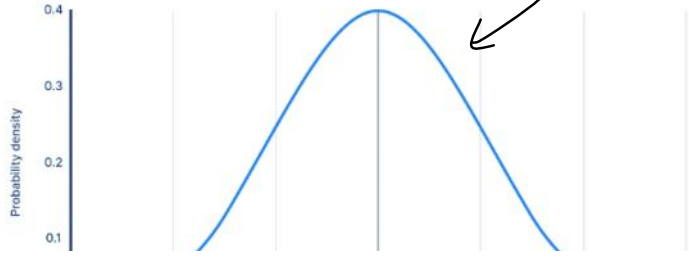
Z-table

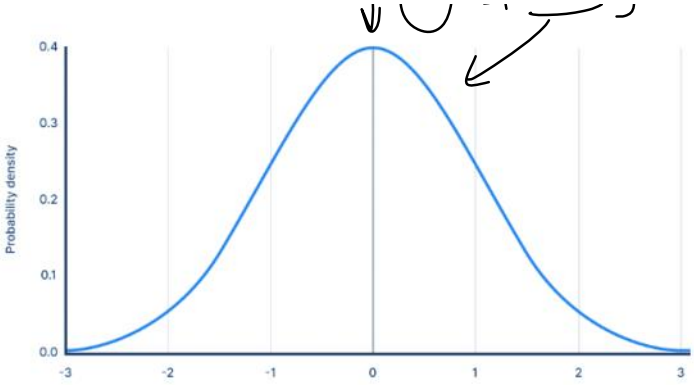




4. The area under the curve

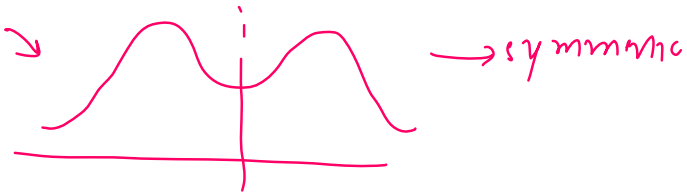
1 → PDF




Probability density
0.4
0.3
0.2
0.1
0.0
-3
-2
-1
0
1
2
3

Skewness

20 March 2023 18:07



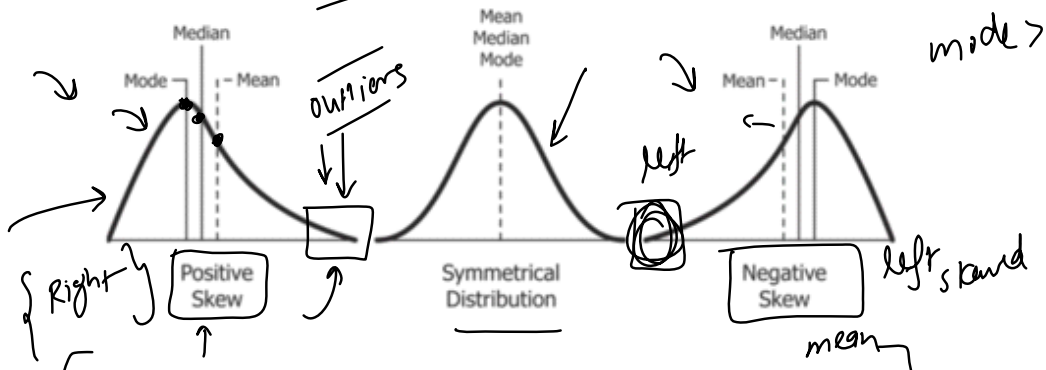
- What is skewness?

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.



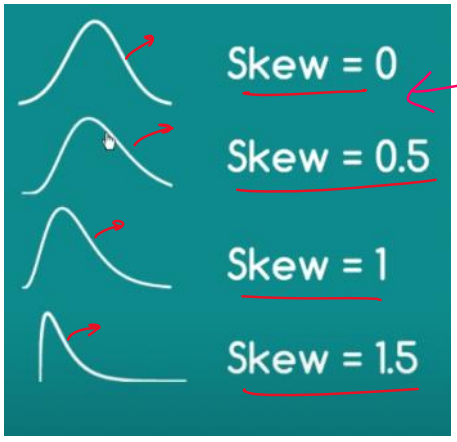
The greater the skew the greater the distance between mode, median and mode

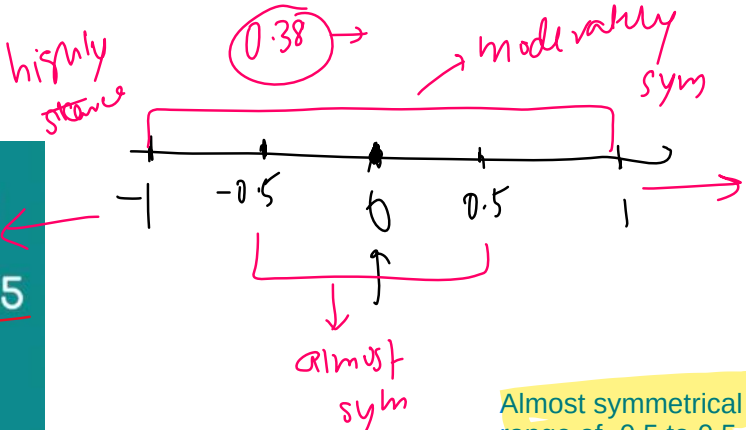
- How skewness is calculated?

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

Formula for statistical moment (3rd) note that it is the formula for sample skew

- Python Example
- Interpretation





Almost symmetrical if in the skewness is in range of -0.5 to 0.5

Having skew between this range doesn't mean its normal it simply means its symmetrical. If the distribution looks like normal and have a skewness of 0.5 then you can assume that is normal distribution

CDF of Normal Distribution

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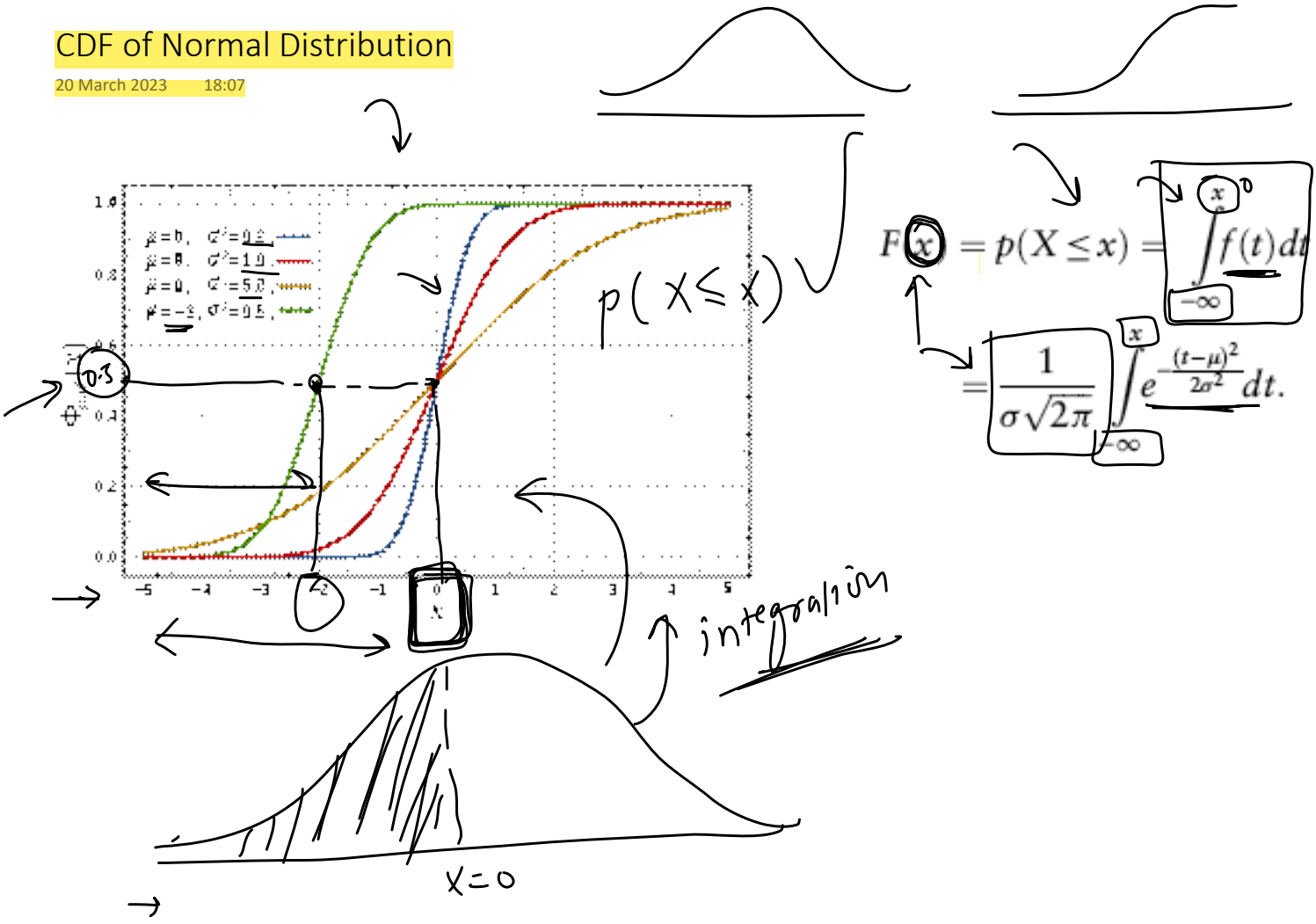

Use in Data Science

20 March 2023 18:08

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