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Statistics

It deals with the collection, analysis, interpretation, presentation and organizing data.

Probability

It is the likelihood or chance of different outcomes in uncertain situations.

Mean

The mean (or average) is the sum of all data points divided by number of data points.

Examples

1) Set = {6, 7, 11, 26, 3}

$$\text{Mean} = \frac{6+7+11+26+3}{5}$$

$$\text{Mean} = \frac{53}{5} \Rightarrow 10.6$$

2) Set = {3, 2, 4, 17, 6}

$$\text{Mean} = \frac{3+2+4+17+6}{5}$$

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Median

It is the middle value in a dateset when it is ordered from least to greatest.

- If the dateset has an even number of observations the median the mean(Average) of the two middle values.

Examples

1) Set = {6, 4, 7, 15, 9}

order = {4, 6, 7, 9, 15}

Median = 7

2) Set = {11, 7, 4, 26, 14, 30}

order = {4, 7, 11, 14, 26, 30}

$$\text{Median} = \frac{11+14}{2} \Rightarrow \frac{25}{2}$$

Median = 12.5

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Mode

It is the value that appears most frequently in a dataset.

Examples

1) Set = {4, 9, 1, 14, 8, 19, 14}

Mode = 14

2) Set = {2, 4, 6, 15, 9, 8, 2, 4, 4}

Mode = 4

Variance

It measures the spread of a set of data points around their mean.

Formula

$$\sigma^2 = \frac{\sum_{i=1}^{n} (x_i - \mu)^2}{n}$$

- μ is the mean of dataset

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Example

Set = {4, 8, 6, 5, 3}

1) Calculate the mean

$$\mu = \frac{4+8+6+5+3}{5} \Rightarrow \frac{26}{5}$$

$$\mu = 5.2$$

2) Calculate Squared difference

$$(x_i - \mu)^2$$

$(4 - 5.2)^2 \Rightarrow (-1.2)^2 \Rightarrow 1.44$

$(8 - 5.2)^2 \Rightarrow (2.8)^2 \Rightarrow 7.84$

$(6 - 5.2)^2 \Rightarrow (0.8)^2 \Rightarrow 0.64$

$(5 - 5.2)^2 \Rightarrow (-0.2)^2 \Rightarrow 0.04$

$(3 - 5.2)^2 \Rightarrow (-2.2)^2 \Rightarrow 4.84$

$1.44 + 7.84 + 0.64 + 0.04 + 4.84$

$= 14.8$

3) Calculate the variance

$$\sigma^2 = \frac{14.8}{5}$$

$$\sigma^2 = 2.96$$

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Standard Deviation

It is the square root of the variance, providing a measure of average distence of each date point from the mean.

Formula

$$\sigma = \sqrt{\sigma^2}$$

(or)

$$\sigma = \sqrt{\frac{\Sigma (x_i - \mu)^2}{n}}$$

Example

Set = {4, 2, 6, 5, 3}

Using the variance calculated in previous example.

$$\sigma = \sqrt{2.96}$$

$$\sigma = 1.72$$

Normal Distribution

It is a continuous probability distribution that is symmetric around the mean, depicting the data in a bell shaped curve.

Formula

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

- x is variable
- μ is mean
- σ is standard deviation

Examples

i) Given $x = 5$, $\mu = 8$, $\sigma = 3$

$$f(5, 8, 3) = \frac{1}{3\sqrt{2\pi}} e^{-\frac{(5-8)^2}{2(3)^2}}$$

$$= \frac{1}{3(2.51)} e^{-\frac{(-3)^2}{2(9)}}$$

$$= \frac{1}{7.52} e^{-\frac{9}{18}} = \frac{1}{7.52} e^{-3.56}$$

$$= 0.0038$$

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2) Given $x = 2$, $\mu = 5$, $\sigma = 4$

$$f(2,5,4) = \frac{1}{4\sqrt{2\pi}} e^{\frac{-(2-5)^2}{2(4)^2}}$$

$$= \frac{1}{4(2.51)} e^{-\frac{(-3)^2}{2(16)}} \Rightarrow \frac{1}{10.03} e^{\frac{-9}{32}}$$

$$= \frac{1}{10} e^{-1/32} \Rightarrow 0.078$$

Bionomial Distribution

It is a discrete probability distribution that models the likelihood of observing one of two independent outcomes in a sequence of experiments. Outcomes are typically labeled as "success" or "failure".

Poission Distribution

It is a discrete probability distribution that expresses the probability of a given number of events occuring within a fixed interval of time or space. given the average no. of times the event occurs.

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Uniform Distribution

It is continuous probability distribution where all outcomes are equally likely within a given interval.

Formula

$$f(x|a,b) = \frac{1}{b-a} \quad \text{for } a \leq x \leq b$$

Examples

1) U.D b/w 2 and 5

$$f(x|2,5) = \frac{1}{5-2} \quad \text{for } 2 \leq x \leq 5$$

$$= \frac{1}{3} \quad \text{for } 2 \leq x \leq 5$$

2) U.D b/w 0 and 1

$$f(x|0,1) = \frac{1}{1-0} \Rightarrow 1 \quad \text{for } 0 \leq x \leq 1$$

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Combination

It is a selection of items from a larger set where order does not matter. It is used to determine the no. of ways to choose a subset of items from a larger set.

Formula

$$^{n}C_{r} = \frac{n!}{r!(n-r)!}$$

- n is total number of items
- r is the number of items to choose.

Example

How many ways 3 students can be choosen from a class of 5 students?

$n = 5 \qquad r = 3$

$$^{5}C_{3} = \frac{5!}{3!(5-3)!} \Rightarrow \frac{5!}{3!(2)!}$$

$$= \frac{5 \times 4 \times 3!}{3!(2!)} \Rightarrow \frac{20}{2} \Rightarrow 10$$

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Permutation

It is an arrangement of items from a larger set where order does matter. It is used to determine the number of ways to arrange a subset of items from a set where sequence is important.

Formula

$$^{n}P_{r} = \frac{n!}{(n-r)!}$$

Example

How many ways can 3 books be arranged in a 5 books shelf?

$$n = 5 \quad , \quad r = 3$$

$$^{5}P_{3} = \frac{5!}{(5-3)!} \Rightarrow \frac{5!}{2!}$$

$$= \frac{5 \times 4 \times 3 \times 2!}{2!}$$

$$= 60$$