Statistics & Probability Formulas

Mean

Formula

$$\mu = \frac{\sum_{i=1}^{i=n} x_i}{n}$$

μ → mean

n → number of data points

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Sample Size

Formula

$$n = Z^2\left(\frac{\sigma}{MOE}\right)^2$$

n → sample size

Z → critical value

σ → standard deviation

MOE → margin of error

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Standard Deviation

Formula

$$\sigma_{n-1} = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

σ_{n-1} → sample standard deviation

$\bar{x}$ → sample mean

n → sample size

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Population Standard Deviation

Formula

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

σ_n → population standard deviation

μ → population mean

n → population size

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Standard Error

Formula

$$SE_\mu = \frac{\sigma}{\sqrt{n}}$$

SE_μ ⟶ standard error

σ ⟶ standard deviation

n ⟶ sample size

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Coefficient of Variation

Formula

$$CV = \frac{\sigma}{\mu}$$

CV ⟶ coefficient of variation

σ ⟶ standard deviation

μ ⟶ mean

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Correlation Coefficient

Formula

$$\text{cor}(x,y) = \frac{n\sum(xy) - \sum(x)\sum(y)}{\sqrt{(n\sum x^2 - (\sum x)^2) - (n\sum y^2 - (\sum y)^2)}}$$

cor(x,y) → correlation coefficient between groups x & y

n → number of data points

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Standard or Z Score

Formula

$$Z_{score} = \frac{(x - \mu)}{\sigma}$$

Z_{score} → Z or Standard score

x → individual data value

μ → mean

σ → standard deviation

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Probability

Formula

$$P(A) = \frac{\text{number of favourable events}}{\text{number of total events}}$$

$$P(A) = \frac{n(A)}{n}$$

$$P(B) = \frac{n(B)}{n}$$

$$P(A \cap B) = P(A)\,P(B)$$

for Mutually Exclusive Events

$$P(A \cup B) = P(A) + P(B)$$

for non-Mutual Events

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

for Conditional probability

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

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Conditional Probability

Formula

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

$P(A \mid B)$ ⟶ conditional probability

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Linear Regression

Formula

$$y = a + bx$$

y ⟶ linear regression line

a ⟶ y-intercept

b ⟶ slope of regression line

$$a = \frac{(\Sigma y)(\Sigma x^2) - (\Sigma x)(\Sigma xy)}{n(\Sigma x^2) - (\Sigma x)^2}$$

$$b = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{}$$

$$b = \qquad n(\sum x^2) - (\sum x)^2$$

- $\sum x$ ⟶ sum of x values
- $\sum y$ ⟶ sum of y values
- $\sum x^2$ ⟶ sum of squard x values
- $\sum xy$ ⟶ sum of xy products
- $(\sum x)^2$ ⟶ sum of x values squared

nPr - Permutations

Formula

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

- $^{n}P_{r}$ ⟶ permutation
- n ⟶ total number of objects
- r ⟶ number of objects taken at a time

nCr - Combinations

Formula

$$^nC_r = \frac{^nP_r}{r!}$$

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

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

^nC_r ⟶ combinations

^nP_r ⟶ permutations

n ⟶ total number of objects

r ⟶ number of objects taken at a time

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Normal Distribution

Formula

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

$f(x,\mu,\sigma)$	→	normal probability density distribution
μ	→	mean of x_i
σ	→	standard deviation of x_i
π	→	3.14159
e	→	exponential constant = 2.71828

Binomial Distribution

Formula

$$P(X) = {}^{n}C_{r}\, p^{r}\, q^{(n-r)}$$

$$P(X) = \frac{n!}{r!(n-r)!}\, p^{r}\, q^{(n-r)}$$

- n → total number of trails
- r → number of success
- p → probability of success
- q → probability of failure
- $P(X)$ → Binomial probability function

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Negative Binomial Distribution

Formula

$$P(X=n \mid r,p) = {}^{n-1}C_{r-1}\, p^{r} (1 - p)^{(n-r)}$$

$P(X=n \mid r,p)$ → Negative binomial distribution

n → total number of trails

r → r^{th} success (an integer)

X → random variable

p → probability of success

Poisson Distribution

Formula

$$p(x,\mu) = \frac{(e^{-\mu})(\mu^{x})}{x!}$$

$p(x,\mu)$ → poisson probability

x → actual number of successes occured in specified region

μ → mean number of successes occured in specified region

e → exponential constant = 2.71828

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Exponential Distribution

Formula

General Formula:

$$f(x) = \frac{1}{\beta} e^{-(x-\mu)/\beta} \quad \text{where } x \geq \mu;\ \beta > 0$$

$$f(x) = \lambda e^{-\lambda(x-\mu)} \quad \text{where } \lambda = \frac{1}{\beta}$$

Standard Exponential Distribution :

$$f(x) = \lambda e^{-x} \quad \text{where } \mu = 0;\ \beta = 1;$$

Cummulative Exponential Distribution :

$$f(x) = 1 - e^{-x/\beta} \quad \text{where } x > 0;\ \beta > 0;\ \mu = 0$$

$f(x)$ ⟶ exponential probability distribution

μ ⟶ mean of x_i

λ ⟶ average rate parameter

e ⟶ exponential constant = 2.71828

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T Distribution

Formula

$$t\text{ - score} = \frac{(\bar{x} - \mu)}{\frac{\sigma}{\sqrt{n}}}$$

t - score ⟶ T - distribution score

$\bar{x}$ ⟶ sample size

μ ⟶ mean

$\frac{\sigma}{\sqrt{n}}$ ⟶ standard error

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Margin of Error

Formula

$$MOE = Z \frac{\sigma}{\sqrt{n}}$$

MOE = critical value x standard error

Z → critical value

$\frac{\sigma}{\sqrt{n}}$ → standard error

σ → standard deviation

n → sample size

MOE → margin of error

Anova

Formula

$$F = \frac{MSE}{MST}$$

F ⟶ ANOVA coefficient

MST ⟶ mean sum of squares due to treatment

MSE ⟶ mean sum of squares due to error

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CHI-squared Distribution

Formula

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

χ^2 ⟶ Chi - squared distributions

O_i ⟶ observed frequencies

E_i ⟶ expected frequencies

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Population Variance

Formula

$$\sigma_n^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}$$

σ_n^2 → population variance

$\bar{x}$ → population mean

n → population size

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Population Variance Estimation

Formula

$$\sigma_{n-1}^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}$$

σ_{n-1}^2 → population variance estimation

$\bar{x}$ → sample mean

n → sample size

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