

User's Manual

STAT
Version 1.9.7

Statistics and probability tools for Windows

Windows XP® - Windows Vista® - Windows 7® - Windows 8® - Windows 10®



INDEX

Introduction.....	3
Terms of use.....	3
Formats for input values.....	4
Types of calculations.....	4
Hypothesis testing.....	4
Confidence interval estimation.....	5
Probability distributions.....	5
One variable statistics.....	6
Two variables statistics.....	6
Total Probability Law and Bayes' Theorem.....	7
Probability of two events A and B.....	7
Formulae of Probability distributions.....	8
Formulae of Confidence interval estimation.....	11
Formulae of Hypothesis testing.....	13
Formulae of One variable statistics	22
Formulae of Two variables statistics.....	24
Formulae of Total Probability Law and Bayes' Theorem.....	25
Formulae of Probability of two events A and B	26
Specifications.....	27
Registered trademarks.....	28

Introduction

StaTool is a Windows application for Statistics and Probability calculations.

StaTool performs 7 types of Statistics and Probability calculations:
Hypothesis testing, Confidence interval estimation, Probability distributions,
One variable statistics, Two variables statistics, Total Probability Law and Bayes' Theorem,
Probability of A and B events

Please, read this manual carefully in order to learn all the capabilities of the application.

Terms of use

In no event shall VaxaSoftware be liable to anyone for direct, indirect, special, collateral, incidental, or consequential damages by the use or impossibility of use of the software, nor by the effects in the operation of other software or the operating system.

Before the installation we recommended to make backup of your data and create a restoration point.

You will be able freely to evaluate the software during the time that considers necessary. Passed this period of evaluation you would have or to register it or uninstall it.

To register the software, please see the option "REGISTER APPLICATION" in the help menu of the software.

After paying the registry fee you will receive by email the REGISTRATION KEY of the software.
Once registered the software, it will be able to use the options that were disabled until that moment.

The REGISTRATION KEY is UNIQUE for EACH COMPUTER.

You cannot use the same REGISTRATION KEY for multiple computers.

You can freely distribute unaltered copies of the installation system of the software to other users.
You cannot decompile the software nor use no type of reverse engineer for its analysis or modification.
You cannot use part or the totality of the software to create a new software.

COOKIES

Our site www.vaxasoftware.com does not use cookies.

Conflicts of shared files:

VaxaSoftware assumes no liability for conflicts due to the incompatibility of shared files (*.dll, *.ocx and other files).

VaxaSoftware's software use shared files (*.dll, *.ocx and other files).

It is possible that the shared file already exists and whether or not previously replaced by a different version during the installation of the VaxaSoftware's software.

This can cause the installed software may not work and/or a third party software that shares the same file does not.

Also the installation of a third party software can cause the VaxaSoftware's software or third party software may not work correctly.

VaxaSoftware will try to resolve these conflicts in a reasonable manner, despite its satisfactory resolution is not guaranteed.

Design, products, specifications, and prices are for information purposes only. VaxaSoftware reserves the right to change or modify design, products, specifications, and prices at any time without prior notice.

Formats for input values

The numeric values can be entered in the following formats:

- Standard numbers: 0.24; 15.23
- Percentage: 90%; 12%
- Fractions: 2/3; 5/8
- Scientific notation: 2E-4 (equal to $2 \times 10^{-4} = 0.0002$)

The decimal separator is a POINT.

Even, if you enter a COMMA, a POINT is entered instead.

Types of calculations

StaTool features 7 types of Statistics and Probability calculations:

- Hypothesis testing.
- Confidence interval estimation.
- Probability distributions.
- One variable statistics.
- Two variables statistics.
- Total Probability Law and Bayes' Theorem.
- Probability of A and B events.

We have to press the relevant label in the main window in order to access to each calculation type.

Hypothesis testing

Allows us to test a population statistics using sample statistics.

Always, we have to enter the confidence level or the significance level.

Hypothesis testing can be two-sided, left side or right side.

StaTool has 9 types of Hypothesis testing:

One population:

- 1) Mean of population (known population variance).
- 2) Mean of population (unknown population variance).
- 3) Variance of population.
- 4) Ratio of population.

Two populations:

- 5) Mean difference of two populations (known population variances).
- 6) Mean difference of two populations (unknown and equal population variances).
- 7) Mean difference of two populations (unknown and different population variances).
- 8) Variance ratio of two populations.
- 9) Ratio difference of two populations.

Confidence interval estimation

Allows us estimate the Confidence Interval of a population statistics using sample statistics.

Always, we have to enter the confidence level or the significance level.

StaTool has 9 types of Confidence Intervals:

One population:

- 1) Mean of population (known population variance).
- 2) Mean of population (unknown population variance).
- 3) Variance of population.
- 4) Ratio of population.

Two populations:

- 5) Mean difference of two populations (known population variances).
- 6) Mean difference of two populations (unknown and equal population variances).
- 7) Mean difference of two populations (unknown and different population variances).
- 8) Variance ratio of two populations.
- 9) Ratio difference of two populations.

Probability distributions

For each probability distribution, we can calculate the percentage point or the probability (*).

Probability can be left cumulative, right cumulative, interval, centered interval or point.

StaTool has 6 types of probability distribution:

- 1) Normal.
- 2) t-Student.
- 3) Chi-Square.
- 4) F-Snedecor.
- 5) Binomial.
- 6) Poisson.

(*) In the Binomial or Poisson distribution, we can calculate only the probability, not the percentage point.

One variable statistics

Allows us to calculate statistical data for one numeric variable.

Data can be ungrouped or grouped (intervals or classes).

StaTool calculates the following statistical data:

- 1) Mean.
- 2) Median.
- 3) Mode.
- 4) Standard deviation.
- 5) Variance.
- 6) Coefficient of variation.
- 7) Skewness.
- 8) Kurtosis.
- 9) Moments (0th to 4th, about mean and origin).
- 10) Quartiles, deciles and percentiles and his inverses.
- 11) Graphic (bar and histogram chart) and printing.

- We can save and open data as a file (E1V extension).

- Also, we can print data and results.

Two variables statistics

Allows us to calculate statistical data for two numeric variables X and Y.

We can calculate 5 types of functions for regression analysis using the least squared method:

- 1) Linear
- 2) Logarithmic
- 3) Exponential
- 4) Power
- 5) Quadratic

StaTool calculates the following statistical data:

- 1) Means of X and Y.
- 2) Standard deviations of X and Y.
- 3) Variances of X and Y.
- 4) Covariance.
- 5) Coefficient of correlation.
- 6) Formula of regression curve.
- 7) Estimation of X or Y.
- 8) Graphic (scatter plot and regression curve) and printing.

- We can save and open data as a file (E2V extension).

- Also, we can print data and results.

Total Probability Law and Bayes' Theorem

We have a set of incompatible A_i events as a finite partition of the probability space.
Also, we have the event B that is compatible with each A_i .

If we know the probabilities $p(A_i)$ and $p(B / A_i)$, then StaTool calculates $p(B)$ and $p(A_i / B)$

Probability of two events A and B

For A and B events, we can calculate some probability values when we know some other probability values:

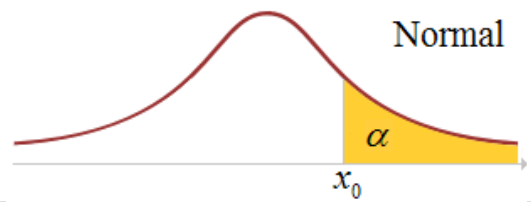
We have to know some of the following values of probability:

$p(A)$	$p(\bar{A})$
$p(B)$	$p(\bar{B})$
$p(A \cap B)$	$p(\overline{A \cap B})$
$p(A \cup B)$	$p(\overline{A \cup B})$
$p(\bar{A} \cap \bar{B})$	$p(\bar{A} \cup \bar{B})$
$p(A / B)$	$p(A - B)$
$p(B / A)$	$p(B - A)$

Formulae of Probability distributions

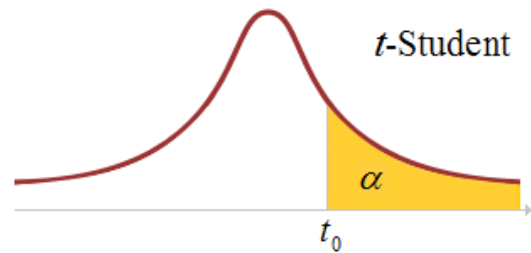
Normal distribution (Gauss)

$$\alpha = p(x \geq x_0) = \int_{x_0}^{\infty} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} dx$$



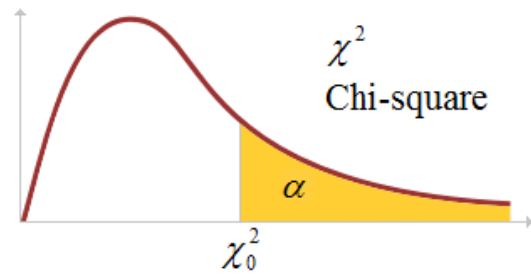
t-Student distribution (Gosset)

$$\alpha = p(t \geq t_0) = \int_{t_0}^{\infty} \frac{\Gamma\left(\frac{n+1}{2}\right) \left(1 + \frac{t^2}{n}\right)^{-\frac{n+1}{2}}}{\Gamma\left(\frac{n}{2}\right) \sqrt{n\pi}} dt$$



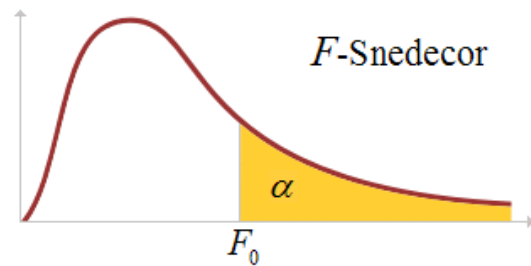
Chi-square distribution (Pearson)

$$\alpha = p(\chi^2 \geq \chi_0^2) = \int_{\chi_0^2}^{\infty} \frac{e^{-x/2} x^{n/2-1}}{2^{n/2} \Gamma(n/2)} dx$$



F distribution (Fisher-Snedecor)

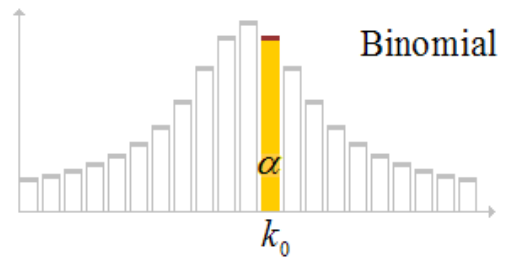
$$\alpha = p(F \geq F_0) = \int_{F_0}^{\infty} \frac{\Gamma\left(\frac{n_1+n_2}{2}\right) \left(\frac{n_1}{n_2}\right)^{\frac{n_1}{2}} F^{\frac{n_1}{2}-1}}{\Gamma\left(\frac{n_1}{2}\right) \Gamma\left(\frac{n_2}{2}\right) \left(1 + \frac{n_1}{n_2} F\right)^{\frac{n_1+n_2}{2}}} dF$$



Binomial distribution

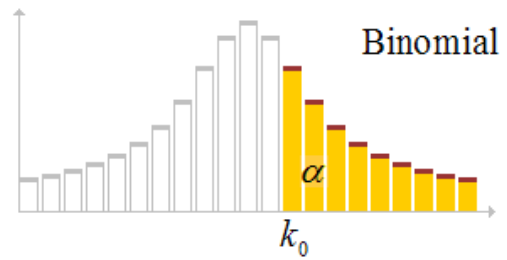
Probability at a point:

$$\alpha = p(x = k_0) = \binom{n}{k_0} p^{k_0} (1-p)^{n-k_0}$$



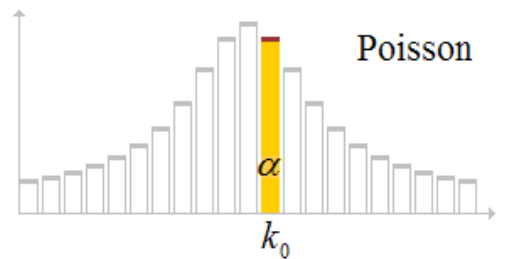
Upper cumulative probability:

$$\alpha = p(x \geq k_0) = \sum_{i=k_0}^n \binom{n}{i} p^i (1-p)^{n-i}$$

**Poisson distribution**

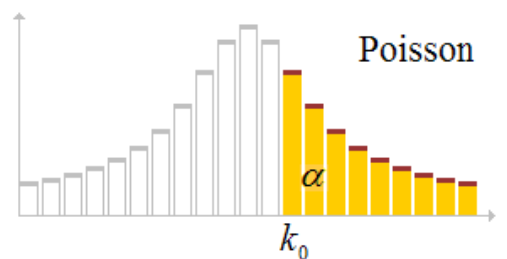
Probability at a point:

$$\alpha = p(x = k_0) = e^{-\lambda} \frac{\lambda^{k_0}}{k_0!}$$



Upper cumulative probability:

$$\alpha = p(x \geq k_0) = \sum_{n=k_0}^{\infty} e^{-\lambda} \frac{\lambda^n}{n!}$$



Where:

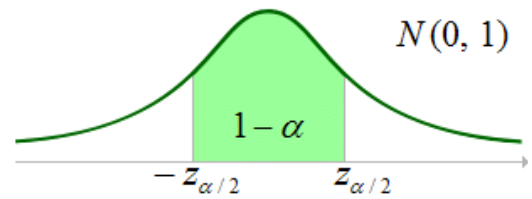
α	Probability
x	Random variable of Normal distribution
μ	Mean of Normal distribution
σ	Standard deviation of Normal distribution
x_0	Percentage point of Normal distribution
t	Random variable of t -Student distribution
n	Degrees of freedom of t -Student distribution
t_0	Percentage point of t -Student distribution
χ^2	Random variable of Chi-square distribution
n	Degrees of freedom of Chi-square distribution
χ_0^2	Percentage point of Chi-square distribution
F	Random variable of F -Snedecor distribution
n_1	Numerator degrees of freedom of F -Snedecor distribution
n_2	Denominator degrees of freedom of F -Snedecor distribution
F_0	Percentage point of F -Snedecor distribution
n	Number of trials in Binomial distribution
p	Probability of success for each alone event in Binomial distribution
x	Random variable of Binomial distribution
k_0	Percentage point of Binomial distribution
λ	(Lambda): Mean and standard deviation of Poisson distribution
x	Random variable of Poisson distribution
k_0	Percentage point of Poisson distribution

Formulae of Confidence interval estimation

Mean of population

(known population variance)

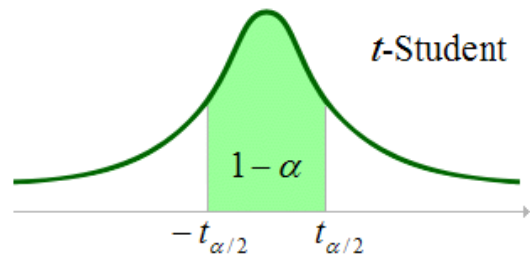
$$\mu \in \left(\bar{x} - z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}, \bar{x} + z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}} \right)$$



Mean of population

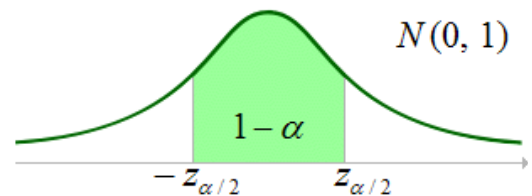
(unknown population variance)

$$\mu \in \left(\bar{x} - t_{\left(\frac{\alpha}{2}, n-1\right)} \frac{S}{\sqrt{n}}, \bar{x} + t_{\left(\frac{\alpha}{2}, n-1\right)} \frac{S}{\sqrt{n}} \right)$$



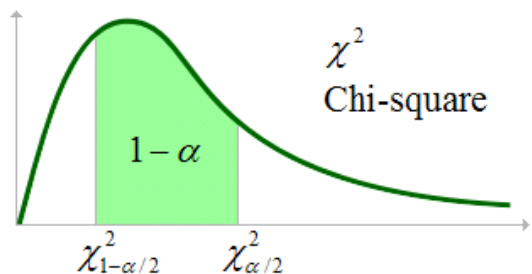
Ratio of population

$$p \in \left(\hat{p} - z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}, \hat{p} + z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \right)$$



Variance of population

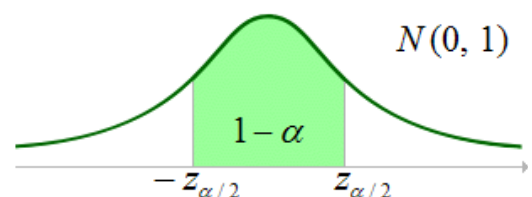
$$\sigma^2 \in \left(\frac{(n-1)S^2}{\chi^2_{\left(\frac{\alpha}{2}, n-1\right)}}, \frac{(n-1)S^2}{\chi^2_{\left(1-\frac{\alpha}{2}, n-1\right)}} \right)$$



Mean difference of two populations

(known population variances)

$$\mu_1 - \mu_2 \in \left(\bar{x}_1 - \bar{x}_2 \pm z_{\frac{\alpha}{2}} \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} \right)$$



Mean difference of two populations

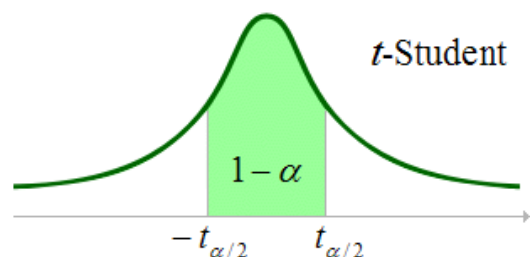
(unknown and equal population variances)

$$\mu_1 - \mu_2 \in \left(\bar{x}_1 - \bar{x}_2 \pm t_{\left(\frac{\alpha}{2}, n_1+n_2-2\right)} S_P \sqrt{\frac{1}{n_1} + \frac{1}{n_2}} \right)$$

Where:
$$S_P^2 = \frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1 + n_2 - 2}$$

(Pooled variance of the samples)

$$\sigma_1^2 = \sigma_2^2$$

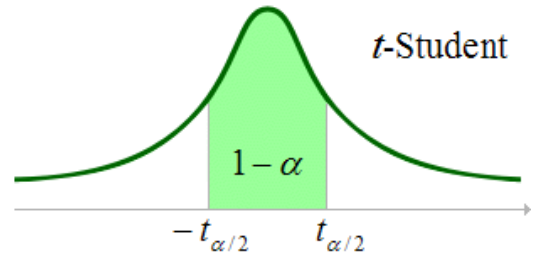


Mean difference of two populations
(unknown and different population variances)

$$\mu_1 - \mu_2 \in \left(\bar{x}_1 - \bar{x}_2 \pm t_{\left(\frac{\alpha}{2}, \nu\right)} \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}} \right)$$

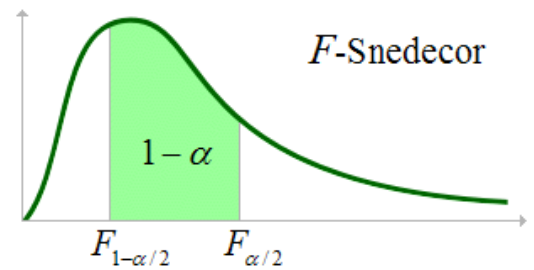
Where:
$$\nu \approx \frac{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^2}{\frac{\left(\frac{S_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{S_2^2}{n_2}\right)^2}{n_2 - 1}}, \quad \sigma_1^2 \neq \sigma_2^2$$

(Welch approximation)



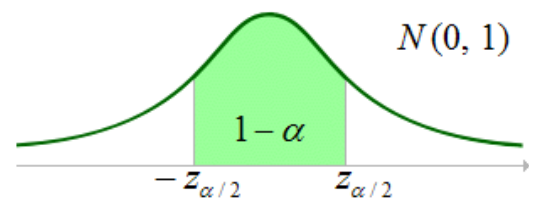
Variance ratio of two populations

$$\frac{\sigma_1^2}{\sigma_2^2} \in \left(\frac{S_1^2}{S_2^2} F_{\left(1-\frac{\alpha}{2}, n_2-1, n_1-1\right)}, \frac{S_1^2}{S_2^2} F_{\left(\frac{\alpha}{2}, n_2-1, n_1-1\right)} \right)$$



Ratio difference of two populations

$$p_1 - p_2 \in \left(\hat{p}_1 - \hat{p}_2 \pm z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}} \right)$$

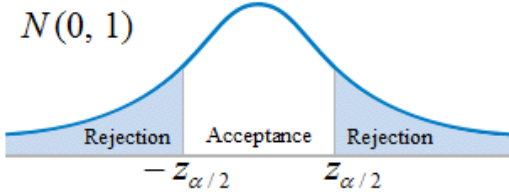
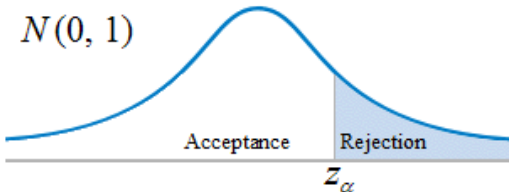
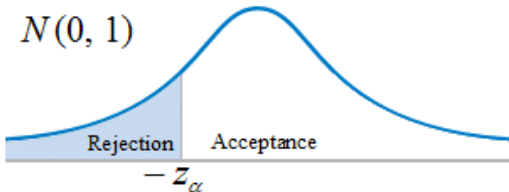


Where:

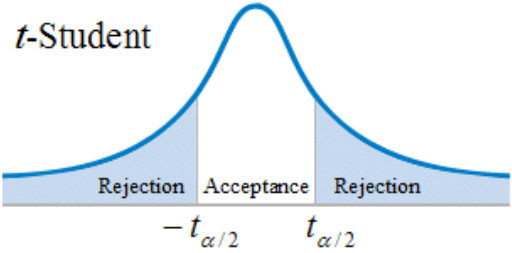
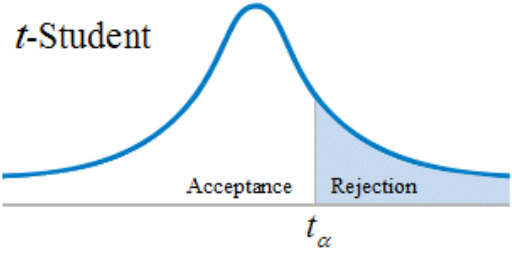
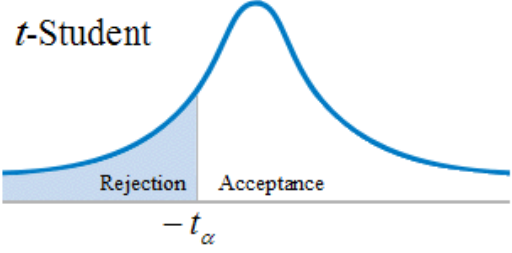
μ	Mean of the population
\bar{x}	Mean of the sample
σ	Standard deviation of the population
S	Standard deviation of the sample
p	Ratio of the population
\hat{p}	Ratio of the sample
n	Sample size
α	Significance level
$1 - \alpha$	Confidence level
$z_{\frac{\alpha}{2}}$	Percentage point of the Normal distribution with an upper cumulative probability of $\frac{\alpha}{2}$
$t_{(\alpha, \nu)}$	Percentage point of the t-Student distribution with an upper cumulative probability α and ν degrees of freedom.
$\chi^2_{(\alpha, \nu)}$	Percentage point of the Chi-square distribution with an upper cumulative probability α and ν degrees of freedom.
$F_{(\alpha, \nu_1, \nu_2)}$	Percentage point of F-Snedecor distribution with an upper cumulative probability α and ν_1 and ν_2 degrees of freedom

Formulae of Hypothesis testing

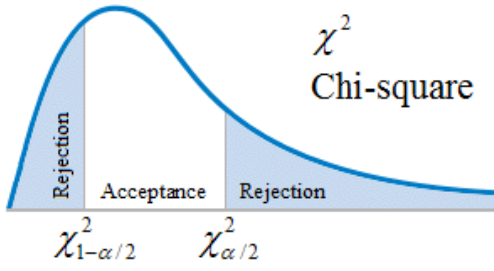
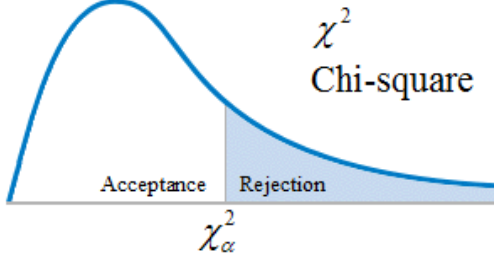
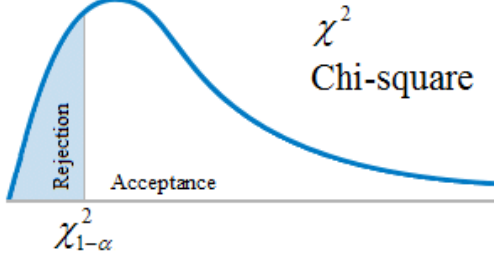
Mean of population (known population variance)

<p>Two-sided: $H_0: \mu = \mu_0$ $H_1: \mu \neq \mu_0$</p>	<p>Reject H_0 if: $z_0 \notin \left(-z_{\alpha/2}, z_{\alpha/2} \right)$</p> <p>Where $z_0 = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$</p> <p>The statistic z_0 follows a normal distribution $N(0, 1)$.</p>	<p>$N(0, 1)$</p> 
<p>Right side: $H_0: \mu \leq \mu_0$ $H_1: \mu > \mu_0$</p>	<p>Reject H_0 if: $z_0 > z_{\alpha}$</p>	<p>$N(0, 1)$</p> 
<p>Left side: $H_0: \mu \geq \mu_0$ $H_1: \mu < \mu_0$</p>	<p>Reject H_0 if: $z_0 < -z_{\alpha}$</p>	<p>$N(0, 1)$</p> 

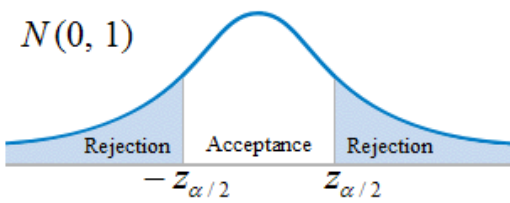
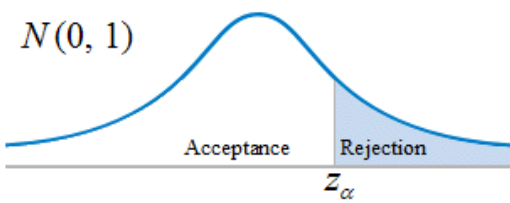
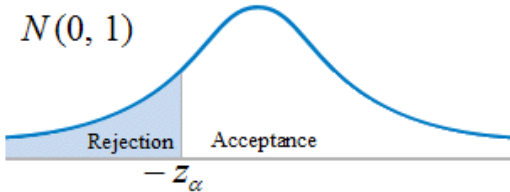
Mean of population (unknown population variance)

<p>Two-sided: $H_0: \mu = \mu_0$ $H_1: \mu \neq \mu_0$</p>	<p>Reject H_0 if: $t_0 \notin \left(-t_{\left(\frac{\alpha}{2}, n-1\right)}, t_{\left(\frac{\alpha}{2}, n-1\right)} \right)$</p> <p>Where $t_0 = \frac{\bar{x} - \mu_0}{S/\sqrt{n}}$</p> <p>The statistic t_0 follows a t-Student distribution with $n-1$ degrees of freedom.</p>	<p>t-Student</p> 
<p>Right side: $H_0: \mu \leq \mu_0$ $H_1: \mu > \mu_0$</p>	<p>Reject H_0 if: $t_0 > t_{(\alpha, n-1)}$</p>	<p>t-Student</p> 
<p>Left side: $H_0: \mu \geq \mu_0$ $H_1: \mu < \mu_0$</p>	<p>Reject H_0 if: $t_0 < -t_{(\alpha, n-1)}$</p>	<p>t-Student</p> 

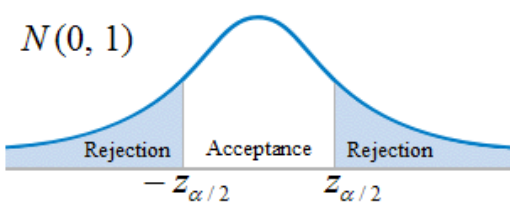
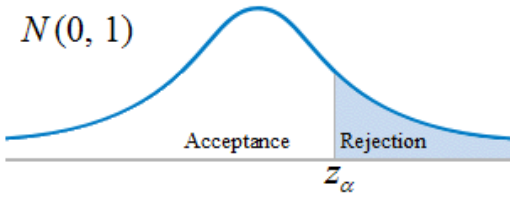
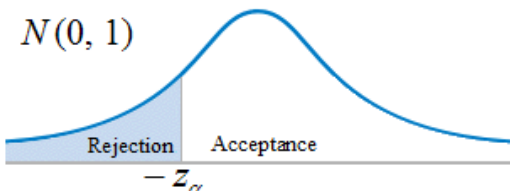
Variance of population

<p>Two-sided: $H_0: \sigma^2 = \sigma_0^2$ $H_1: \sigma^2 \neq \sigma_0^2$</p>	<p>Reject H_0 if: $\chi_0^2 \notin \left(\chi_{(1-\frac{\alpha}{2}, n-1)}^2, \chi_{(\frac{\alpha}{2}, n-1)}^2 \right)$</p> <p>Where $\chi_0^2 = \frac{(n-1)S^2}{\sigma_0^2}$</p> <p>The statistic χ_0^2 follows a Chi-square distribution with $n-1$ degrees of freedom.</p>	 <p style="text-align: right;">χ^2 Chi-square</p>
<p>Right side: $H_0: \sigma^2 \leq \sigma_0^2$ $H_1: \sigma^2 > \sigma_0^2$</p>	<p>Reject H_0 if: $\chi_0^2 > \chi_{(\alpha, n-1)}^2$</p>	 <p style="text-align: right;">χ^2 Chi-square</p>
<p>Left side: $H_0: \sigma^2 \geq \sigma_0^2$ $H_1: \sigma^2 < \sigma_0^2$</p>	<p>Reject H_0 if: $\chi_0^2 < \chi_{(1-\alpha, n-1)}^2$</p>	 <p style="text-align: right;">χ^2 Chi-square</p>

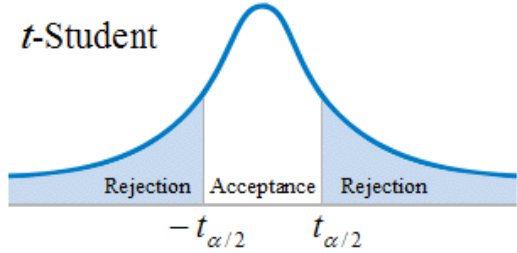
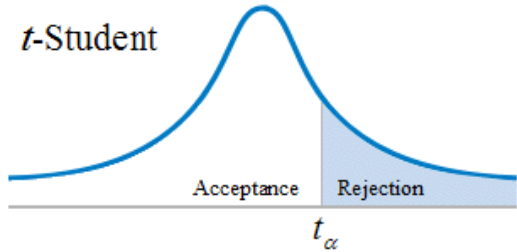
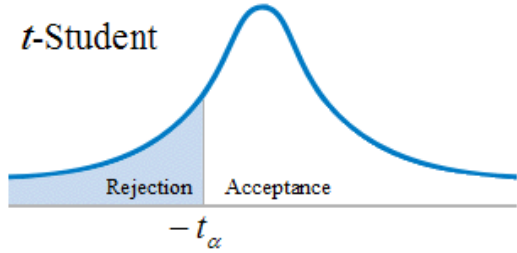
Ratio of population

<p>Two-sided: $H_0: p = p_0$ $H_1: p \neq p_0$</p>	<p>Reject H_0 if: $z_0 \notin \left(-z_{\frac{\alpha}{2}}, z_{\frac{\alpha}{2}} \right)$</p> <p>Where $z_0 = \frac{n \hat{p} - n p_0}{\sqrt{n p_0 (1 - p_0)}}$</p> <p>The statistic z_0 follows a normal distribution $N(0, 1)$.</p>	 <p>A normal distribution curve $N(0, 1)$ with the central area between $-z_{\alpha/2}$ and $z_{\alpha/2}$ labeled 'Acceptance'. The two tail areas beyond these points are shaded and labeled 'Rejection'.</p>
<p>Right side: $H_0: p \leq p_0$ $H_1: p > p_0$</p>	<p>Reject H_0 if: $z_0 > z_\alpha$</p>	 <p>A normal distribution curve $N(0, 1)$ with the area to the right of z_α shaded and labeled 'Rejection'. The area to the left is labeled 'Acceptance'.</p>
<p>Left side: $H_0: p \geq p_0$ $H_1: p < p_0$</p>	<p>Reject H_0 if: $z_0 < -z_\alpha$</p>	 <p>A normal distribution curve $N(0, 1)$ with the area to the left of $-z_\alpha$ shaded and labeled 'Rejection'. The area to the right is labeled 'Acceptance'.</p>

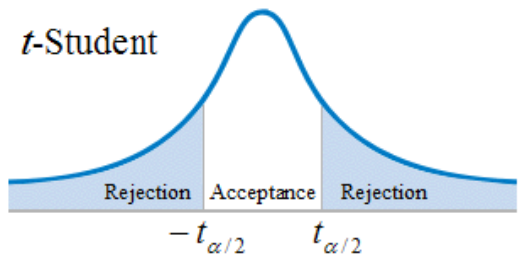
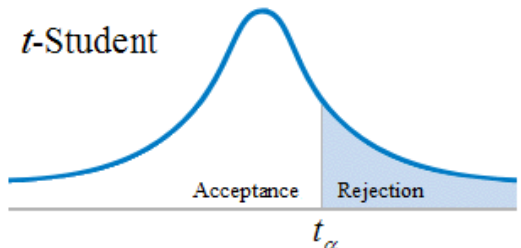
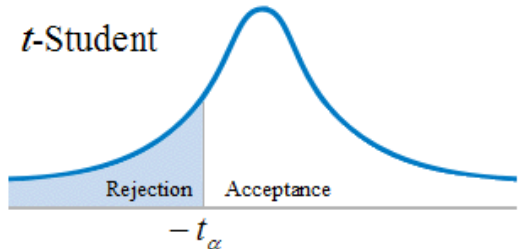
Mean difference of two populations (known population variances)

<p>Two-sided: $H_0: \mu_1 - \mu_2 = \Delta_0$ $H_1: \mu_1 - \mu_2 \neq \Delta_0$</p> <p>($\sigma_1^2 \neq \sigma_2^2$)</p>	<p>Reject H_0 if: $z_0 \notin \left(-z_{\frac{\alpha}{2}}, z_{\frac{\alpha}{2}} \right)$</p> <p>Where $z_0 = \frac{\bar{x}_1 - \bar{x}_2 - \Delta_0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$</p> <p>The statistic z_0 follows a normal distribution $N(0, 1)$.</p>	 <p>A normal distribution curve $N(0, 1)$ with the central area between $-z_{\alpha/2}$ and $z_{\alpha/2}$ labeled 'Acceptance'. The two tail areas beyond these points are shaded and labeled 'Rejection'.</p>
<p>Right side: $H_0: \mu_1 - \mu_2 \leq \Delta_0$ $H_1: \mu_1 - \mu_2 > \Delta_0$</p>	<p>Reject H_0 if: $z_0 > z_\alpha$</p>	 <p>A normal distribution curve $N(0, 1)$ with the area to the right of z_α shaded and labeled 'Rejection'. The area to the left is labeled 'Acceptance'.</p>
<p>Left side: $H_0: \mu_1 - \mu_2 \geq \Delta_0$ $H_1: \mu_1 - \mu_2 < \Delta_0$</p>	<p>Reject H_0 if: $z_0 < -z_\alpha$</p>	 <p>A normal distribution curve $N(0, 1)$ with the area to the left of $-z_\alpha$ shaded and labeled 'Rejection'. The area to the right is labeled 'Acceptance'.</p>

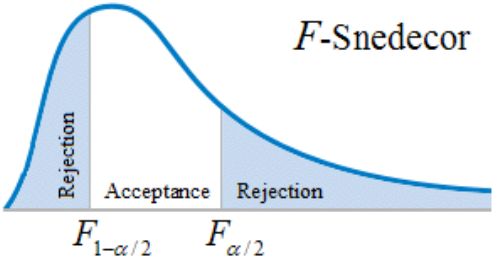
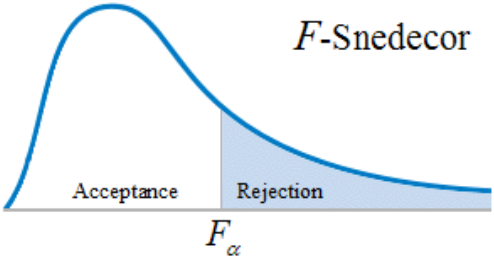
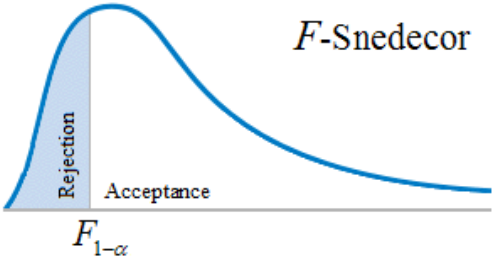
Mean difference of two populations (unknown and equal population variances)

<p>Two-sided: $H_0: \mu_1 - \mu_2 = \Delta_0$ $H_1: \mu_1 - \mu_2 \neq \Delta_0$ $(\sigma_1^2 = \sigma_2^2)$</p>	<p>Reject H_0 if: $t_0 \notin \left(-t_{\left(\frac{\alpha}{2}, n_1+n_2-2\right)}, t_{\left(\frac{\alpha}{2}, n_1+n_2-2\right)} \right)$ Where $t_0 = \frac{\bar{x}_1 - \bar{x}_2 - \Delta_0}{S_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$ $S_p^2 = \frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2}$ (Pooled variance of the samples) The statistic t_0 follows a t-Student distribution with $n_1 + n_2 - 2$ degrees of freedom.</p>	<p>t-Student</p> 
<p>Right side: $H_0: \mu_1 - \mu_2 \leq \Delta_0$ $H_1: \mu_1 - \mu_2 > \Delta_0$</p>	<p>Reject H_0 if: $t_0 > t_{(\alpha, n_1+n_2-2)}$</p>	<p>t-Student</p> 
<p>Left side: $H_0: \mu_1 - \mu_2 \geq \Delta_0$ $H_1: \mu_1 - \mu_2 < \Delta_0$</p>	<p>Reject H_0 if: $t_0 < -t_{(\alpha, n_1+n_2-2)}$</p>	<p>t-Student</p> 

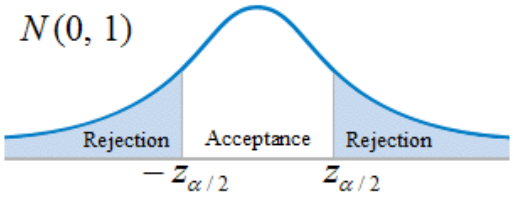
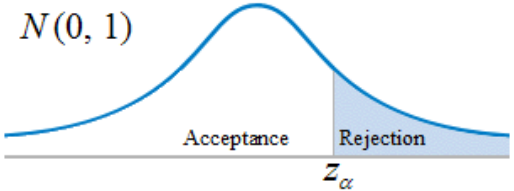
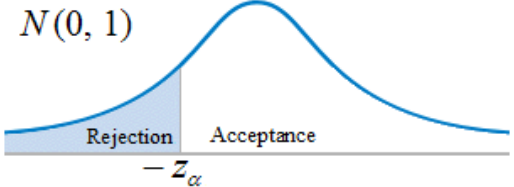
Mean difference of two populations (unknown and different population variances)

<p>Two-sided: $H_0: \mu_1 - \mu_2 = \Delta_0$ $H_1: \mu_1 - \mu_2 \neq \Delta_0$ $(\sigma_1^2 \neq \sigma_2^2)$</p>	<p>Reject H_0 if: $t_0 \notin \left(-t_{\left(\frac{\alpha}{2}, \nu\right)}, t_{\left(\frac{\alpha}{2}, \nu\right)} \right)$ Where $t_0 = \frac{\bar{x}_1 - \bar{x}_2 - \Delta_0}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$ $\nu = \frac{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^2}{\frac{\left(\frac{S_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{S_2^2}{n_2}\right)^2}{n_2 - 1}}$ (Welch approximation) The statistic t_0 follows a t-Student distribution with ν degrees of freedom.</p>	<p>t-Student</p> 
<p>Right side: $H_0: \mu_1 - \mu_2 \leq \Delta_0$ $H_1: \mu_1 - \mu_2 > \Delta_0$</p>	<p>Reject H_0 if: $t_0 > t_{(\alpha, \nu)}$</p>	<p>t-Student</p> 
<p>Left side: $H_0: \mu_1 - \mu_2 \geq \Delta_0$ $H_1: \mu_1 - \mu_2 < \Delta_0$</p>	<p>Reject H_0 if: $t_0 < -t_{(\alpha, \nu)}$</p>	<p>t-Student</p> 

Variance ratio of two populations

<p>Two-sided: $H_0: \sigma_1^2 = \sigma_2^2$ $H_1: \sigma_1^2 \neq \sigma_2^2$</p>	<p>Reject H_0 if: $F_0 \notin \left(F_{\left(1-\frac{\alpha}{2}, n_1-1, n_2-1\right)}, F_{\left(\frac{\alpha}{2}, n_1-1, n_2-1\right)} \right)$ Where $F_0 = \frac{S_1^2}{S_2^2}$</p> <p>The statistic F_0 follows a F-Snedecor distribution with n_1-1 and n_2-1 degrees of freedom.</p>	 <p style="text-align: right;">F-Snedecor</p>
<p>Right side: $H_0: \sigma_1^2 \leq \sigma_2^2$ $H_1: \sigma_1^2 > \sigma_2^2$</p>	<p>Reject H_0 if: $F_0 > F_{(\alpha, n_1-1, n_2-1)}$</p>	 <p style="text-align: right;">F-Snedecor</p>
<p>Left side: $H_0: \sigma^2 \geq \sigma_0^2$ $H_1: \sigma^2 < \sigma_0^2$</p>	<p>Reject H_0 if: $F_0 < F_{(1-\alpha, n_1-1, n_2-1)}$</p>	 <p style="text-align: right;">F-Snedecor</p>

Ratio difference of two populations

<p>Two-sided: $H_0: p_1 = p_2$ $H_1: p_1 \neq p_2$</p>	<p>Reject H_0 if: $z_0 \notin \left(-z_{\frac{\alpha}{2}}, z_{\frac{\alpha}{2}} \right)$</p> <p>Where</p> $z_0 = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$ $\hat{p} = \frac{n_1 \hat{p}_1 + n_2 \hat{p}_2}{n_1 + n_2}$ <p>The statistic z_0 follows a normal distribution $N(0, 1)$.</p>	
<p>Right side: $H_0: p_1 \leq p_2$ $H_1: p_1 > p_2$</p>	<p>Reject H_0 if: $z_0 > z_{\alpha}$</p>	
<p>Left side: $H_0: p_1 \geq p_2$ $H_1: p_1 < p_2$</p>	<p>Reject H_0 if: $z_0 < -z_{\alpha}$</p>	

Where:

$1 - \alpha$	Confidence level
α	Significance level
H_0	Null hypothesis
H_1	Alternative hypothesis
μ	Mean of the population
\bar{x}	Mean of the sample
σ	Standard deviation of the population
S	Standard deviation of the sample
p	Ratio of the population
\hat{p}	Ratio of the sample
n	Sample size
z_0	Statistic that follows a normal distribution $N(0, 1)$
t_0	Statistic that follows a t -Student distribution
F_0	Statistic that follows a F -Snedecor distribution
χ_0^2	Statistic that follows a Chi-square distribution
z_α	Percentage point of the Normal distribution with an upper cumulative probability of α
$t_{(\alpha, \nu)}$	Percentage point of the t -Student distribution with an upper cumulative probability α and ν degrees of freedom.
$\chi_{(\alpha, \nu)}^2$	Percentage point of the Chi-square distribution with an upper cumulative probability α and ν degrees of freedom.
$F_{(\alpha, \nu_1, \nu_2)}$	Percentage point of F -Snedecor distribution with an upper cumulative probability α and ν_1 and ν_2 degrees of freedom

Formulae of One variable statistics

Mean	$\bar{x} = \frac{\sum x_i n_i}{N}$
Variance (s^2) and standard deviation (s)	$s^2 = \frac{\sum x_i^2 n_i}{N} - \bar{x}^2; \quad s = \sqrt{\frac{\sum x_i^2 n_i}{N} - \bar{x}^2}$
Coefficient of variation	$CV = \frac{s}{ \bar{x} }$
Percentiles	$P_k = L + a \frac{\frac{k \cdot N}{100} - N_{i-1}}{n_i}$
Deciles	$D_k = L + a \frac{\frac{k \cdot N}{10} - N_{i-1}}{n_i}$
Quartiles	$Q_k = L + a \frac{\frac{k \cdot N}{4} - N_{i-1}}{n_i}$
Median	$Me = L + a \frac{\frac{N}{2} - N_{i-1}}{n_i}, \quad Me = P_{50} = D_5 = Q_2$
Mode	$Mo = L + a \frac{\Delta_1}{\Delta_1 + \Delta_2} \quad \Delta_1 = n_i - n_{i-1}, \quad \Delta_2 = n_i - n_{i+1}$ <p>If intervals aren't the same width, density of frequency is used instead frequency.</p>
Moments	<p>About the mean: $m_k = \frac{\sum (x_i - \bar{x})^k n_i}{N}$</p> <p>About the origin: $a_k = \frac{\sum x_i^k n_i}{N}$</p>
Skewness	$g_1 = \frac{m_3}{s^3}$
Kurtosis	$g_2 = \frac{m_4}{s^4} - 3$

Where:

N	Number of items (size of the sample)
L	Left endpoint of the relevant interval
a	Width of the relevant interval
N_{i-1}	Cumulative frequency of the previous interval
n_i	Frequency of the relevant interval
n_{i-1}	Frequency of the previous interval
n_{i+1}	Frequency of the next interval

Formulae of Two variables statistics

Means	$\bar{x} = \frac{\sum x_i n_i}{N}; \quad \bar{y} = \frac{\sum y_i n_i}{N}$
Variances	$s_x^2 = \frac{\sum x_i^2 n_i}{N} - \bar{x}^2; \quad s_y^2 = \frac{\sum y_i^2 n_i}{N} - \bar{y}^2$
Covariance	$s_{xy}^2 = \frac{\sum x_i y_i n_i}{N} - \bar{x} \bar{y}$
Pearson coefficient of correlation	$r = \frac{s_{xy}}{s_x s_y}$
LINEAR regression	$y - \bar{y} = \frac{s_{xy}}{s_x^2} (x - \bar{x}) \quad \rightarrow \quad y = a + b x$
LOGARITHMIC regression	$y - \bar{y} = \frac{s_{\ln x y}}{s_{\ln x}^2} (\ln x - \overline{\ln x}) \quad \rightarrow \quad y = a + b \ln x$
EXPONENTIAL regression	$\ln y - \overline{\ln y} = \frac{s_{x \ln y}}{s_x^2} (x - \bar{x}) \quad \rightarrow \quad y = a \cdot b^x$
POWER regression	$\ln y - \overline{\ln y} = \frac{s_{\ln x \ln y}}{s_{\ln x}^2} (\ln x - \overline{\ln x}) \quad \rightarrow \quad y = a \cdot x^b$
QUADRATIC regression	$\rightarrow y = a x^2 + b x + c$

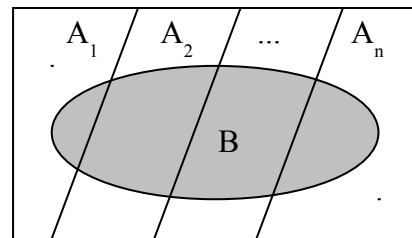
Formulae of Total Probability Law and Bayes' Theorem

Total Probability Law

$$P(B) = P(A_1) \cdot P(B / A_1) + P(A_2) \cdot P(B / A_2) + \dots + P(A_n) \cdot P(B / A_n)$$

Bayes' Theorem

$$P(A_i / B) = \frac{P(A_i) \cdot P(B / A_i)}{P(B)}$$



Formulae of probability of two events A and B

$$P(E)=1$$

$$P(\emptyset)=0$$

$$P(\bar{A}) = 1 - P(A)$$

$$P(\bar{B}) = 1 - P(B)$$

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

$$P(A \cap B) = P(A) \cdot P(B / A)$$

$$P(A \cap B) = P(B) \cdot P(A / B)$$

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

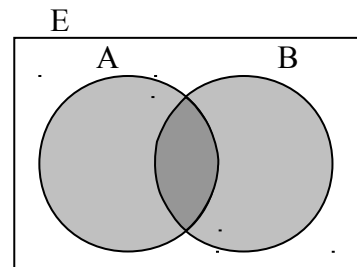
$$P(B - A) = P(B) - P(A \cap B)$$

$$P(\overline{A \cup B}) = P(\bar{A} \cap \bar{B})$$

$$P(\overline{A \cap B}) = P(\bar{A} \cup \bar{B})$$

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

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



Specifications

Description	StaTool. Application for Windows with capabilities of statistics and probability calculations.
Output precision	From 8 to 10 digits
Internal precision	16 digits.
Types of calculations:	7 types: <ul style="list-style-type: none">- Hypothesis testing- Confidence interval estimation- Probability distributions- One variable statistics- Two variables statistics- Total Probability Law and Bayes' Theorem- Probability of A and B events
Size	Width = 1024 pixels, height = 732 pixels.

Registered trademarks

- * VaxaSoftware and VaxaSoftware logo are trademarks of VaxaSoftware.
 - * Microsoft, Windows, Windows XP, Windows Vista, Windows 7, Windows 8, Windows 10 and logos of Windows XP, Windows Vista, and Windows 7 are registered trademarks or trademarks of Microsoft Corporation in the United States of America and/or other countries.
 - * Adobe, Adobe logo, PDF and Reader are registered trademarks or trademarks of Adobe Systems Incorporated in the United States of America and/or other countries.
 - * PayPal and PayPal logo are registered trademarks or trademarks of PayPal Inc. and/or eBay Inc. in the United States of America and/or other countries.
 - * YouTube and YouTube logo are registered trademarks or trademarks of YouTube LLC. and/or Google Inc. in the United States of America and/or other countries.
 - * Google and Google logo are registered trademarks or trademarks of Google Inc. in the United States of America and/or other countries.
 - * Visa and Visa logo are registered trademarks or trademarks of Visa Inc. in the United States of America and/or other countries.
 - * Amex, American Express, Amex logo and American Express logo are registered trademarks or trademarks of American Express Company in the United States of America and/or other countries.
 - * MasterCard and MasterCard logo are registered trademarks or trademarks of MasterCard Incorporated and/or MasterCard Worldwide in the United States of America and/or other countries.
- All the other product names, company names or logos on this site are either trademarks or registered trademarks of their respective owners.