Basic functions and examples of statistics & Six Sigma

The 3 versions of Visual-XSel 20:

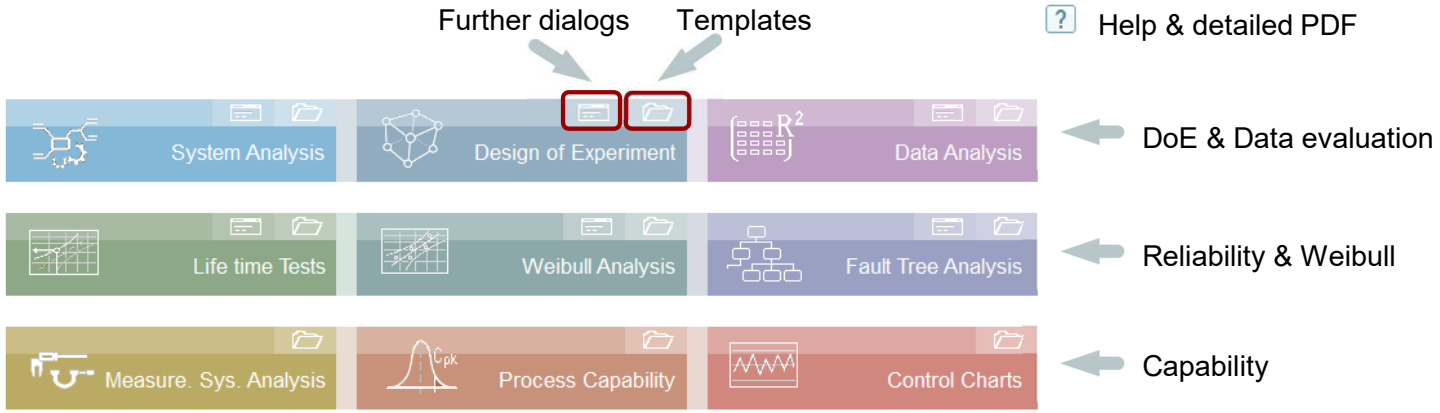
Standard (Home & privat)	**Weibull & DoE**	**Analyzer**
Entry-level version with statistics and Excel-extensions	Full statistics, Weibull-analyses, DoE and Process-Capability	Additionally up to 255 param. for data analysis and FTA

Detailed functions and price list: crgraph.de/downloads/software/Versions.pdf

The Main Guide shows three important statistical methods: DoE, Reliability and Capability analyses. A pre investigation for DoE is to find the relevant parameters with the System Analysis.

Most of the methods are available as templates. The calculation methods are open source, can be viewed and easily modified.


⇦ This icon starts the Main Guide



Detailed profiles with introduction to the methods and subsequent program descriptions can be found under the links shown

www.weibull.de/COM/System_Analysis.pdf

www.weibull.de/COM/Design_of_Experiment.pdf

www.weibull.de/COM/Data_Analysis.pdf

www.weibull.de/COM/Life_Time_Tests.pdf

www.weibull.de/COM/Weibull_Analysis.pdf

www.weibull.de/COM/Fault_Tree_Analysis.pdf

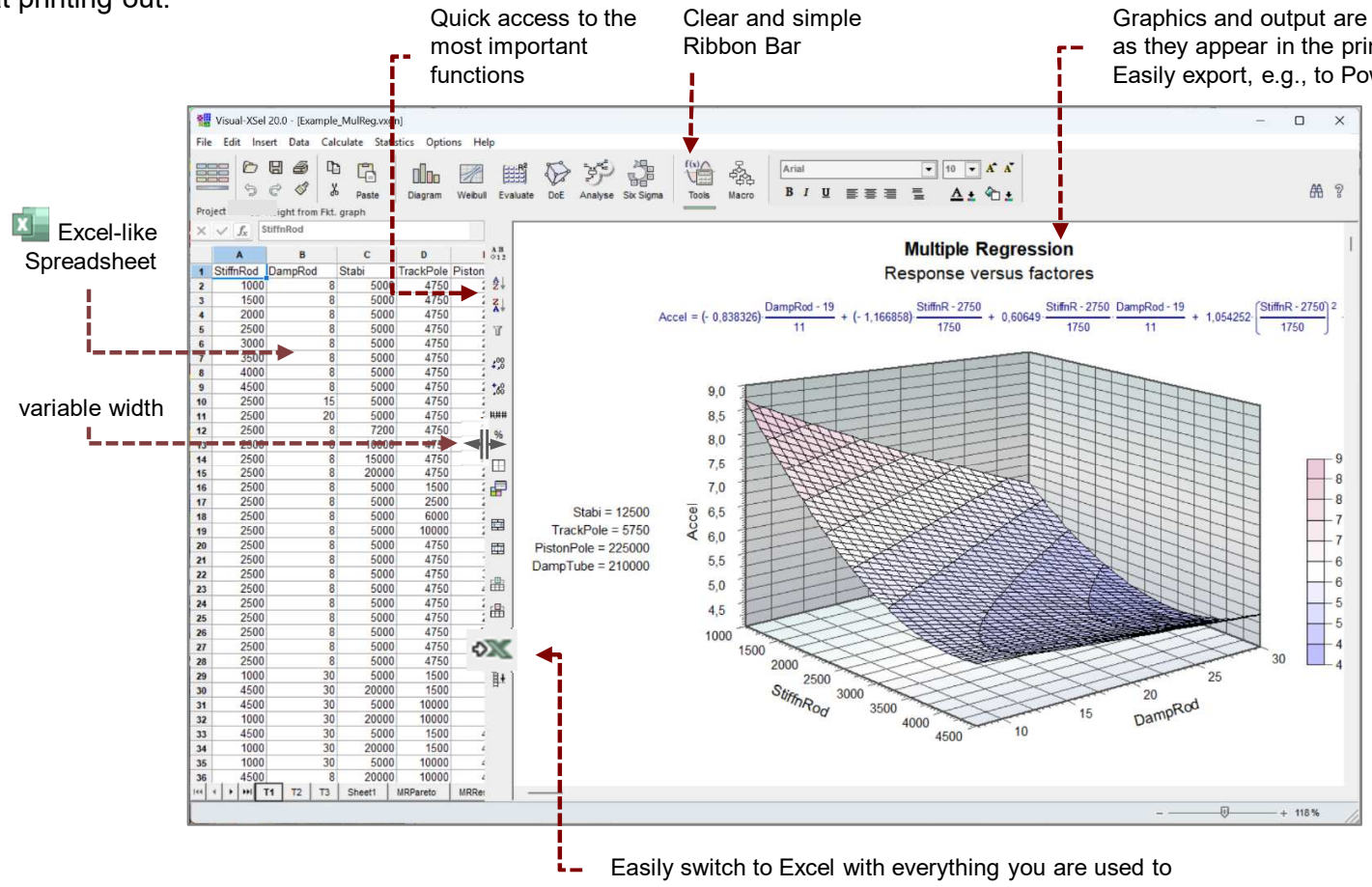
www.weibull.de/COM/Measurement_System_Analysis.pdf

www.weibull.de/COM/Process_Capability_Studies.pdf

www.weibull.de/COM/Control_Charts.pdf

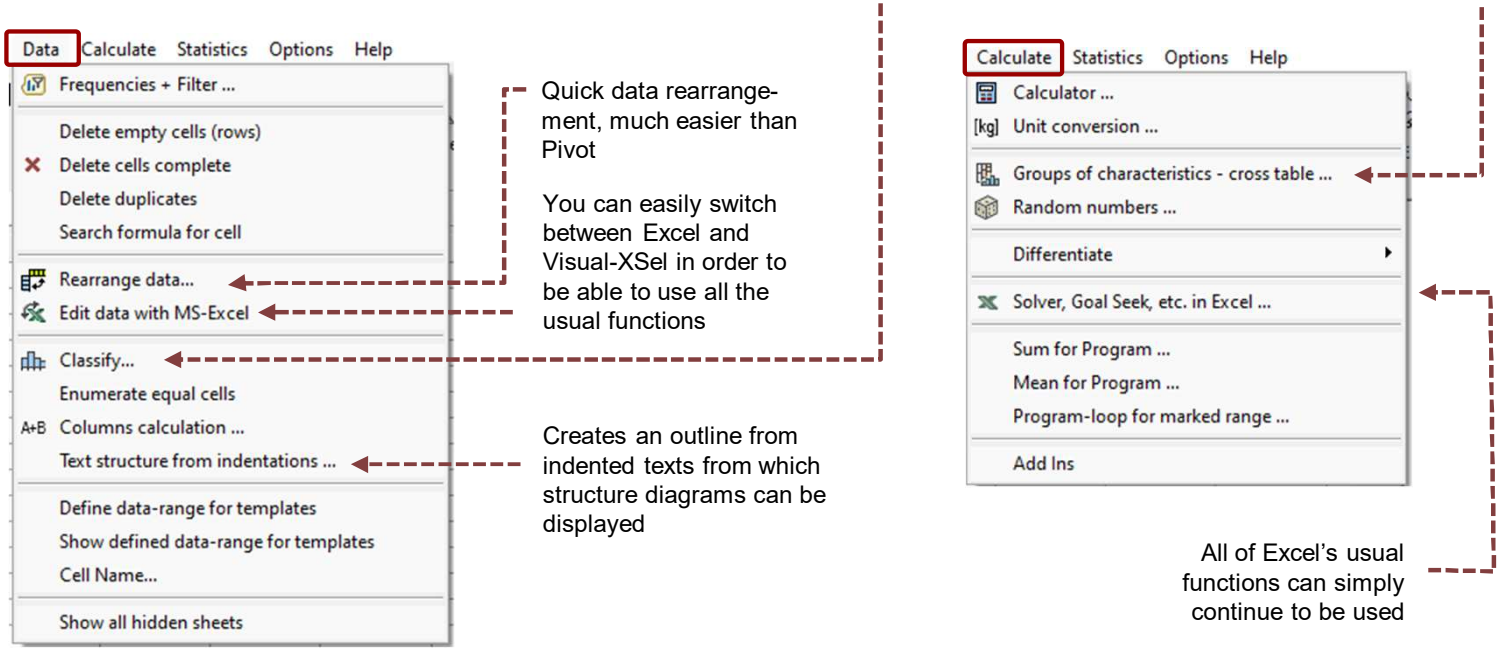
Data and representation

An Excel-like spreadsheet is available on the left, whose width is automatically aligned with the data, or can be adapted manually. On the right there is the main window for all diagrams, output etc. The representation is exact that what you get
at printing out.



Spreadsheet functions

There are powerful editing functions for the table, for example for classifying data or building groups for characteristics

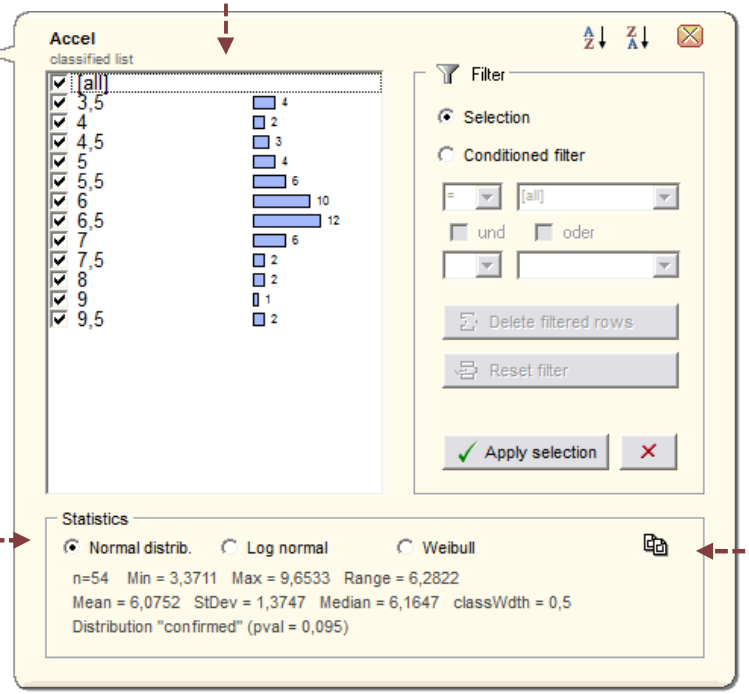


Filter & quick statistics

Click on the first row, or mark the column, a filter symbol appears

D	E	F	G	H	I
kPole	PistonPole	DampTube	Accel		
4750	210000	69000	9,49469		
4750	210000	69000	8,08628		
4750	210000	69000	7,23335		
4750	210000	69000	6,67517		
4750	210000	69000	6,28572		
4750	210000	69000	6,00264		
4750	210000	69000	5,78746		
4750	210000	69000	5,61431		
4750	210000	69000	6,18275		
4750	210000	69000	5,8643		
4750	210000	69000	6,67517		

Depending on the data, a frequency distribution is shown (numerical are classified here).

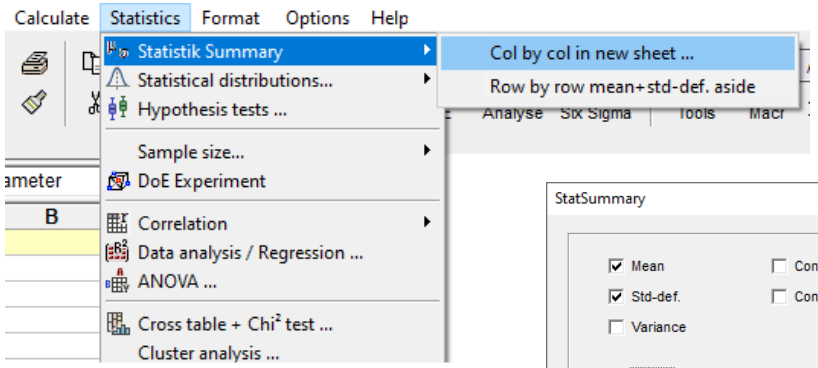


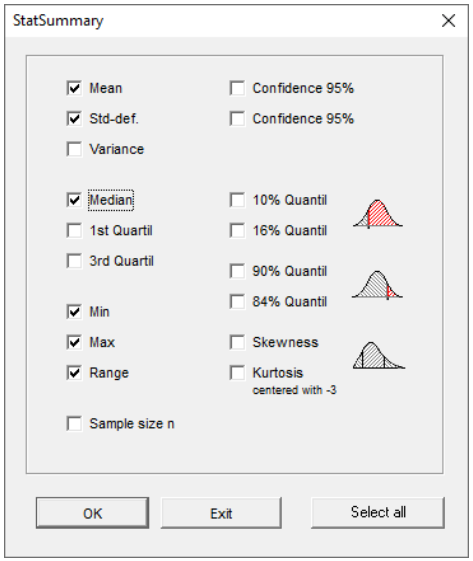
The statistics below show the most important charac-teristic values as well as a statistical test for normal distribution.

click here to copy the results to the clipboard

Descriptive statistics

More extensive characteristic values also for several columns are possible via Statistics Summary

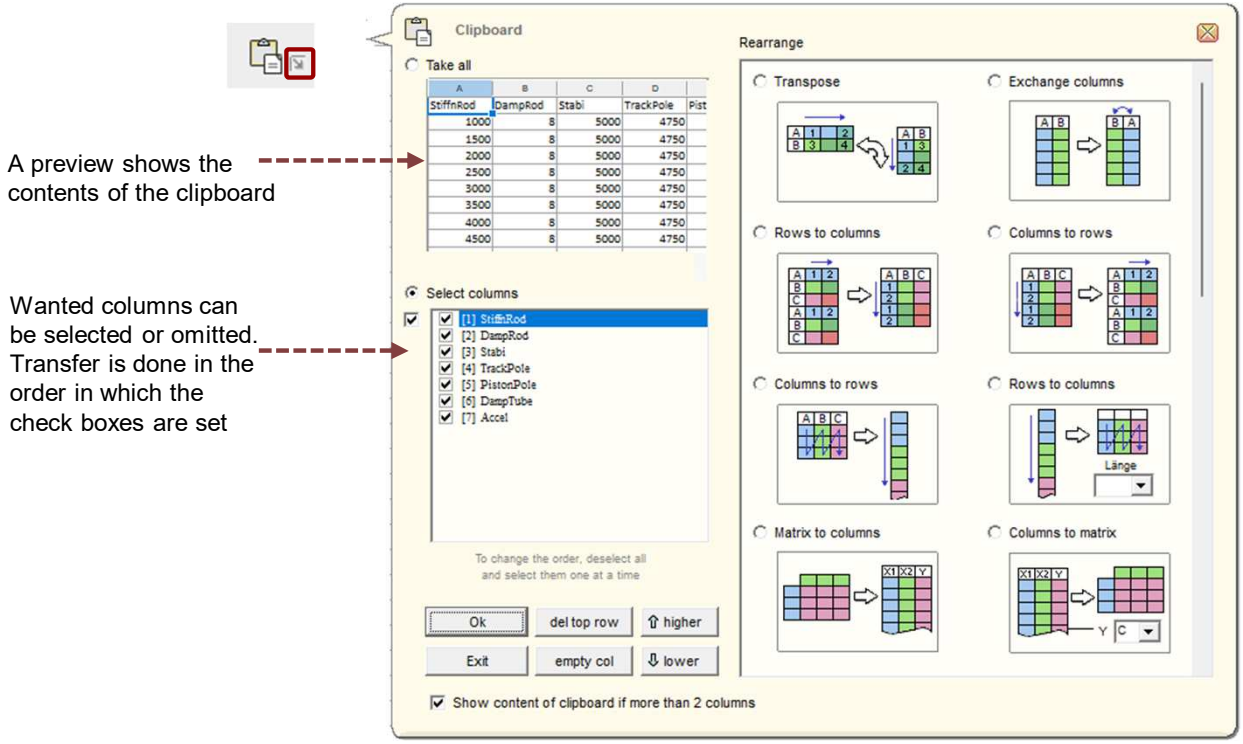




	A	B
1		Diameter
2	Mean	15,217
3	StdDef	0,025093
4	Median	15,22
5	Min	15,145
6	Max	15,245

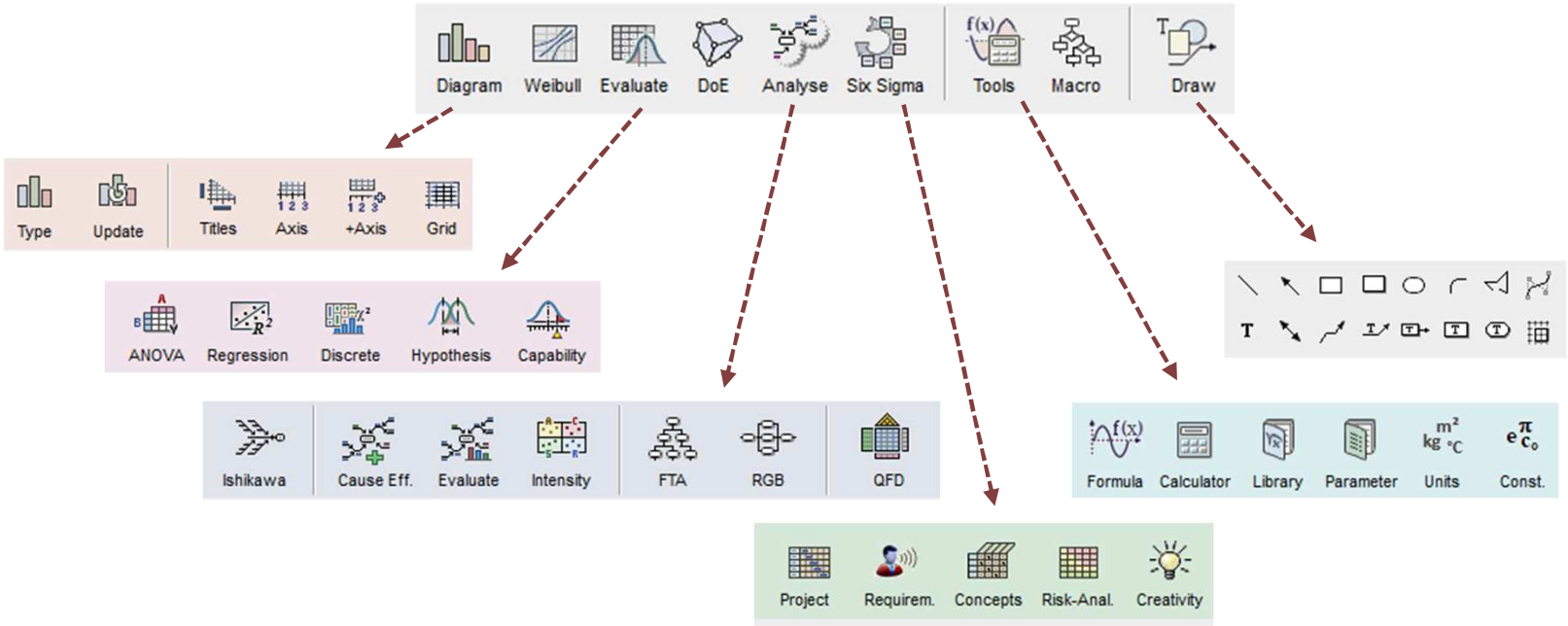
Special paste

When pasting data from the clipboard, data columns can be selected and or rearranged if there are more than 2 columns of data on the clipboard (equal to Edit / Paste contents / transform before paste)



The icon bar

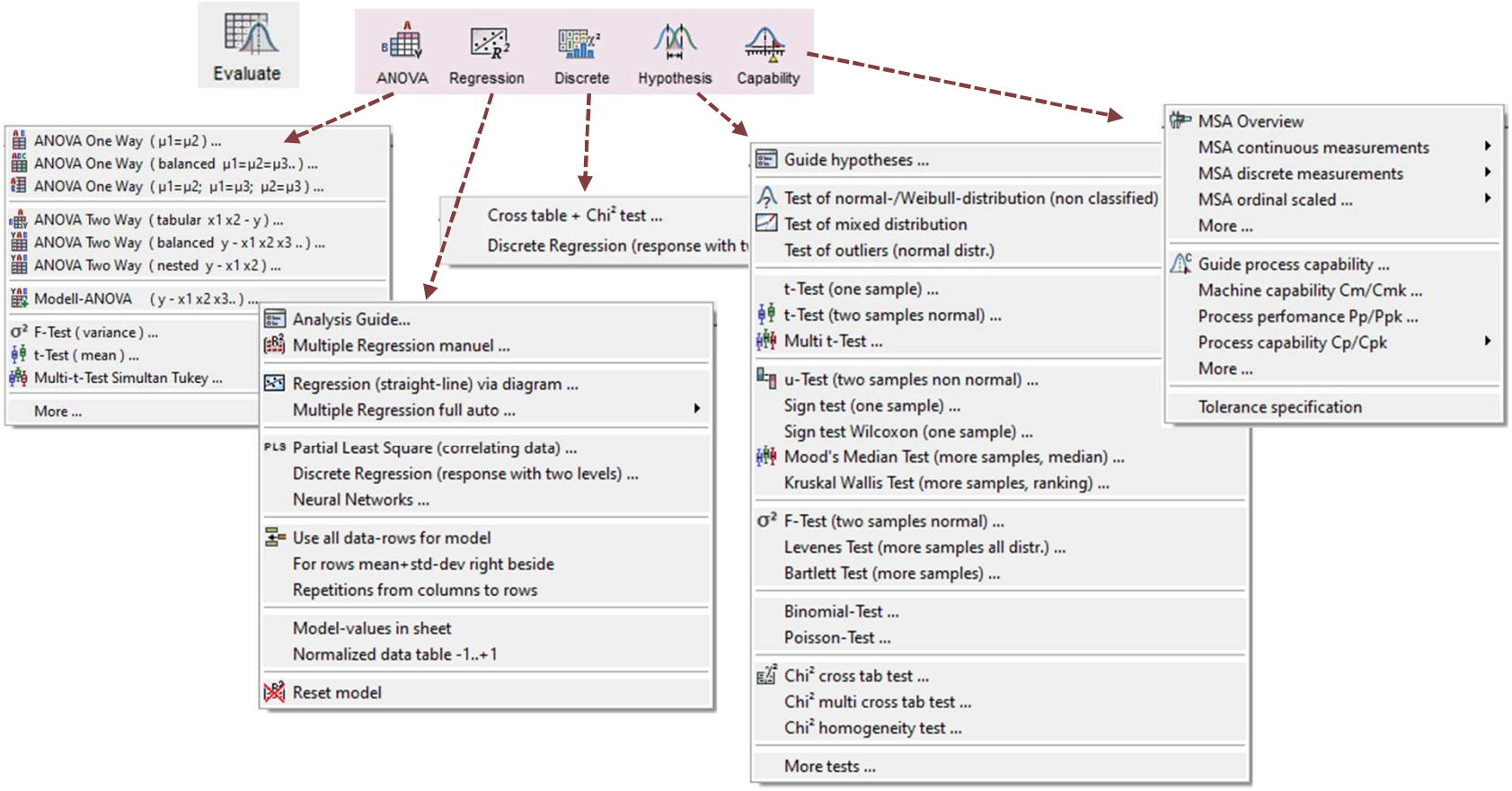
The most important statistical methods



The icons Weibull and DoE are described in separate sections

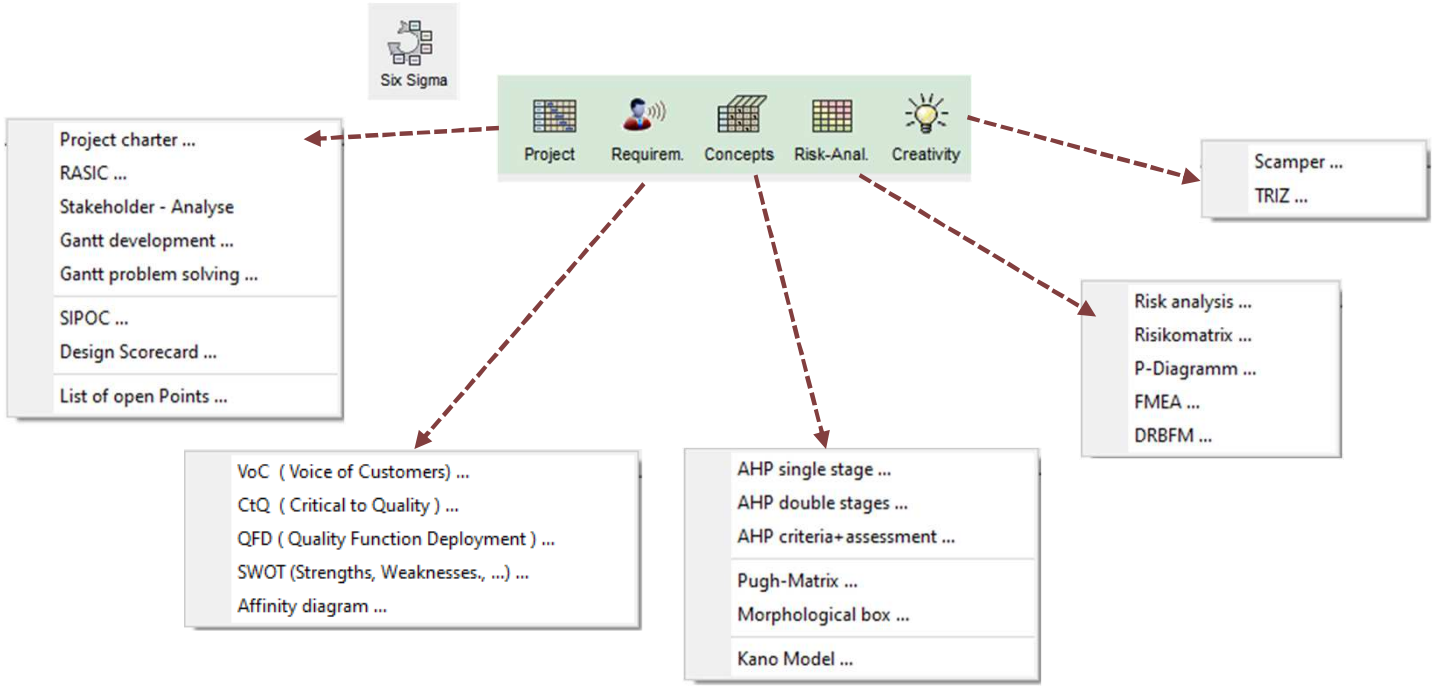
Icon bar Evaluation

Data evaluation



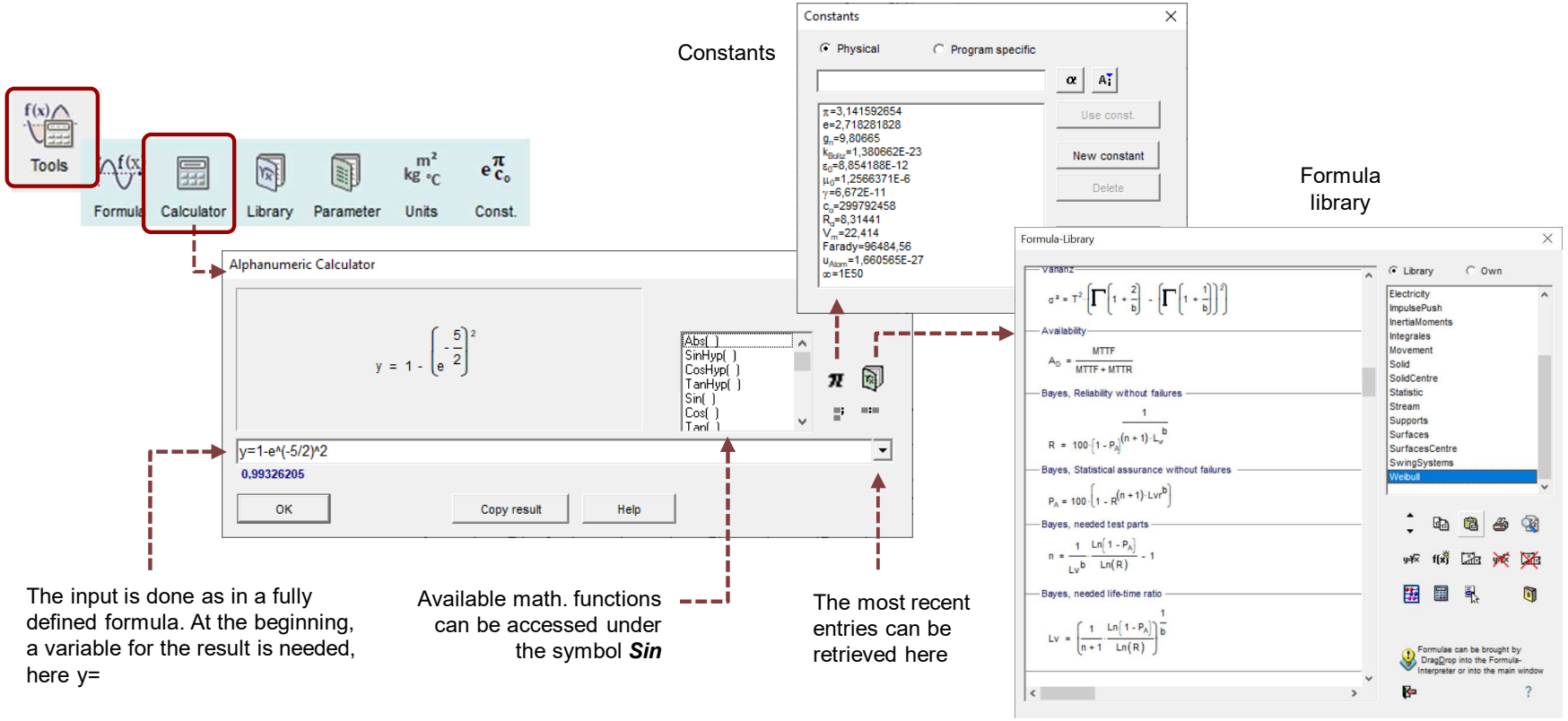
Icon bar Six Sigma

The most important Six Sigma and DFSS methods



The calculator

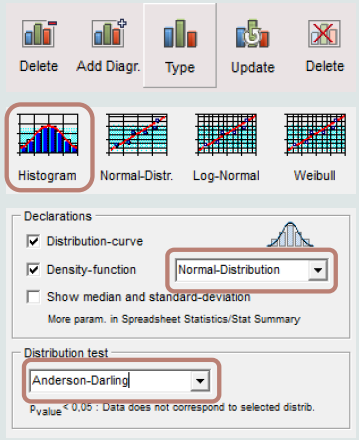
The alphanumerical calculator with special functions

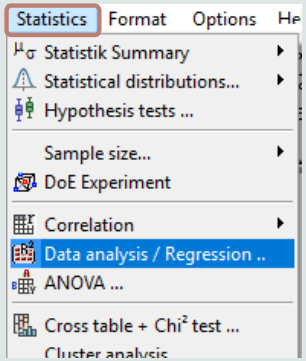


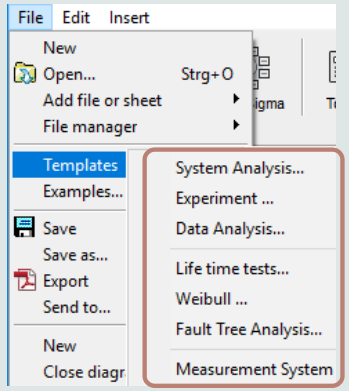
Statistical methods/functions

There are three ways to apply statistical methods.

Diagram-functions	Internal functions	Templates
e.g. test of normality, hypothesis of equality with Boxplot or test of normality ⇨ Select *Diagram*	e.g. calculation of distributions, DoE, regression, sample size, etc. ⇨ Select menu *Statistics*	e.g. hypothesis-test, or Weibull-Analysis. ⇨ Select menu *File/Templates*



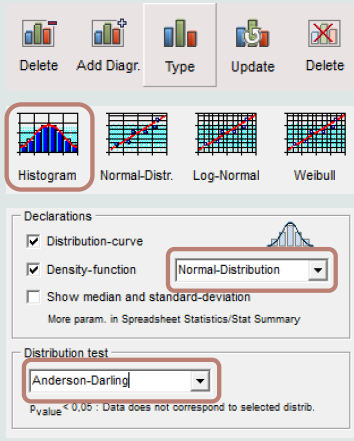


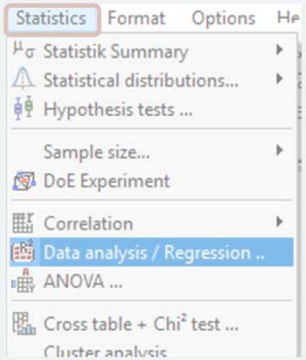


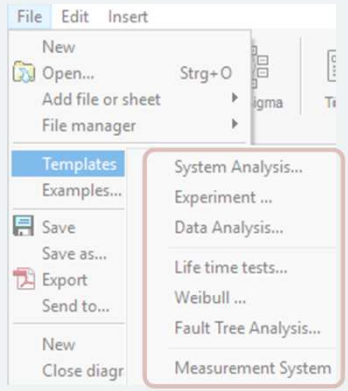
Examples for diagram functions

Examples from the diagram functions are shown first

Diagram-functions	Internal functions	Templates
e.g. test of normality, hypothesis of equality with Boxplot or test of normality ⇨ Select *Diagram*	e.g. calculation of distributions, DoE, regression, sample size, etc. ⇨ Select menu *Statistics*	e.g. hypothesis-test, or Weibull-Analysis. ⇨ Select menu *File/Templates*



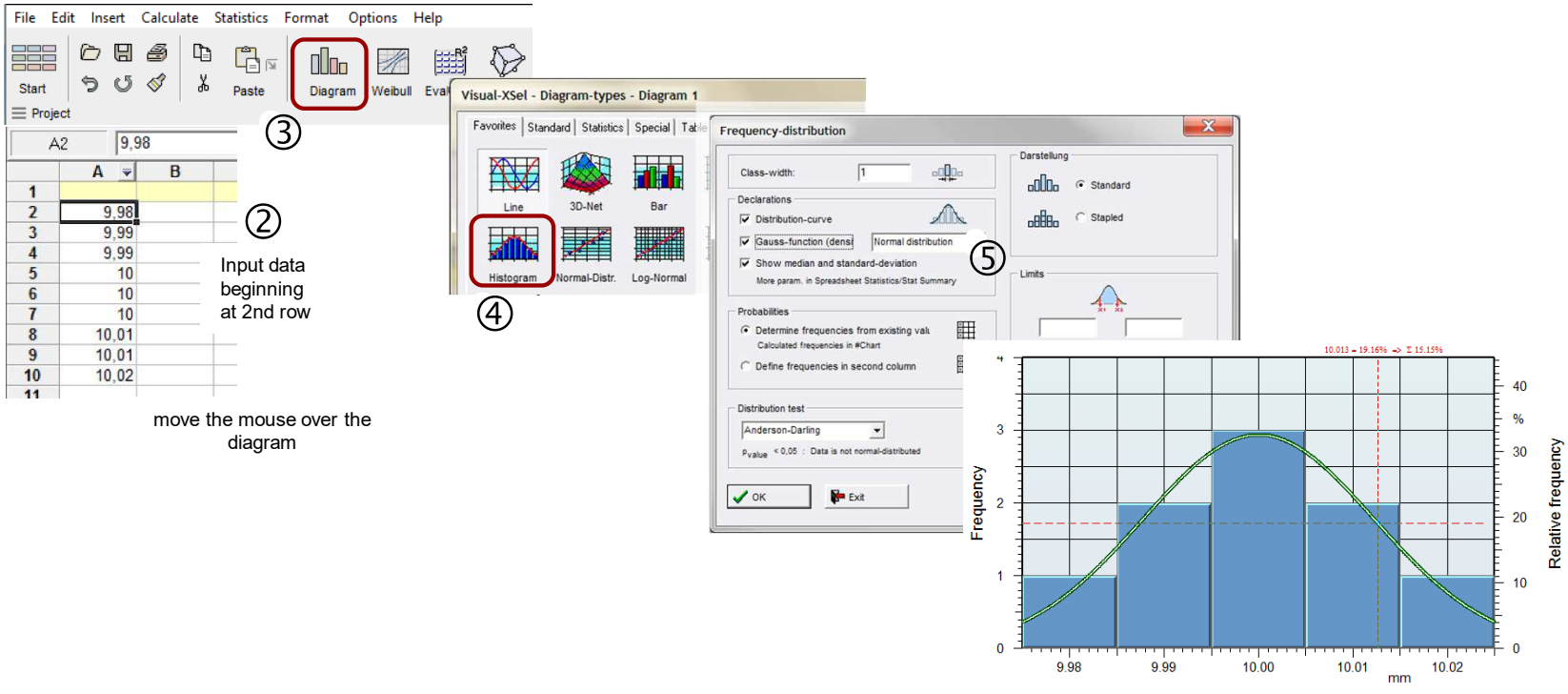




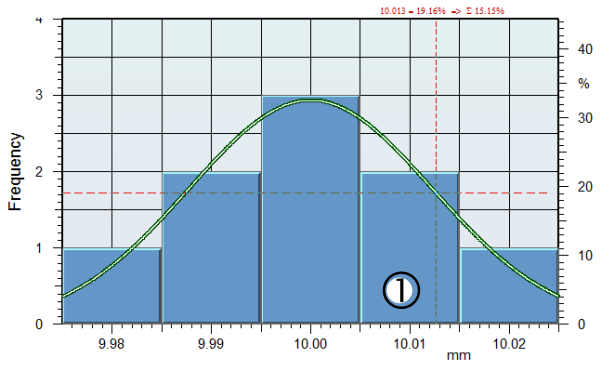
Creating a Histogram

A histogram can be made with various settings and representations

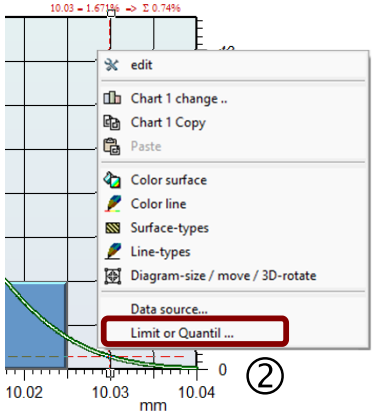
① Click in left area of the program to make visible the spreadsheet



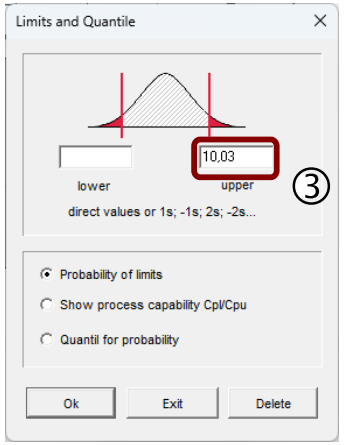
Set a limit, for example for process capability

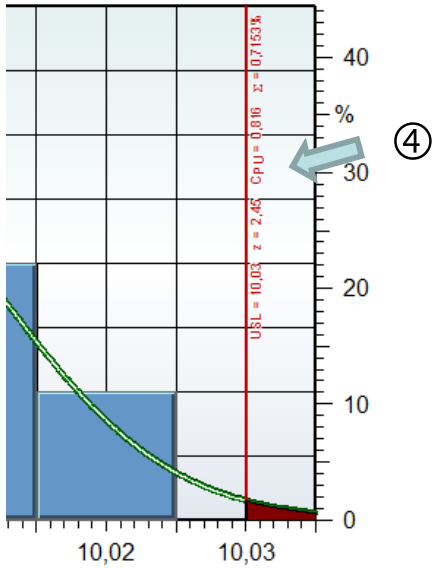


move mouse along the gaussian curve



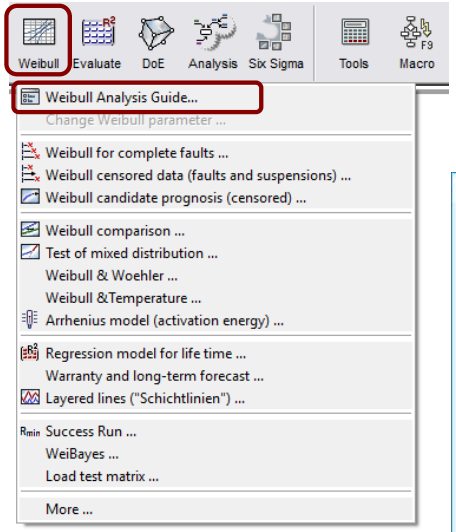
click the right mouse button and use Limit (hint: no element has to be clicked before and the mouse must be over the diagram)



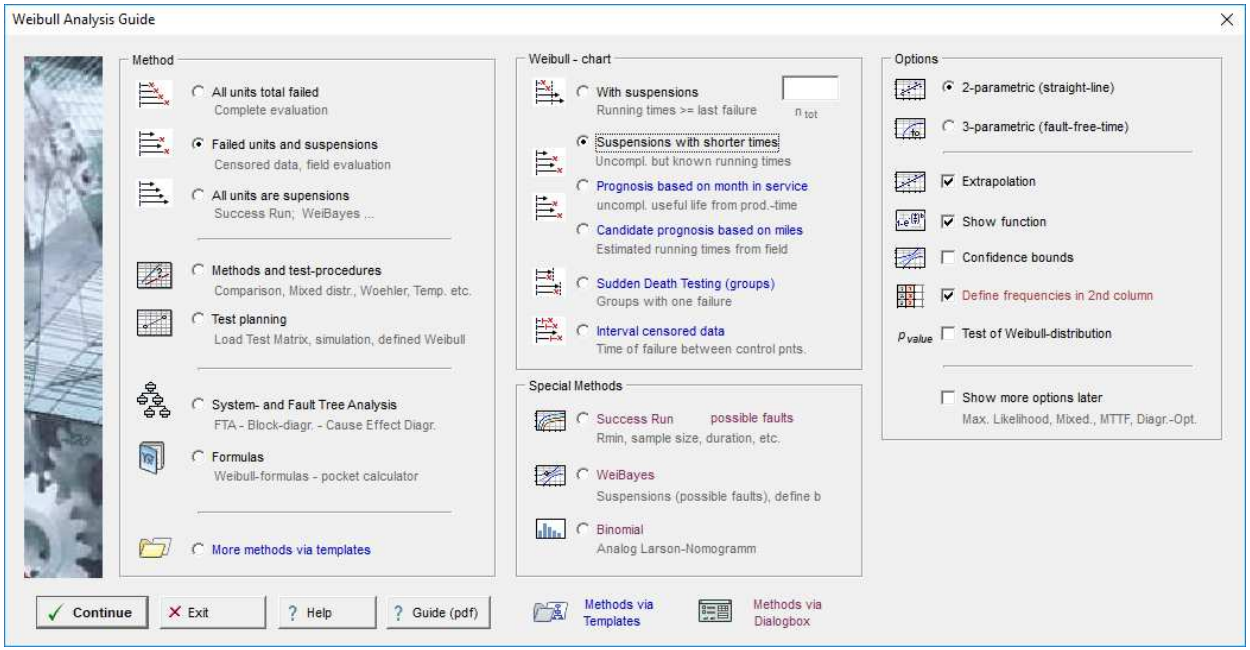


Reliability & Weibull

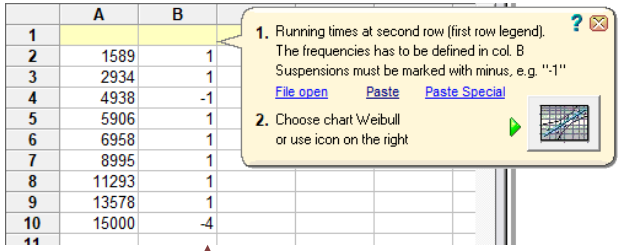
The most important reliability issues are available via the icon Weibull.
The Weibull Analysis Guide pilots you through more methods, especially for variants of the Weibull-chart.



More information
www.weibull.de/COM/Weibull_Analysis.pdf



Creating a Weibull-chart



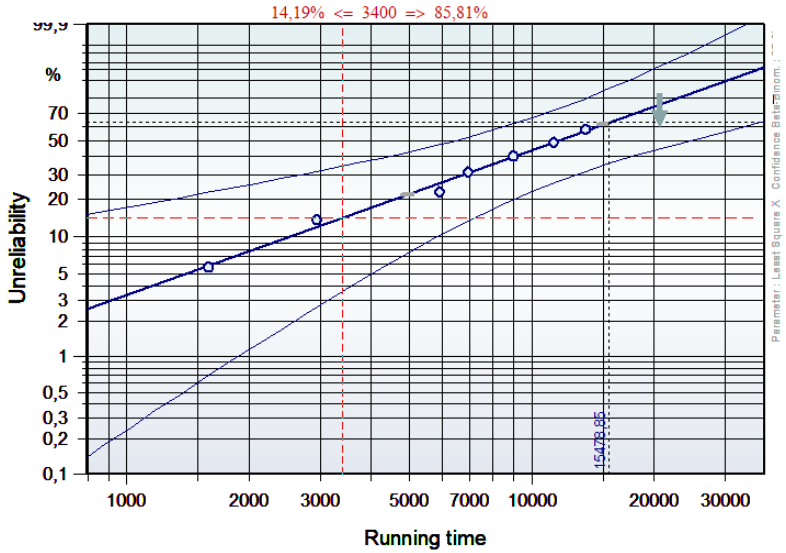
define here the number of faults and suspensions (marked with „-“).

define here the running times

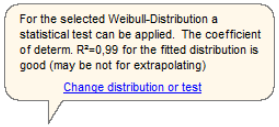
Define running times (col A) and frequencies,
(col B) or use *Paste.*
Click the Weibull icon and define the axis titles.

More information
www.weibull.de/COM/Weibull_Analysis.pdf

Move with the mouse over the chart for crosslines



Move with the mouse over the formula, to get expert information

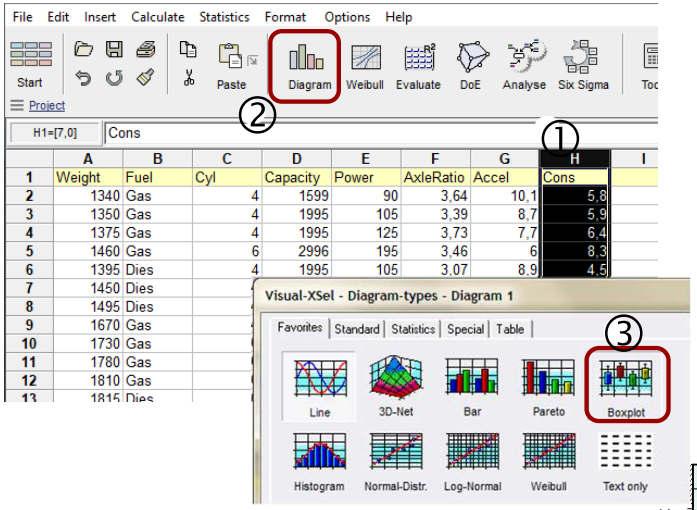


$T = 15478{,}85 \quad b = 1{,}239$

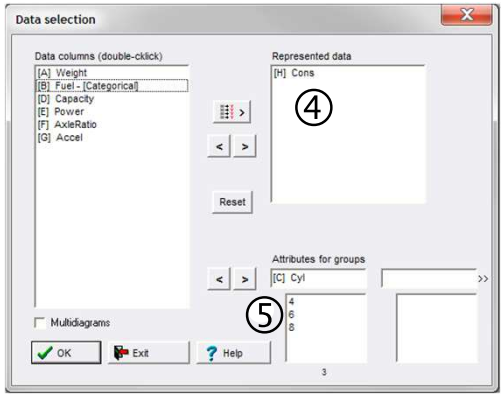
$H = 100\% \cdot \left(1 - e^{-\left(\frac{t}{T}\right)^{b}}\right)$

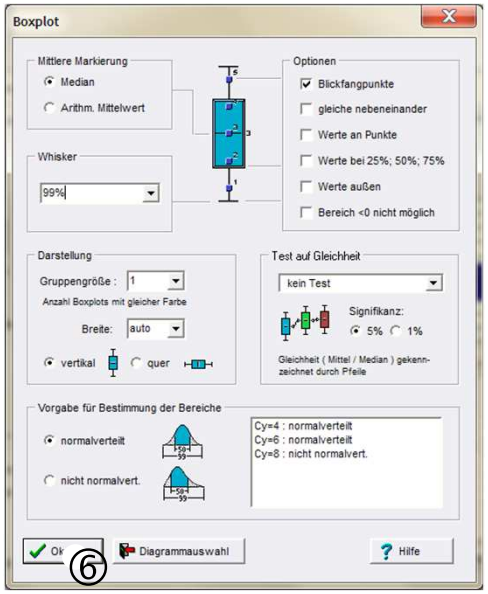
$t_{10} = 2515{,}6 \quad R^2 = 0{,}9905$

Boxplot with category „Cylinder“

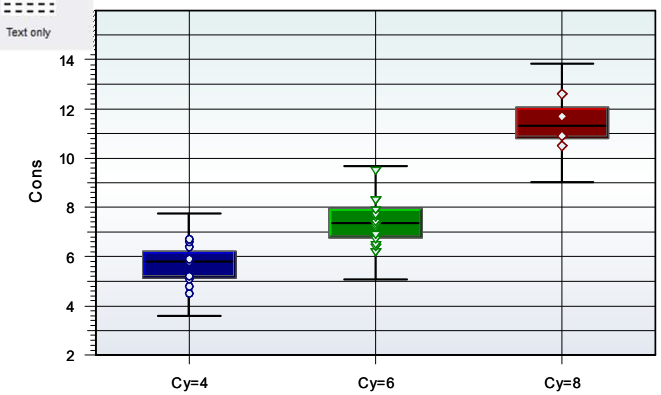


	A	B	C	D	E	F	G	H	I
1	Weight	Fuel	Cyl	Capacity	Power	AxleRatio	Accel	Cons	
2	1340	Gas	4	1599	90	3,64	10,1	5,8	
3	1350	Gas	4	1995	105	3,39	8,7	5,9	
4	1375	Gas	4	1995	125	3,73	7,7	6,4	
5	1460	Gas	6	2996	195	3,46	6	8,3	
6	1395	Dies	4	1995	105	3,07	8,9	4,5	
7	1450	Dies							
8	1495	Dies							
9	1670	Gas							
10	1730	Gas							
11	1780	Gas							
12	1810	Gas							
13	1815	Dies							



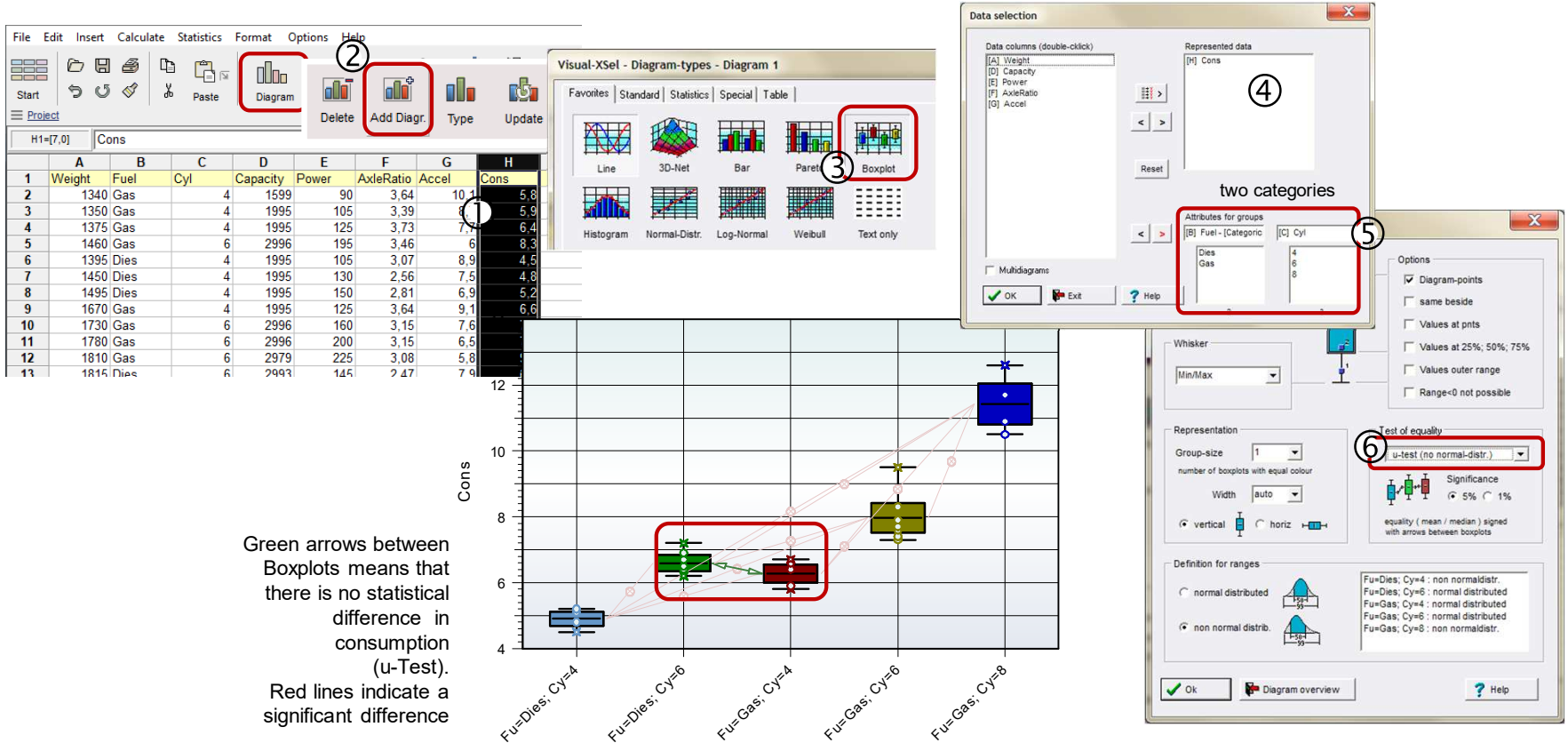


Menu Data/Spreadsheet and open file:
Examples/Example_PLS_Consumption.xlsx



2nd Boxplot with category Fuel

Open Data/Spreadsheet T1 and mark column H. Add diagram with symbol (+)

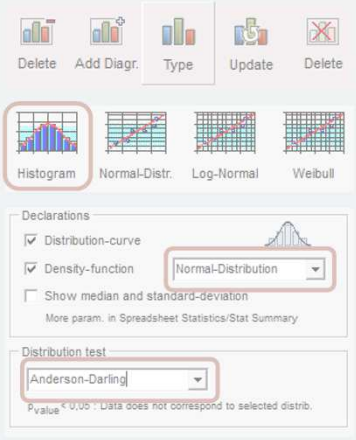


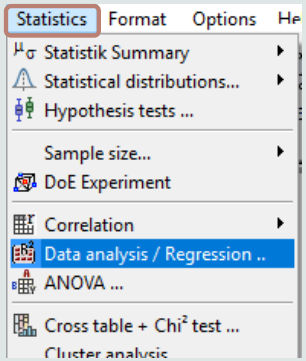
Green arrows between Boxplots means that there is no statistical difference in consumption (u-Test).
Red lines indicate a significant difference

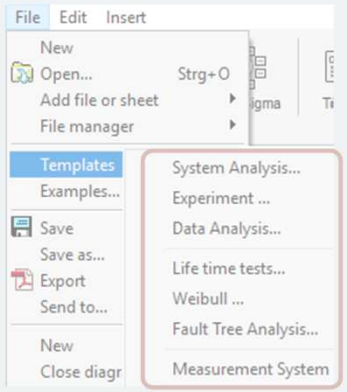
Examples for diagram functions

The following examples show internal functions

Diagram-functions	**Internal functions**	Templates
e.g. test of normality, hypothesis of equality with Boxplot or test of normality ⇨ Select *Diagram*	e.g. calculation of distributions, DoE, regression, sample size, etc. ⇨ Select menu *Statistics*	e.g. hypothesis-test, or Weibull-Analysis. ⇨ Select menu *File/Templates*

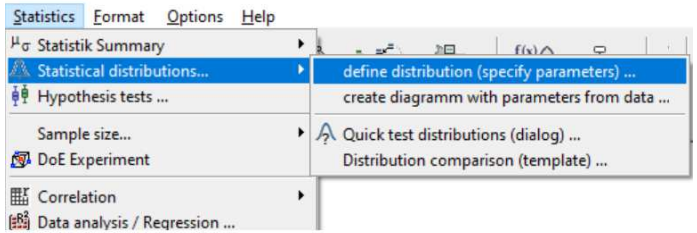


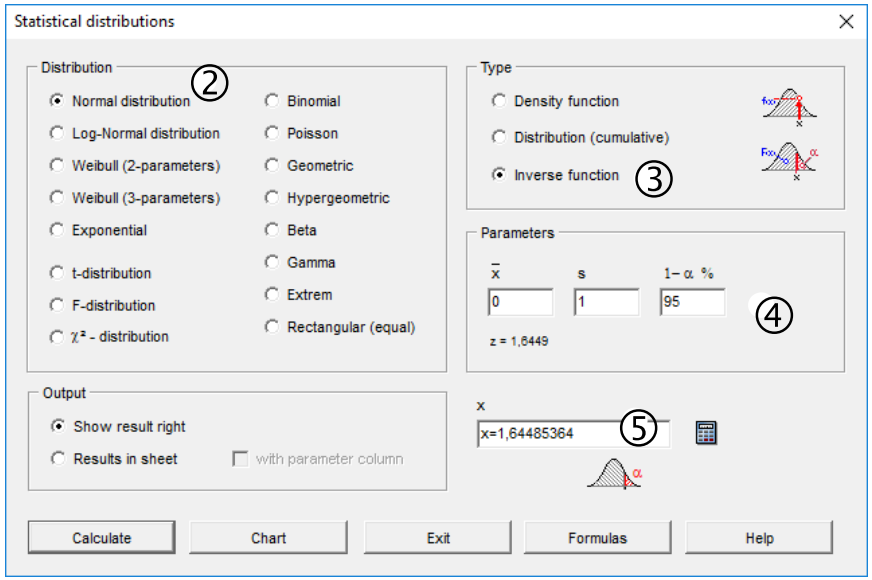




How to calculate distribution values or the „z“-value

Statistical distributions - calculate values or display them as a graph

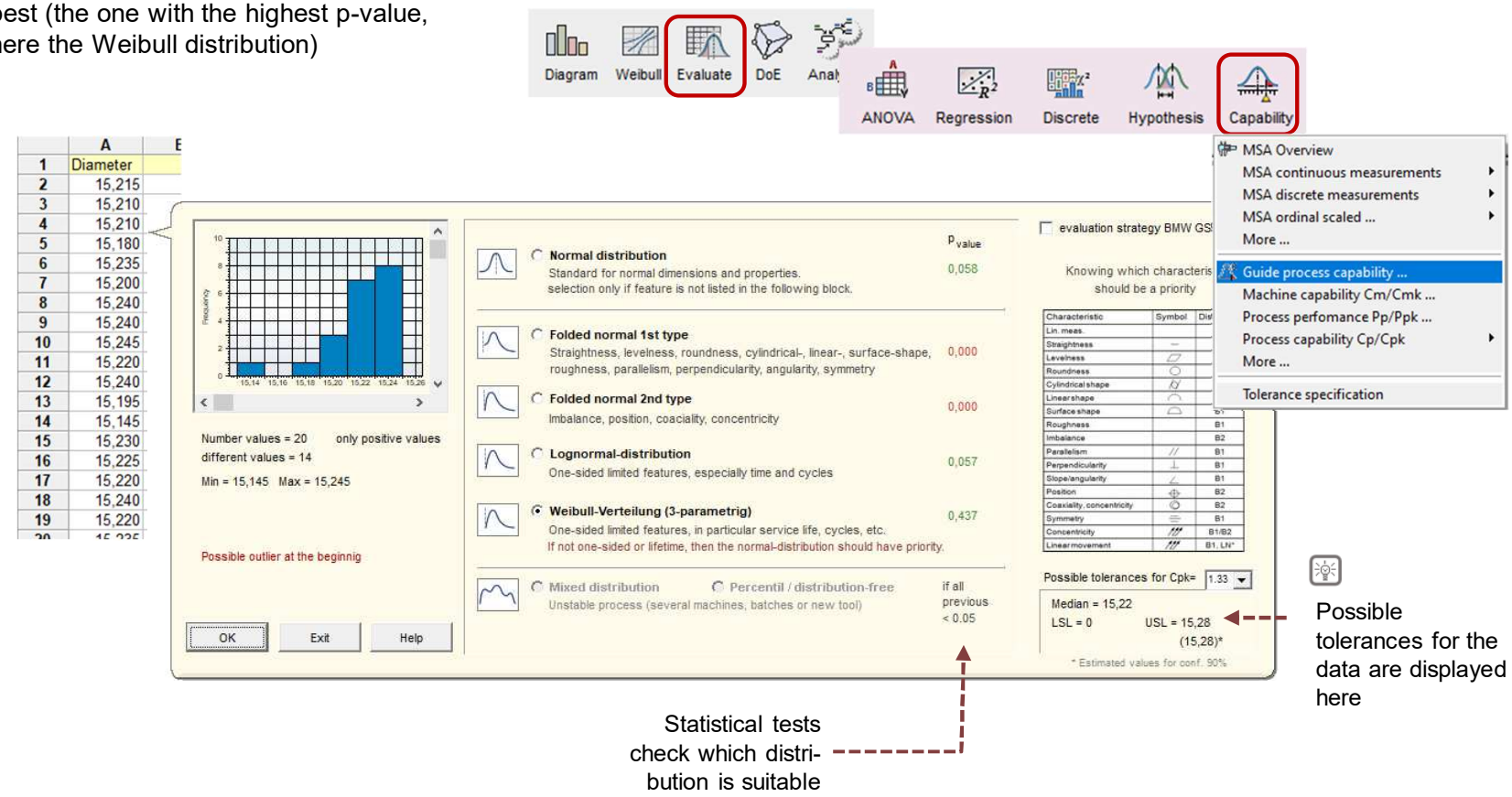




If using the Inverse normal distribution with mean = 0 and std-dev = 1, the result x (normally the quantile) has in this case the meaning of the so called „z“-value

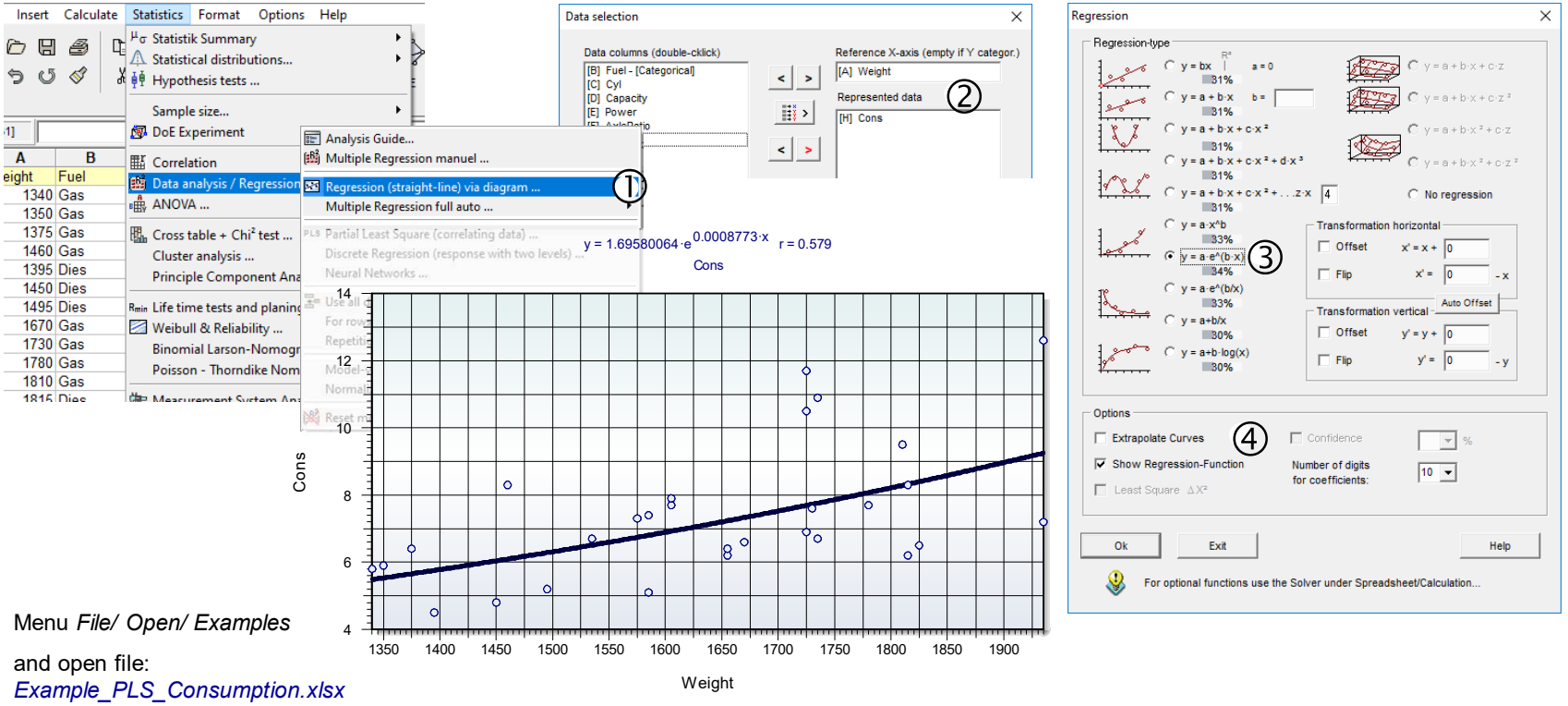
Find the right distribution of data

The guide includes a distribution test and makes a suggestion which is the best (the one with the highest p-value, here the Weibull distribution)



Standard Regression

x-y regression can be realized via a line diagram

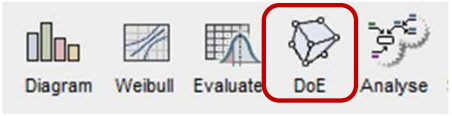


Menu *File/ Open/ Examples*

and open file:
Example_PLS_Consumption.xlsx

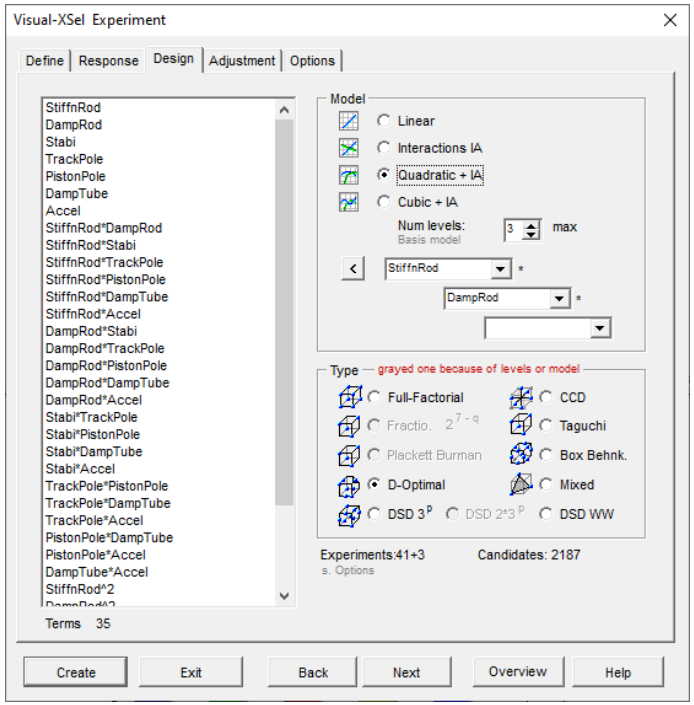
Design of Experiments - DoE

In Visual-XSel all important designs are available and new the DSD 2*3^p and DSD IA (extension for Definitive Screening Designs, e.g. for interactions)

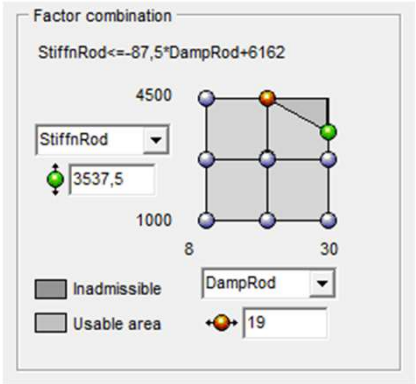


Detailed description under:

www.weibull.de/COM/
Design_of_Experiment.pdf

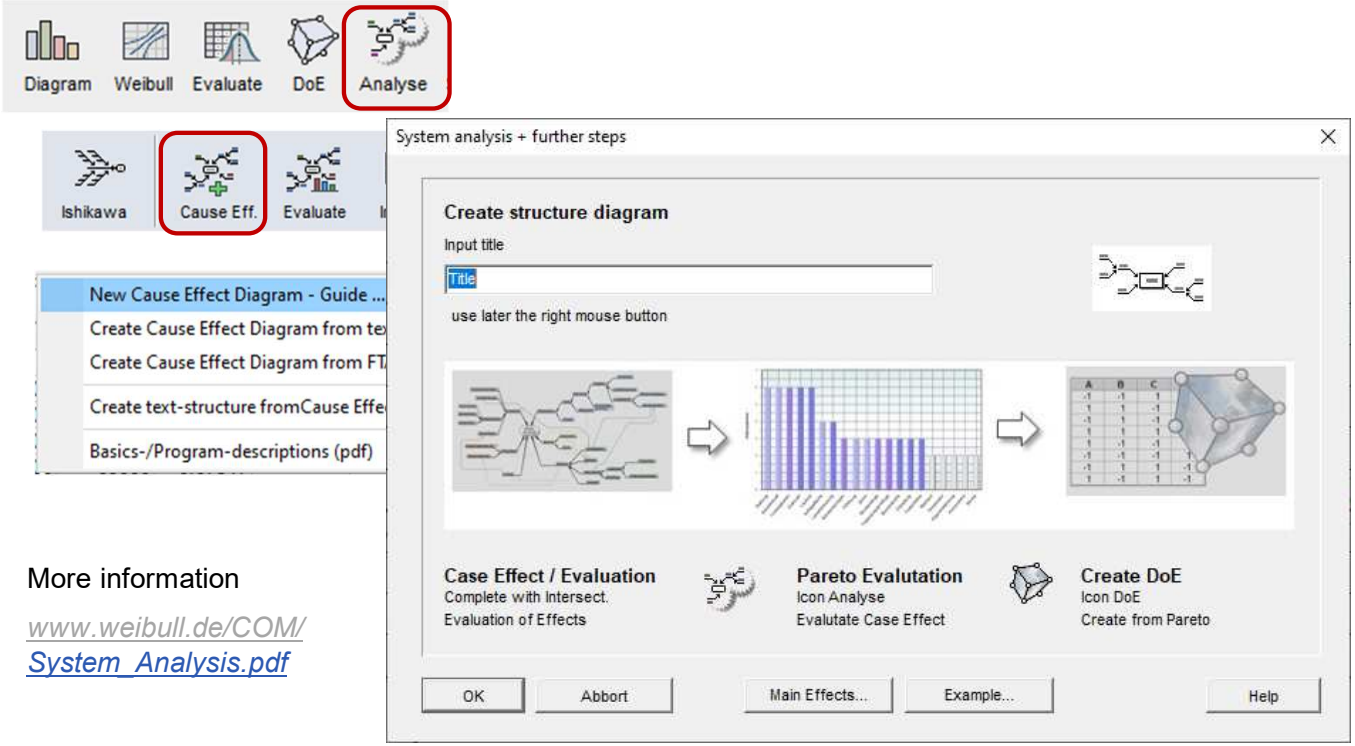


- Import parameters from tables (other progr.)
- Derive DoE's from structure diagrams
- Up to 120 parameters and 16 responses
- Categorial parameters
- 3-times interactions
- Considering existing experiments
- Techn. constrains can be defined
- and much more …



In Visual-XSel there are a variety of analyses tools, like a cause effect diagram

③



More information

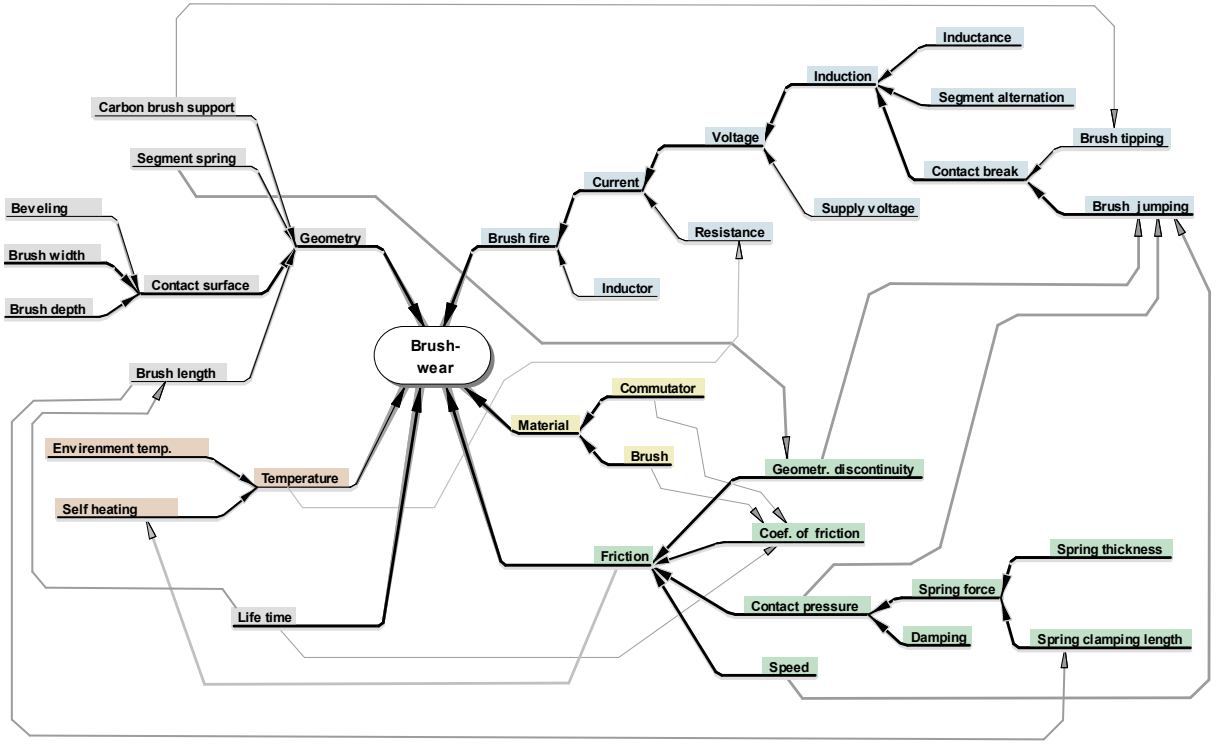
www.weibull.de/COM/System_Analysis.pdf

Continuous functionality – from the cause effect diagram to pareto evaluation to the experimental design.

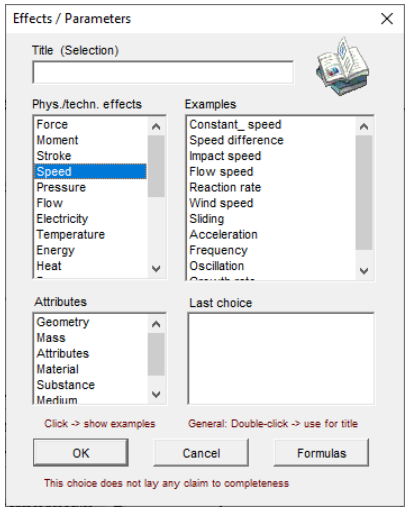
A fault tree analysis can be derived from a cause effect diagram

The cause effect diagram can be evaluated and provides cross-links to the assessment of dependencies important to decide what needs to go into a design and what doesn't.

③

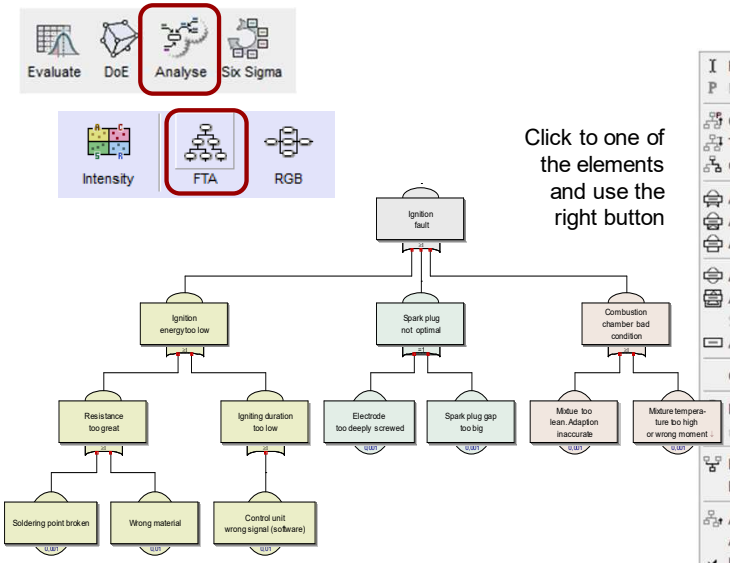


A parameter library helps to overlook anything

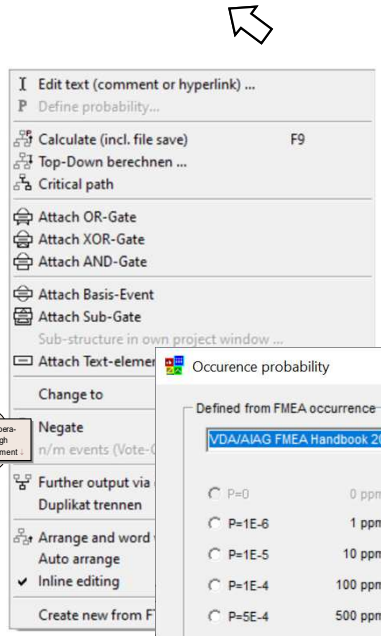


Fault-Tree-Analysis

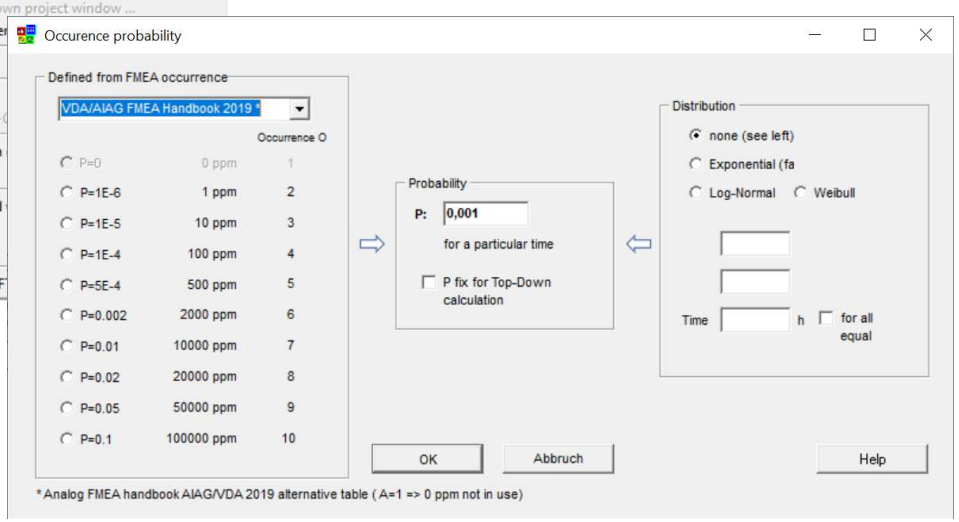
The graphical FTA with powerful functions



Click to one of the elements and use the right button



- All FTA elements also Vote-Gates
- Sub-Gates with layers
- Short-cuts
- Calculation of the critical path
- Probability from distribution or via a standardized FMEA table
- Import from text structure
- Export as FMEA form or cause-effect-diagram
- Supports new VDA/AIAG FEMA Handbook 2019

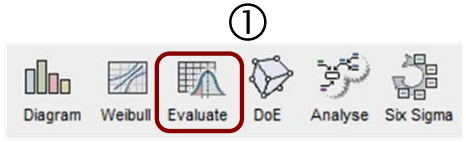


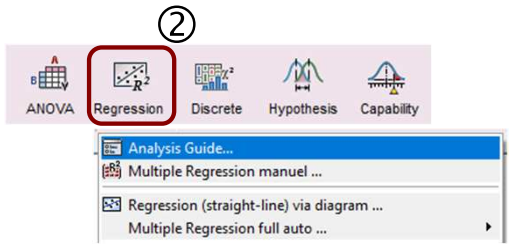
See examples in menu *File*, *Templates*, *System-Analysis*

For more information read
www.weibull.de//COM/Fault_Tree_Analysis.pdf

Multiple Regression

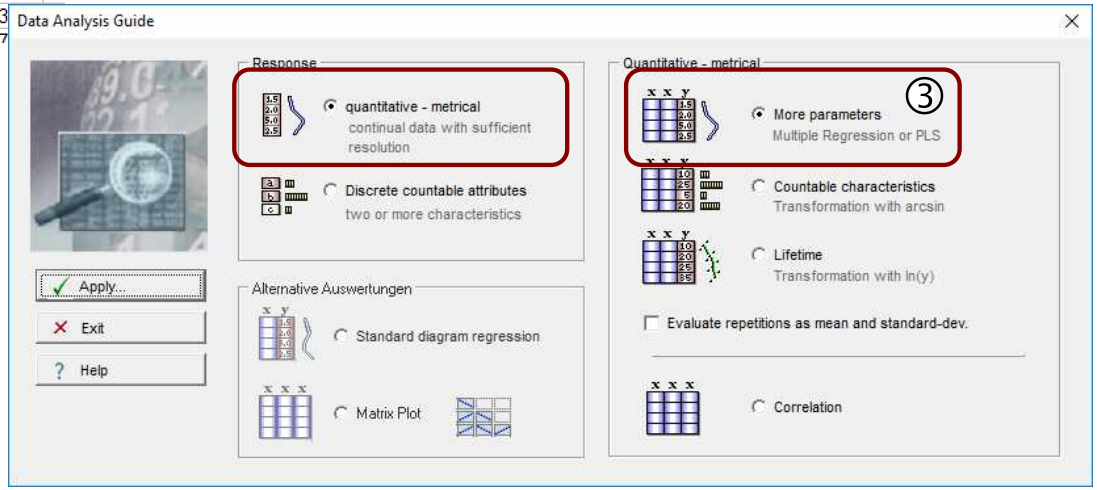
The multiple regression is the most powerfull analysis tool for the DoE results or historical data





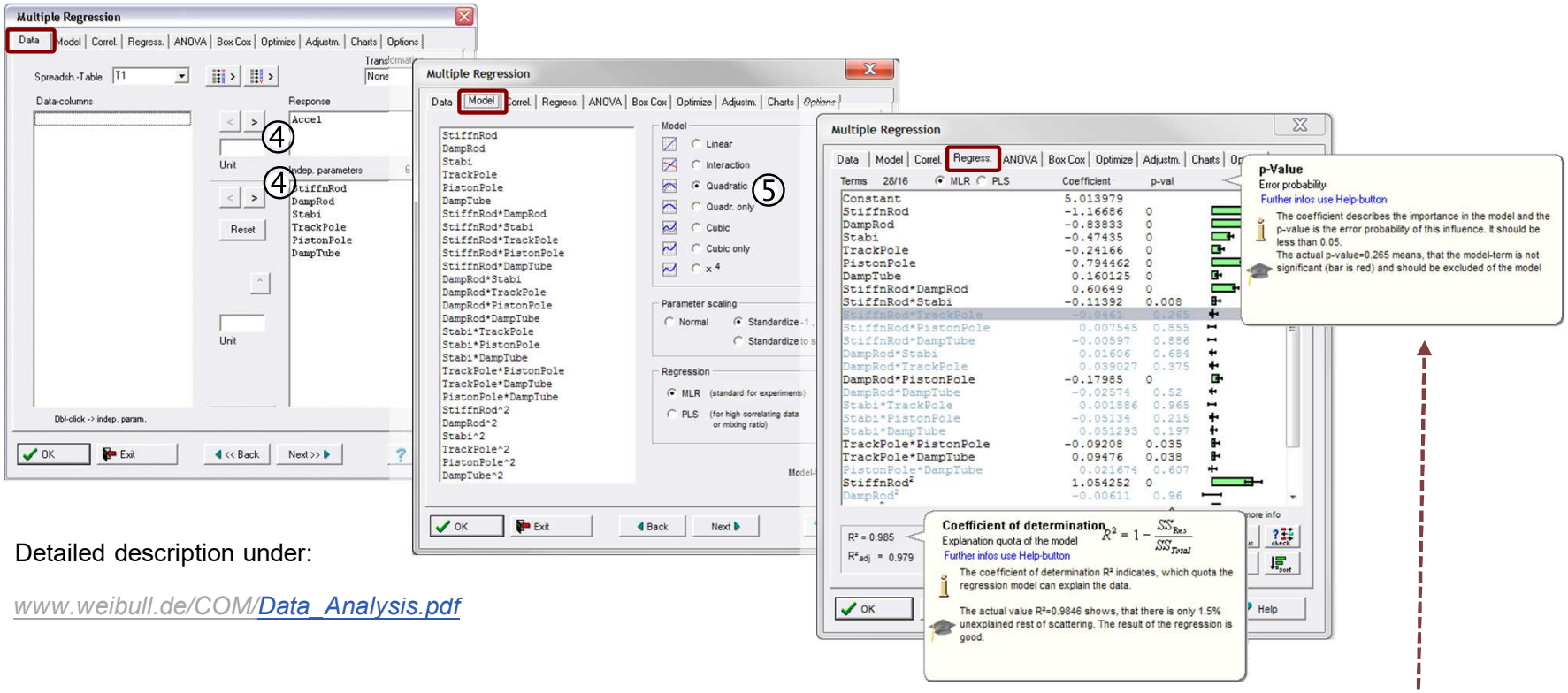
C	D	E	F	G
abi	TrackPole	PistonPole	DampTube	Accel
5000	4750	210000	69000	9,49469
5000	4750	210000	69000	8,08628
5000	4750	210000	69000	7,23
5000	4750	210000	69000	6,67

Menu Data/Spreadsheet and open file:
Example_MulReg.xlsx



Data analysis Multiple Regression

Menu Data/Spreadsheet and open file:
Example_MulReg.xlsx



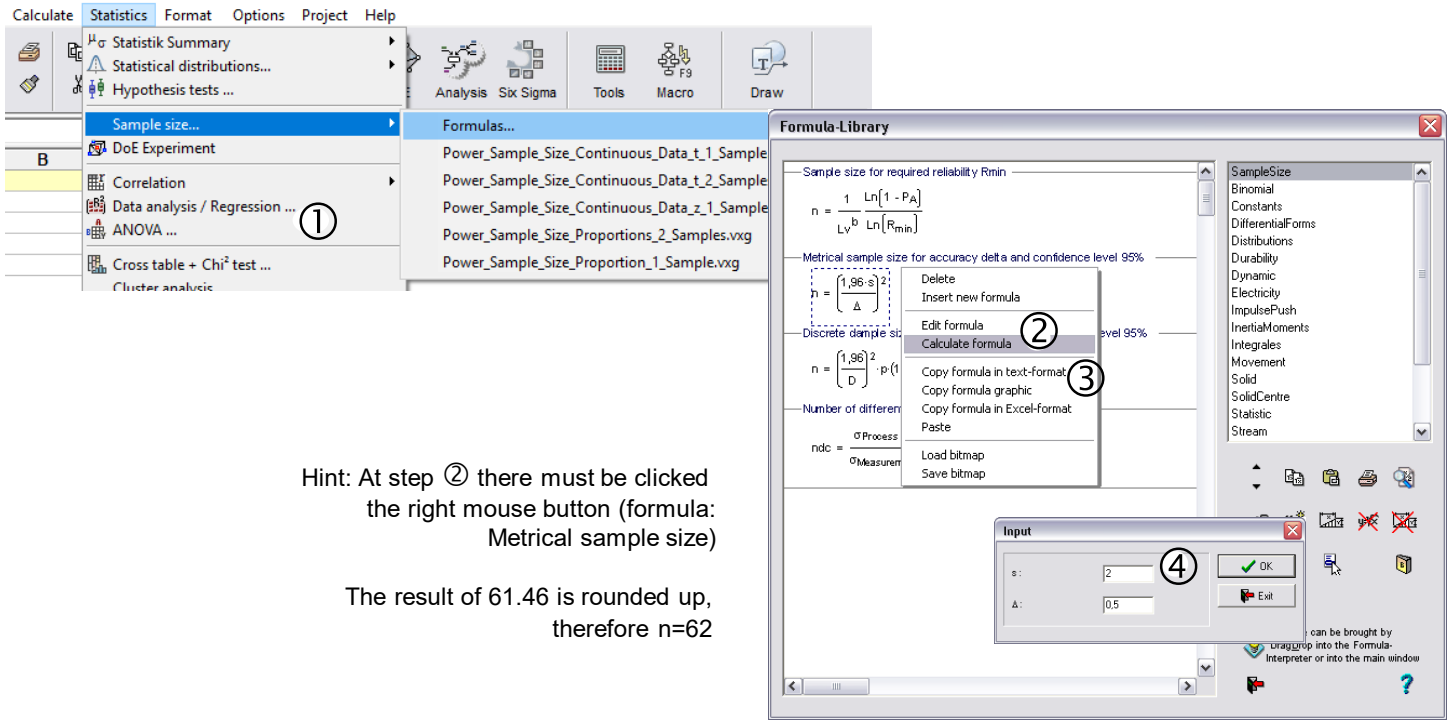
Detailed description under:

www.weibull.de/COM/Data_Analysis.pdf

Speech bubbles provide explanations of the properties and interpret the actual values

Calculation of a spot check size

Example car wash: The drying time of a varnish should be examined. It should be reached an exactness from ±0,5 hrs. The drying time has a standard deviation of 2 hrs. How big has to be the necessary sample size? The calculation can occur with the Calculator (view of the main window):



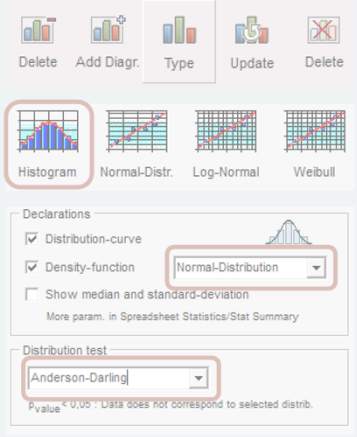
Hint: At step ② there must be clicked the right mouse button (formula: Metrical sample size)

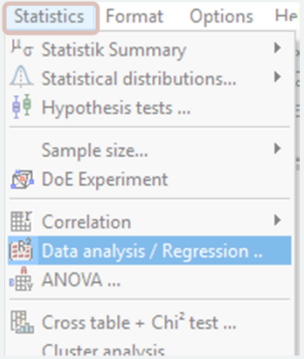
The result of 61.46 is rounded up, therefore n=62

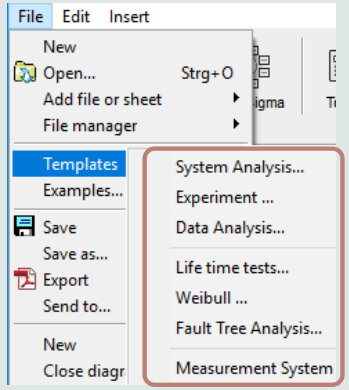
Examples for templates

The other examples treat templates

Diagram-functions	Internal functions	**Templates**
e.g. test of normality, hypothesis of equality with Boxplot or test of normality ⇨ Select *Diagram*	e.g. calculation of distributions, DoE, regression, sample size, etc. ⇨ Select menu *Statistics*	e.g. hypothesis-test, or Weibull-Analysis. ⇨ Select menu *File/Templates*



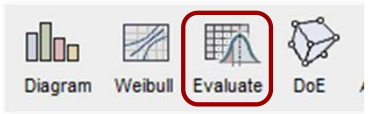


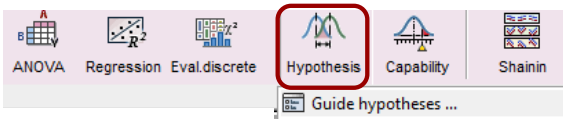


Statistical t-tests via templates

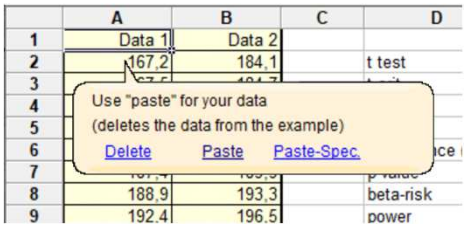
Hypothesis tests are available via templates

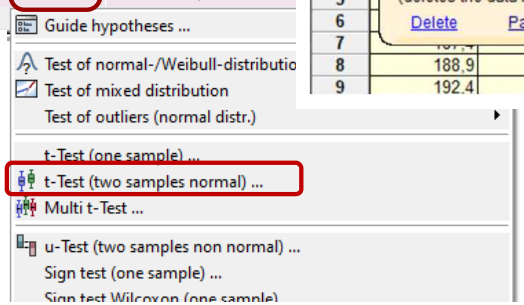
Open the Spreadsheet and the table where are the sub-groups of the Boxplots.
Mark column A and B.





Paste data in the yellow fields





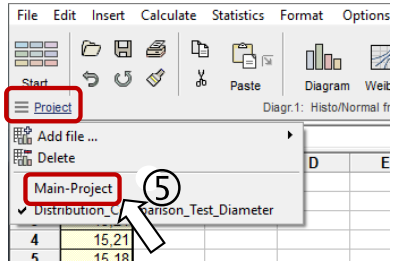
Note:
The template for the test is embedded in the actual project. To have a view to the previous representation and data select *Project* / *Main-Project*!

Start the macro for evaluation

t_test	4,71
t_crit	2,07
Significance	0,05
Mean 1	5,6667
Mean 2	7,3625
p-Value	0,000

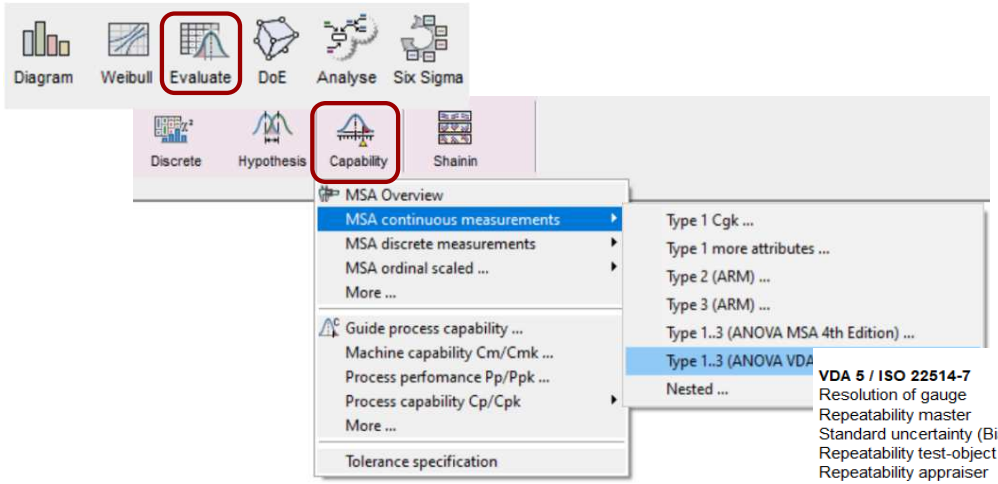
The null hypothesis, that the means are equal, must be rejected!

The null hypothesis, that the variances are equal, can not be rejected.

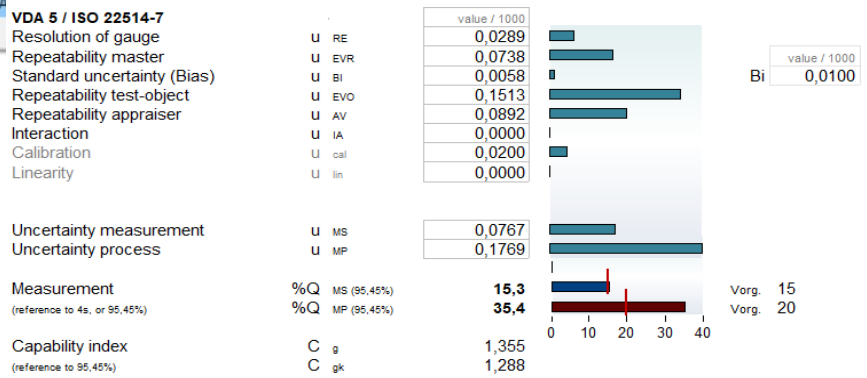


Measurement-System-Analysis

All important methods for continuous or discrete data are available



- Supports VDA 5 or MSA4th edition Type 1,2 and 3
- ANOVA or nested ANOVA
- One sided tolerances or natural limits
- Supports AQDEF format for import
- Gage R&R, Bowker, Fleiss-Kappa, Kendal

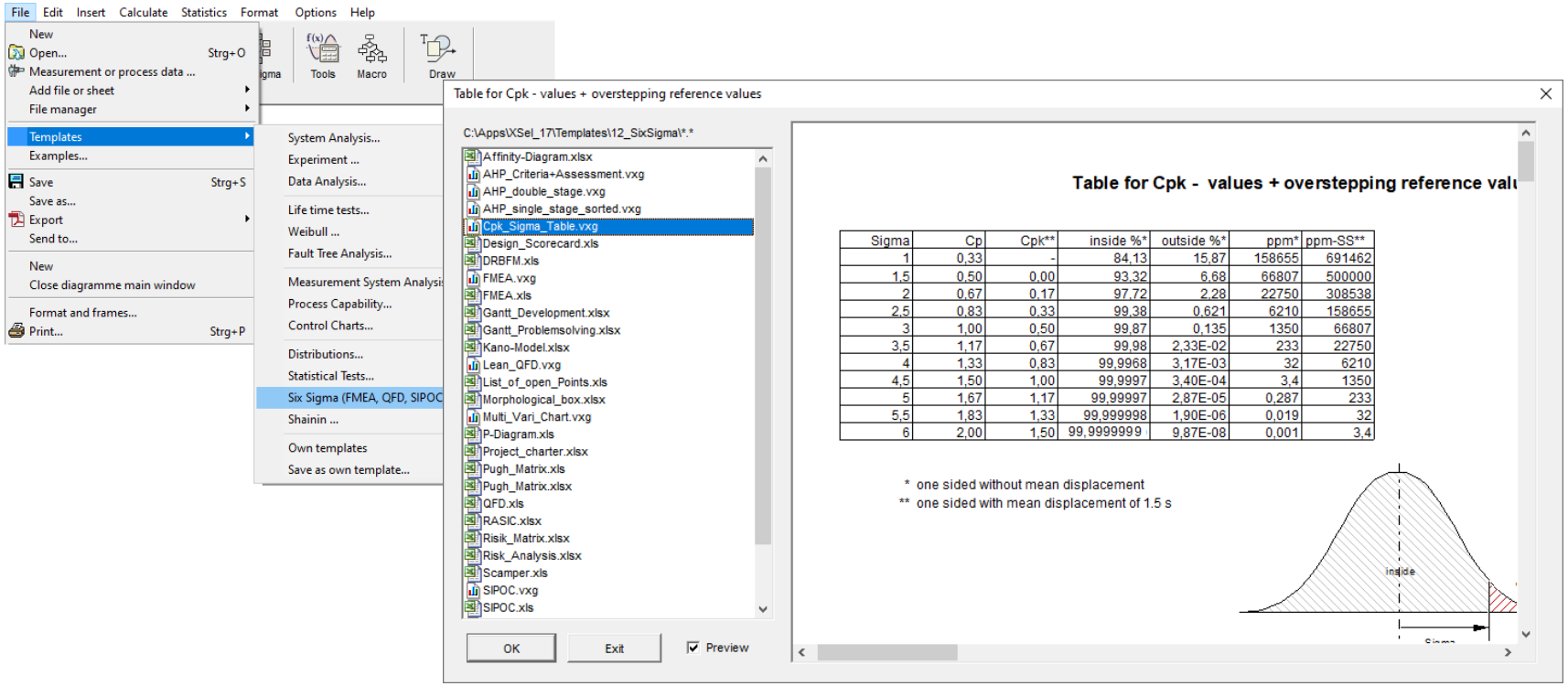


More information's:

www.weibull.de/COM/Measurement_System_Analysis.pdf
www.weibull.de/COM/Measurement_System_Analysis_discrete.pdf

Six Sigma - templates

For Six Sigma also powerful Excel and Visual-XSel templates are available



More information's at

https://crgraph.de/en/search-index

and

https://crgraph.de/en/download/

Contact: info@crgraph.de