



- ▶ Monte-Carlo Simulation of MS Excel® models

# RISK-LAB

# Risk-Lab

# System overview

# Risk-Lab

## Connectivity

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- ▶ Risk-Lab can run Monte-Carlo simulations of any model designed in MS Excel®.
- ▶ It does not require the use of *add-ins* or macros

## Productivity

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- ▶ Risk-Lab employs a streamlined object-oriented user interface, with presentation-quality graphics and tables. All results can be easily exported.
- ▶ It operates with any version of MS Excel®.
- ▶ It is possible to simulate cells containing formulas.
- ▶ Being a portable application, it is possible to take the software with you in a USB flash drive or cloud drive and use it on any PC connected to the web.

## Dependability

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- ▶ Being a stand-alone application, Risk-Lab is independent to the spreadsheet. Model design and analysis may be entirely conducted inside its specialized environment.

## Designed for decision-making

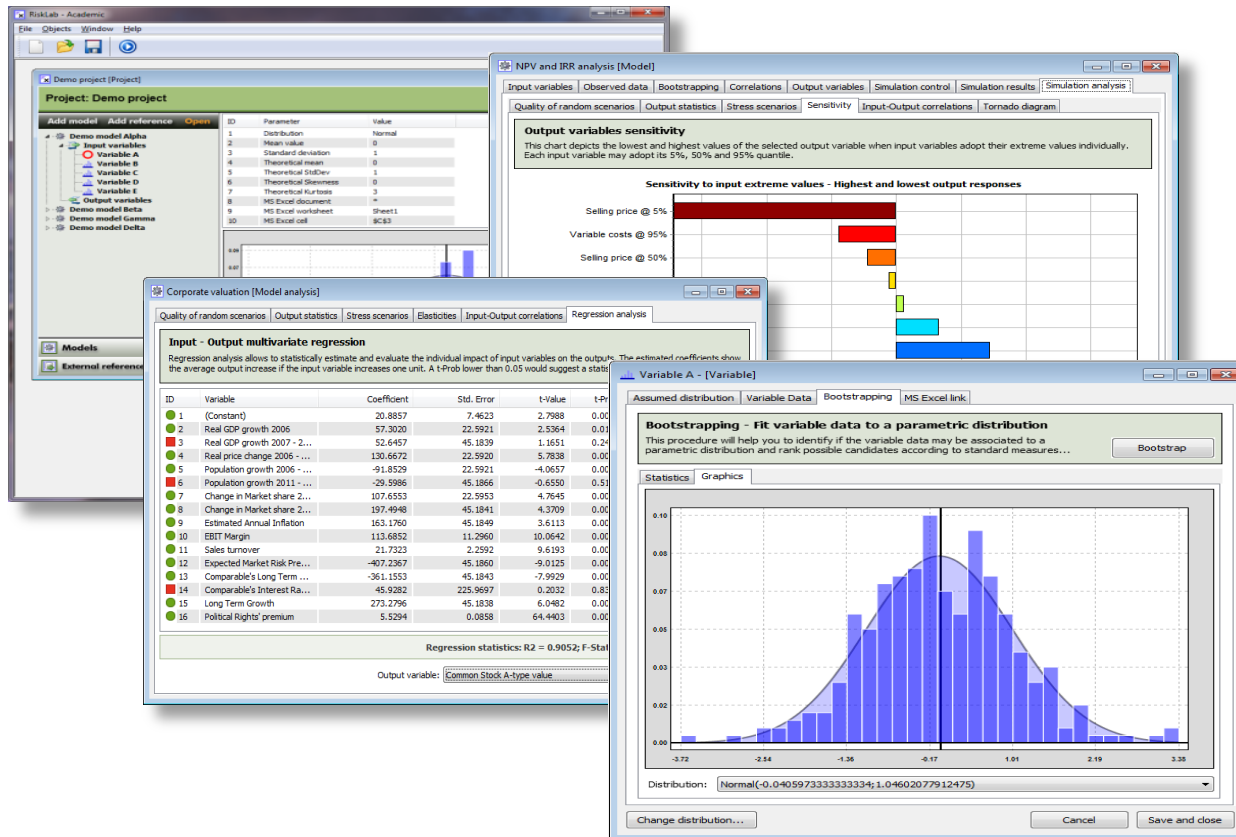
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- ▶ Risk-Lab can help you detect which variables have more impact on results, model past behavior of data series, fit statistical distributions for assumptions, calculate inter-variable correlations, percentiles and more.
- ▶ Risk-Lab implements state-of-the-art Elliptic and Archimedean copulas to generate random scenarios.
- ▶ Site licenses allow an institution to provide Risk-Lab access to a whole community in one simple step. No individual PC installations are needed.

# Program interface

# Welcome to a better user experience

# Risk-Lab



- Projects and models are configured and analyzed from Risk-Lab's specialized interface outside the spreadsheet.
- Risk-Lab transparently communicates with MS Excel® spreadsheets to automatically introduce simulated scenarios and retrieve results at high speed.
- Say goodbye to spreadsheet chaos. The structure and results of your models will be always available and neatly presented inside Risk-Lab.

# Model simulation

# Remote spreadsheet operation

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The screenshot shows the Risk-Lab Academic interface. On the left, there is a tree view with 'Add model', 'Add reference', and 'Open' options. Below this is a table of parameters for an 'Investment Project - Capital Budgeting example'. The table lists parameters such as 'Distribution', 'Mean value', 'Standard deviation', 'Theoretical mean', 'Theoretical StdDev', 'Theoretical Skewness', 'Theoretical Kurtosis', 'Simulated values', 'MS Excel document', and 'MS Excel cell'. Below the table is a graph showing a probability distribution curve. A blue arrow labeled '1' points from the graph to the 'Input variables' section of the spreadsheet.

ID	Parameter	Value
1	Distribution	LogNormal
2	Mean value	1
3	Standard deviation	0.2
4	Theoretical mean	2.7721947639643
5	Theoretical StdDev	0.560231840774295
6	Theoretical Skewness	0.815429416196663
7	Theoretical Kurtosis	3.6763657717594
8	Simulated values	Variable level
9	MS Excel document	01 - Investment Proj...
10	MS Excel worksheet	Project
11	MS Excel cell	Price

1 Input variables

The screenshot shows an Excel spreadsheet titled 'Risk-Lab - Application Example' with the following sections:

- Relevant Variables:** A table listing variables and their values, such as 'Cost of capital' (15.00%), 'Investment (US\$)' (800,000), 'Produced and sold quantities (kg/years)' (93,850), 'Annual growth of the quantities' (0.00%), 'Selling price (US\$/Kg)' (3.00), 'Annual growth of the selling price (%)' (14.00%), 'Variable costs (US\$/Kg)' (1.30), 'Annual growth of the variable costs (%)' (14.00%), 'Fixed costs (US\$/year)' (80,800), and 'Annual growth of the fixed costs (%)' (0.00%).
- Cash Flow:** A table showing cash flow over 10 years (EOY 0 to EOY 10). EOY 0 shows an investment of (800,000). EOY 1-10 show net revenues, fixed costs, and cash flows. For example, EOY 1 has a net revenue of 159,545, fixed costs of (80,000), and a cash flow of 79,545.
- Distribution of the Input variables:** A table showing the distribution for 'Selling Price' (LogNormal, 1.00, 0.20), 'Variable Costs' (Weibull, 9.00, 1.50), and 'Quantities' (Normal, 93,850, 6,700).
- Summary:** A bar chart showing cash flow over 10 years. At the bottom, 'Net Present Value' is 132,799 and 'Internal Rate of Return' is 18.10%.

A blue arrow labeled '2' points from the 'Resulting values' section of the spreadsheet back to the Risk-Lab interface.

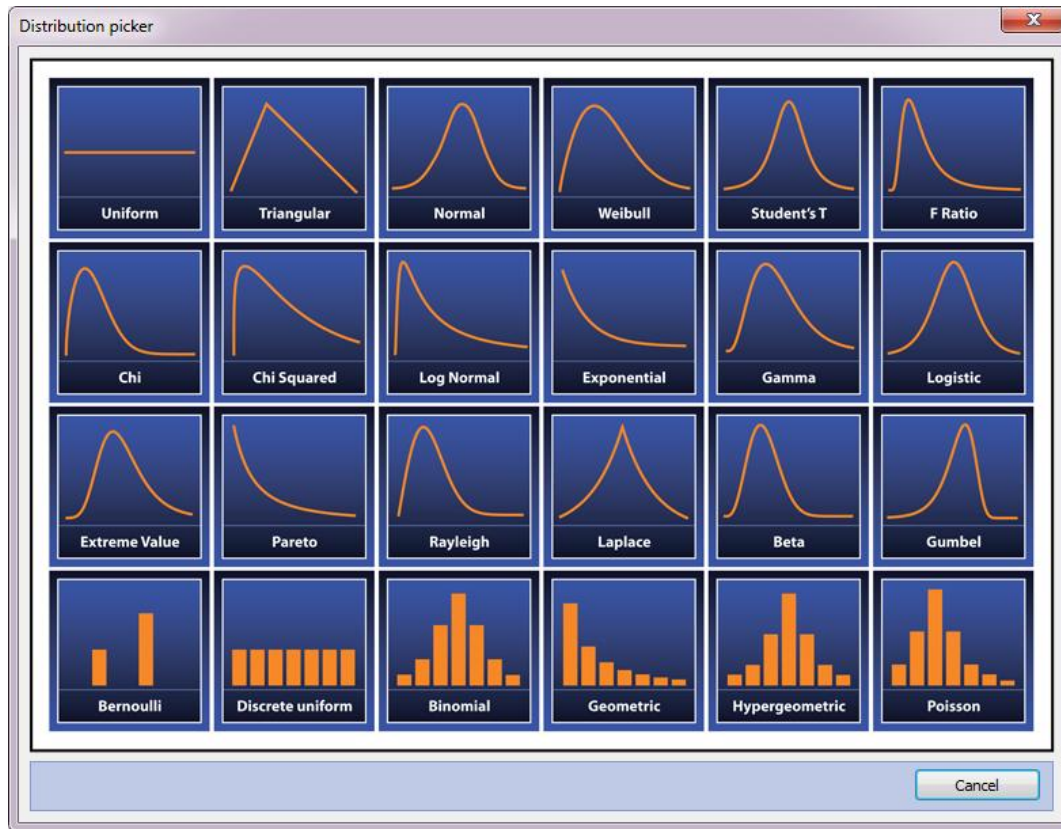
Risk-Lab Academic Edition  
Resulting values

- Risk-Lab connects to the spreadsheet operates it remotely. While the simulation is running, Risk-Lab injects the simulated values into the designated input cells, recalculates formulas and extracts resulting values from the output cells.

## Assumptions

# Statistical distributions

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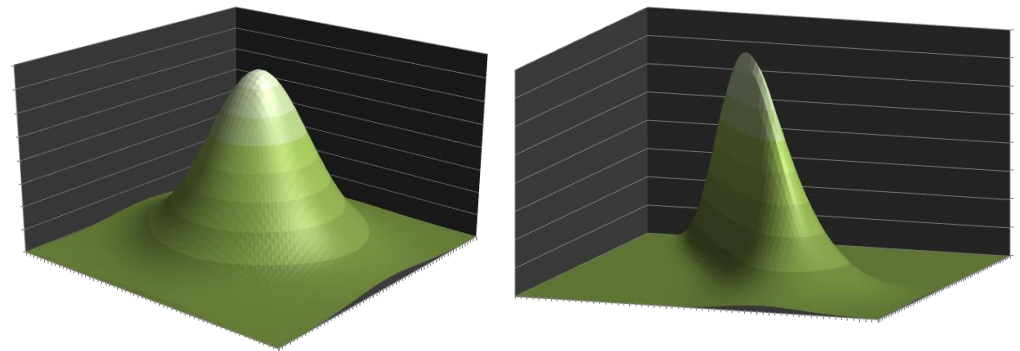
- Risk-Lab allows you to associate your assumptions to more than 20 different probability distributions, both continuous and discrete.
- Distributions can be manually or automatically parameterized, if observed data is available. Inter-variable correlations can also be automatically estimated by the program.

## Scenario generation

# Multivariate copulas

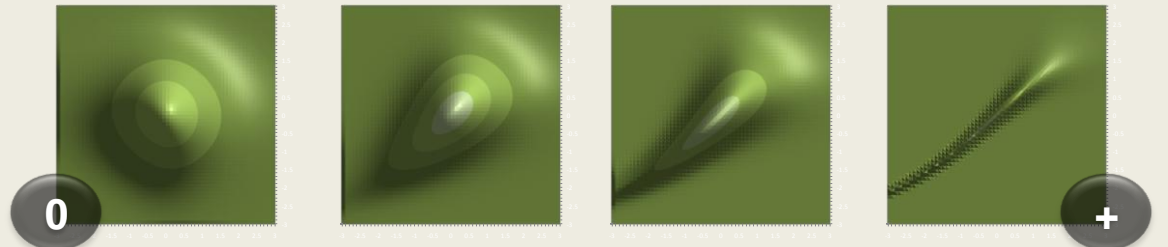
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- Risk-Lab employs advanced Elliptical and Archimedean copulas to generate random scenarios from multi-variate hybrid distributions.
- Correlations are user-definable.
- Using a random seed, a simulation process may be executed multiple times obtaining the same results.



Bivariate copulas with low and high inter-variable correlation

Density of bivariate distributions  
with different correlation levels



# Unprocessed data reporting

## Simulation results

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Corporate valuation [Model]

Input variables | Observed data | Bootstrapping | Correlations | Output variables | Simulation control | **Simulation results** | Simulation Analysis

**Simulation results**

All simulation results may be accessed here. Select the result matrix you want to explore from the list below. Right-click on any matrix to copy its contents to the clipboard.

	Real GDP	Real GDP	Real price	Population	Population	Change in	Change in	Estima
1	0.05	0.04	0.00	0.01	0.01	-0.01	0.00	
2	0.05	0.04	0.00	0.02	0.01	-0.01	0.01	
3	0.06	0.05	0.00	0.01	0.01	-0.02	0.00	
4	0.05	0.04	0.01	0.02	0.01	-0.02	0.00	
5	0.06	0.04	0.00	0.02	0.01	-0.02	0.00	
6	0.05	0.05	0.00	0.01	0.02	-0.01	0.00	
7	0.05	0.05	0.00	0.02	0.01	-0.01	-0.01	
8	0.05	0.04	0.00	0.02	0.01	-0.01	0.00	
9	0.05	0.04	0.00	0.02	0.01	-0.01	0.00	
10	0.05	0.05	0.01	0.01	0.01	-0.01	0.00	
11	0.05	0.04	0.00	0.01	0.02	-0.02	0.00	
12	0.05	0.04	0.00	0.01	0.01	-0.01	0.00	
13	0.04	0.04	0.00	0.01	0.01	-0.01	0.00	

Show: Final (correlated) variables

- Final (correlated) variables
- Uncorrelated random draws
- Cholesky decomposition
- Cholesky decomposition (adjusted)
- Resulting Pearson correlations
- Resulting Kendall's tau correlations
- Observed data Kendall's tau correlations
- MS Excel results

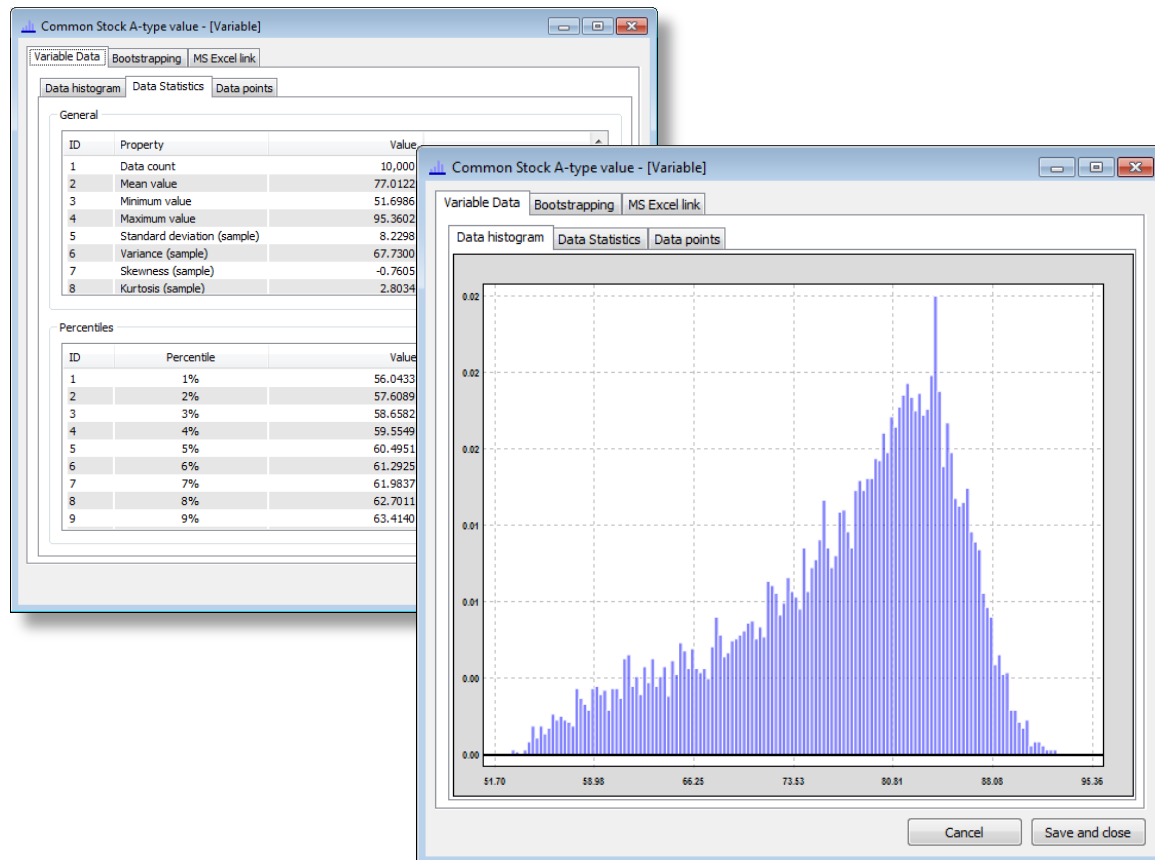
Risk-Lab presents detailed results for Monte-Carlo simulations. These raw results include:

- Correlated (final) random scenarios
- Non-correlated (initial) scenarios
- Cholesky decomposition
- Adjusted Cholesky decomposition
- Pearson correlations
- Kendall 's Tau observed correlations
- Kendall 's Tau resulting correlations
- Values of MS Excel result cells

## Results analysis

# Output distributions

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- Simulation results are summarized using histograms. Descriptive statistics for each variable are also displayed, including minimum, maximum, mean, variance, skewness, kurtosis, percentiles, and the probability of being negative.



# Results analysis

## Stress scenarios

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**Stress scenarios**

This report shows the resulting values of an output variable assuming extreme and mid values for input variables individually, maintaining all the rest of inputs constant. Each input variable may adopt its 5%, 50% and 95% quantile.

Detailed results | Graphic summary

ID	Input variable	Lower 5% response	Mid 50% response	Higher 95% response
1	Real GDP growth 2006	1,433,166.0650	1,449,597.0994	1,465,888.6385
2	Real GDP growth 200...	1,435,847.4479	1,442,273.5791	1,446,907.9898
3	Real price change 20...	1,416,449.0325	1,440,875.2158	1,465,732.4031
4	Population growth 20...	1,453,962.9431	1,438,450.8224	1,391,621.1298
5	Population growth 20...	1,430,123.4002	1,437,705.6813	1,444,594.8137
6	Change in Market sha...	1,432,194.7791	1,449,522.8023	1,466,938.8163
7	Change in Market sha...	1,419,859.5552	1,434,602.9527	1,449,727.8798
8	Estimated Annual Infl...	1,406,618.1071	1,429,559.0562	1,453,144.4466
9	EBIT Margin	1,340,582.2028	1,394,227.1165	1,447,938.4706
10	Sales turnover	1,414,140.1224	1,469,877.4975	1,510,665.2237
11	Expected Market Risk...	1,521,479.5047	1,471,767.8685	1,424,995.0347
12	Comparable's Long T...	1,484,917.8377	1,456,104.1845	1,412,659.9177
13	Comparable's Interes...	1,438,451.1687	1,441,276.0039	1,443,593.0374
14	Long Term Growth	1,430,386.6269	1,448,685.4624	1,469,782.9798
15	Political Rights' premium	1,441,575.3765	1,441,575.3765	1,441,575.3765

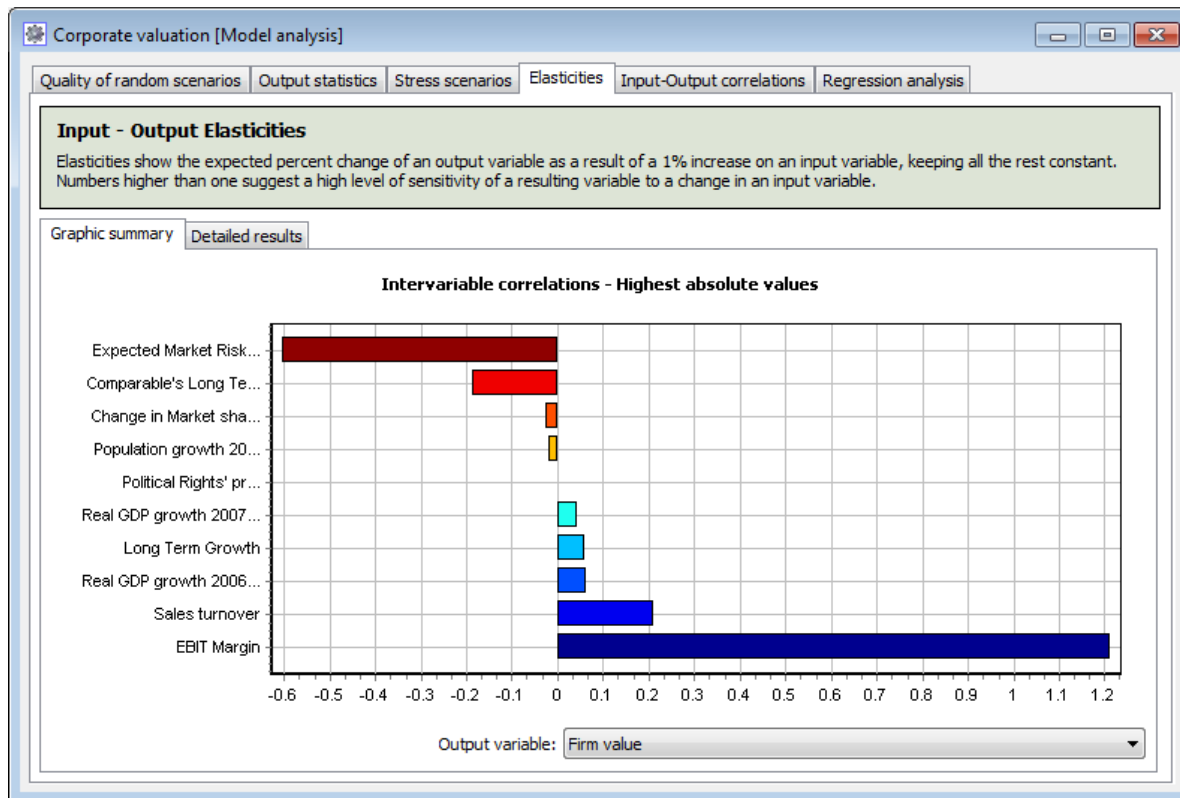
Show assumed values in table      Output variable: Firm value

- As part of the stress-testing phase, the system automatically evaluates extreme scenarios for each of the input variables and calculates their impact on result variables.

## Results analysis

# Input/output elasticities

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- Elasticities show the proportional impact that a 1% variation in input variables produces on output variables.
- Risk-Lab presents a ranking of all elasticities related to a selected output variable, allowing a quick identification of the key instruments that may alter results.

# Results analysis

# Multivariate regression

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Corporate valuation [Model analysis]

Quality of random scenarios | Output statistics | Stress scenarios | Elasticities | Input-Output correlations | Regression analysis

**Input - Output multivariate regression**

Regression analysis allows to statistically estimate and evaluate the individual impact of input variables on the outputs. The estimated coefficients show the average output increase if the input variable increases one unit. A t-Prob lower than 0.05 would suggest a statistically significant impact.

ID	Variable	Coefficient	Std. Error	t-Value	t-Prob
1	(Constant)	20.8857	7.4623	2.7988	0.0053
2	Real GDP growth 2006	57.3020	22.5921	2.5364	0.0115
3	Real GDP growth 2007 - 2...	52.6457	45.1839	1.1651	0.2445
4	Real price change 2006 - ...	130.6672	22.5920	5.7838	0.0000
5	Population growth 2006 - ...	-91.8529	22.5921	-4.0657	0.0001
6	Population growth 2011 - ...	-29.5986	45.1866	-0.6550	0.5128
7	Change in Market share 2...	107.6553	22.5953	4.7645	0.0000
8	Change in Market share 2...	197.4948	45.1841	4.3709	0.0000
9	Estimated Annual Inflation	163.1760	45.1849	3.6113	0.0003
10	EBIT Margin	113.6852	11.2960	10.0642	0.0000
11	Sales turnover	21.7323	2.2592	9.6193	0.0000
12	Expected Market Risk Pre...	-407.2367	45.1860	-9.0125	0.0000
13	Comparable's Long Term ...	-361.1553	45.1843	-7.9929	0.0000
14	Comparable's Interest Ra...	45.9282	225.9697	0.2032	0.8390
15	Long Term Growth	273.2796	45.1838	6.0482	0.0000
16	Political Rights' premium	5.5294	0.0858	64.4403	0.0000

Regression statistics: R2 = 0.9052; F-Stat = 308.0382; F-Prob = 0.0000

Output variable: Common Stock A-type value

- Multivariate regression analysis makes it possible to identify the marginal impact of each input variable on outputs once the effect of all the rest of variables is simultaneously considered.
- Risk-Lab also presents indicators that help to assess the statistical relevance of individual impacts.
- Employing easy-to-read flags, the program classifies variables according to their statistical significance.

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## Main applications

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## Finance

- Capital budgeting
- Derivatives valuation
- Corporate valuation
- Value-at-Risk calculation

## Operations

- Critical route analysis in project management
- *Six Sigma* evaluation
- Decision-tree analysis

## Marketing

- Sensitivity analysis of sales forecasts



**Risk-Lab**

# Contact information

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