



► Strategic Portfolio Optimization and Simulation

# OPTIFOLIO

OptiFolio  
**Solution overview**

OPPF

**Portfolio optimization  
including Stocks Fixed  
income and multiple  
currencies.**

**Markowitz-Sharpe, Black  
and Black-Litterman  
models.**

**Interactive exploration of  
efficient investment  
strategies.**

**Portfolio performance  
attribution.**

**Monte-Carlo forecasting  
of assets and portfolio  
value.**

**Key indicators for  
strategic asset  
allocation decisions.**

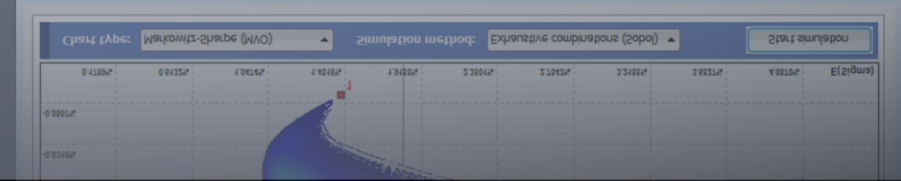
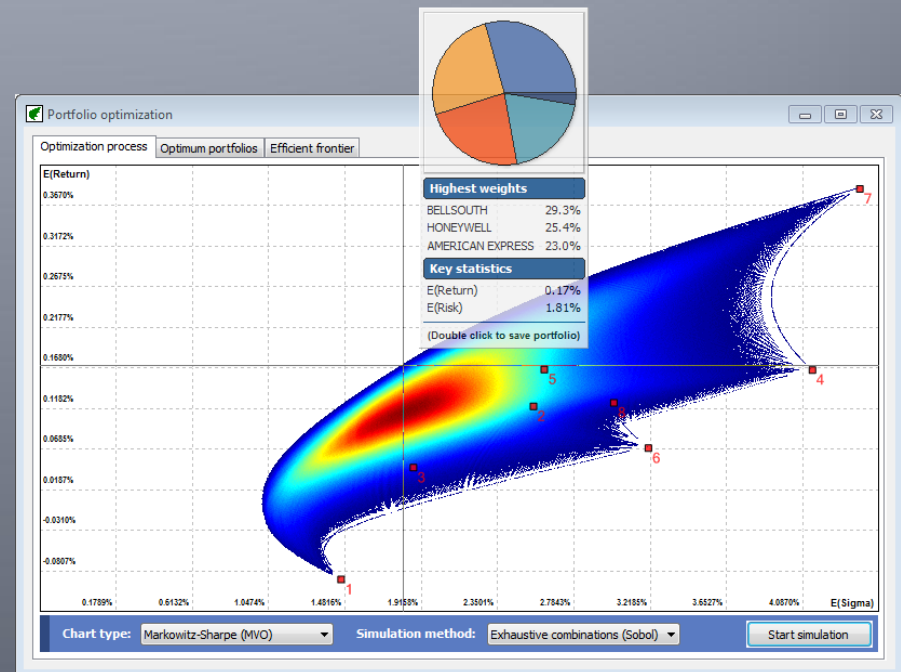
# OptiFolio

## Solution overview

# OPPF

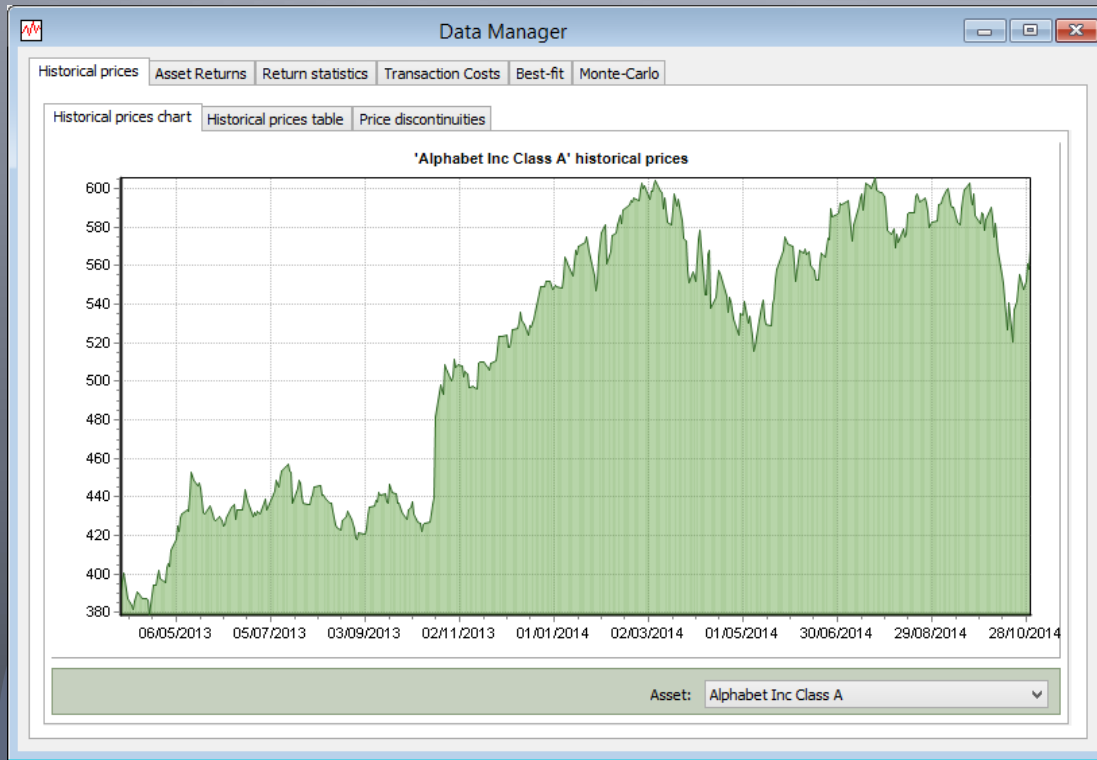
### Key features

- ▶ Interactively visualize all feasible investment portfolios on the Risk/Return plane given a set of investable assets, considering investment limits and portfolio benchmarks.
- ▶ Import prices from MS Excel® worksheets, comma or tab-separated files or directly from the web.
- ▶ Find the optimum portfolio composition applying either the classical Nobel-awarded Markowitz model or the Basel III Conditional-Value-at-Risk model.
- ▶ Conduct Monte-Carlo simulations to forecast the value of portfolios or individual assets, apply Performance Attribution Models, define Risk Factors mapping and more.



# Data manager

- The system allows you to explore the historical prices, returns, correlations and covariances. The user may enter different assumptions to be used as expected values.



bootstrapping | Monte Carlo

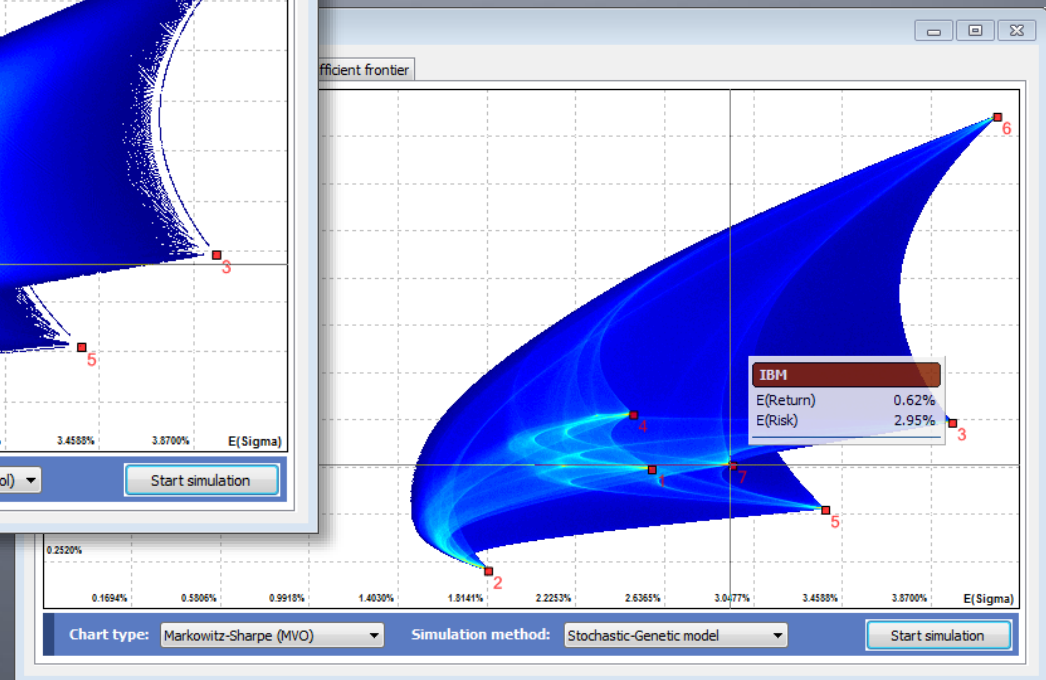
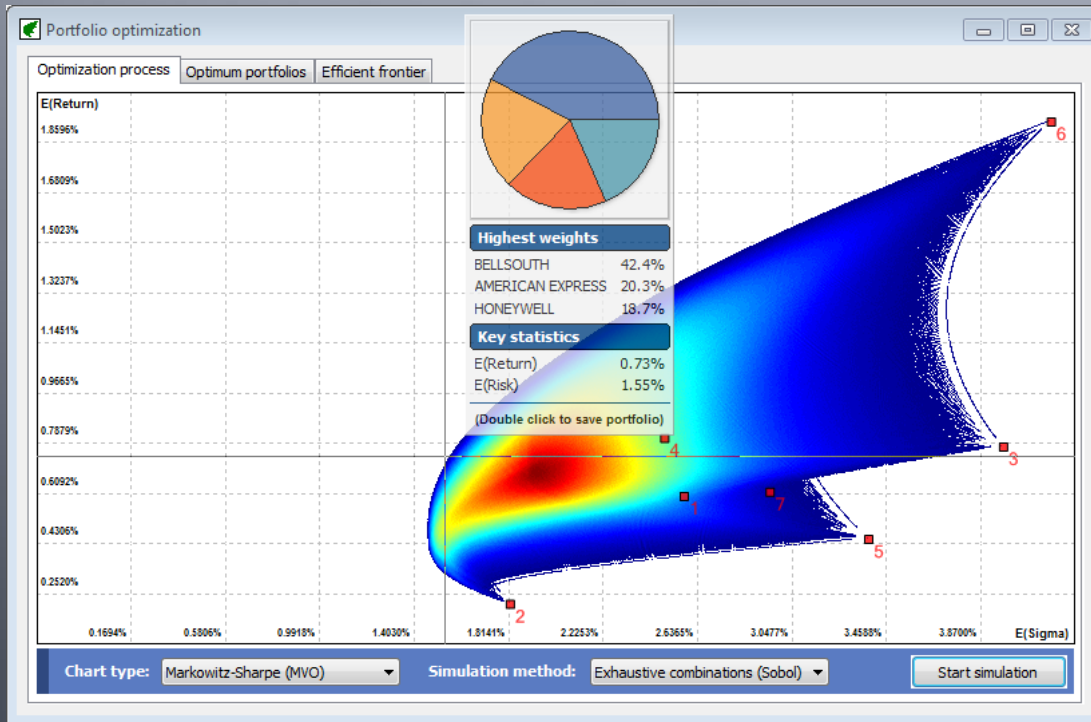
Assume independency Matrix is positive definite

	COCACOLA	DELL	GE	HONEYWELL	IBM
5	0.0009	0.0010	0.0008	0.0008	0.0011
7	0.0001	0.0006	0.0005	0.0001	0.0004
1	0.0086	0.0023	0.0021	0.0063	0.0040
5	0.0023	0.0034	0.0023	0.0021	0.0019
5	0.0021	0.0023	0.0051	0.0022	0.0020
1	0.0063	0.0021	0.0022	0.0097	0.0041
4	0.0040	0.0019	0.0020	0.0041	0.0045

Note: All statistics are calculated and should be entered considering Holding Period returns

# Feasible investment area

- Interactive charts show the feasible investment area and the efficient frontier.
- Color represent the portfolio density in each combination of risk and return.
- The user can select two methods to produce the chart (random or quasi-random).
- The analysis can employ either a Markowitz-Sharpe or Conditional VaR approach.



# Optimum portfolios

- The program automatically reports the minimum risk and maximum risk-adjusted return portfolios.
- These optimum portfolios (as well as any portfolio on the efficient frontier) can be saved to the Portfolio Manager module for further analysis.

**Portfolio optimization**

Optimization process | **Optimum portfolios** | Efficient frontier

**Optimum portfolios**

The following report details the composition and main statistics of two notable portfolios resulting from the optimization: the minimum-risk portfolio and the portfolio with the highest risk-adjusted return.

ID	Asset	Optimum Min StdDev	Optimum Max Sharpe
1	AMERICAN EXPRESS	18.52%	24.65%
2	BELLSOUTH	55.56%	11.64%
3	COCACOLA	3.70%	0.00%
4	DELL	7.41%	24.17%
5	GE	7.41%	0.00%
6	HONEYWELL	0.00%	39.55%
7	IBM	7.41%	0.00%
8	E(Return)	0.0816%	0.2291%
9	E(StdDev)	1.5369%	2.3250%
10	Sharpe	0.0531	0.0986

Save optimum portfolios to Portfolio Manager:

# Alternative portfolio optimization criteria

- **Sharpe ratio**

(Risk-adjusted return)

$$Sh = \frac{E(r_p) - r_f}{E(\sigma_{r_p})}$$

- **Investor utility**

(Considering Arrow-Pratt risk-aversion)

$$U = E(r_p) - 0.005 \cdot A \cdot E(\sigma_{r_p}^2)$$

- **Conditional VaR**

(Extreme losses expected value)

$$CVaR = E(r_p, r_p < VaR)$$

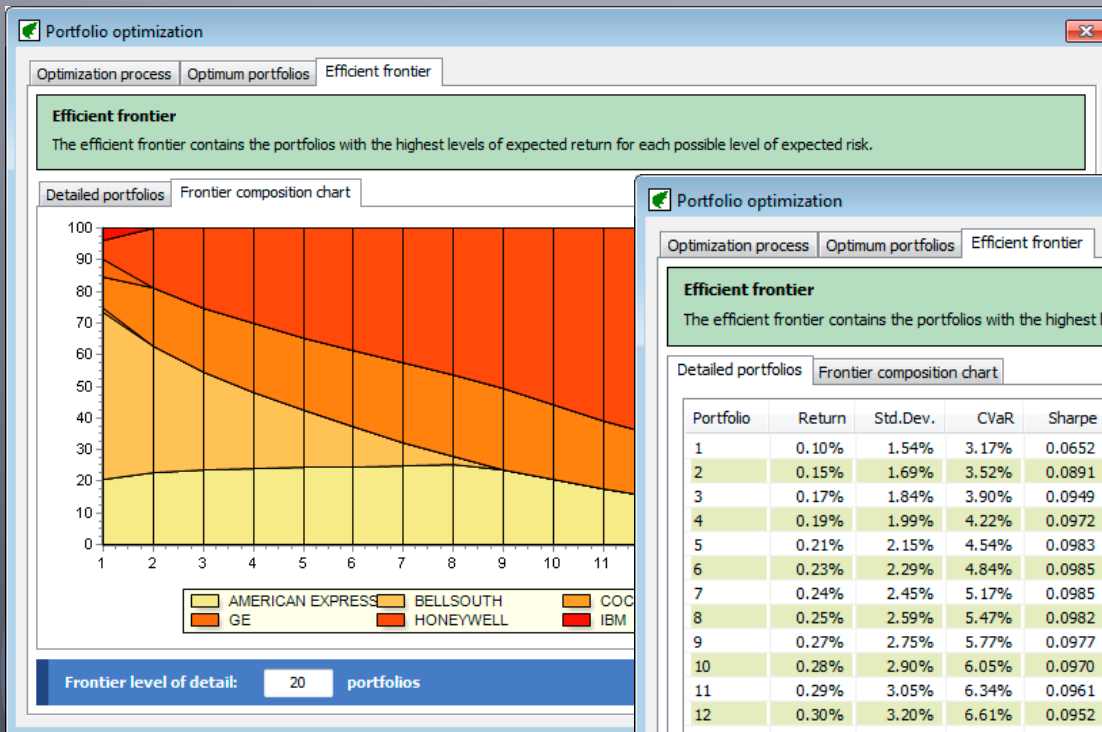
- **Keating's Omega™**

(Non-parametric risk-adjusted return)

$$\Omega^{\text{TM}} = \frac{\sum_{r_t > b} (r_t - b)}{\sum_{r_t < b} (b - r_t)}$$

# Efficient frontier exploration

- OptiFolio reports all optimal positions along the efficient frontier, including key statistics for each portfolio.
- The user can select the level of detail (number of portfolios) along the frontier.



**Efficient frontier**  
The efficient frontier contains the portfolios with the highest levels of expected return for each possible level of expected risk.

Detailed portfolios | Frontier composition chart

Portfolio	Return	Std.Dev.	CVaR	Sharpe	AMERICAN EXPRESS	BELL SOUTH	COCA COLA	DELL	GE
1	0.10%	1.54%	3.17%	0.0652	20.62%	52.64%	1.23%	10.24%	5.31%
2	0.15%	1.69%	3.52%	0.0891	22.88%	39.89%	0.00%	18.23%	0.00%
3	0.17%	1.84%	3.90%	0.0949	23.41%	31.15%	0.00%	20.06%	0.00%
4	0.19%	1.99%	4.22%	0.0972	23.92%	24.34%	0.00%	21.51%	0.00%
5	0.21%	2.15%	4.54%	0.0983	24.26%	18.24%	0.00%	22.76%	0.00%
6	0.23%	2.29%	4.84%	0.0985	24.59%	12.78%	0.00%	23.92%	0.00%
7	0.24%	2.45%	5.17%	0.0985	25.05%	7.26%	0.00%	25.10%	0.00%
8	0.25%	2.59%	5.47%	0.0982	25.37%	2.38%	0.00%	26.04%	0.00%
9	0.27%	2.75%	5.77%	0.0977	23.75%	0.00%	0.00%	25.42%	0.00%
10	0.28%	2.90%	6.05%	0.0970	20.73%	0.00%	0.00%	23.45%	0.00%
11	0.29%	3.05%	6.34%	0.0961	17.64%	0.00%	0.00%	21.61%	0.00%
12	0.30%	3.20%	6.61%	0.0952	14.92%	0.00%	0.00%	19.77%	0.00%
13	0.32%	3.35%	6.90%	0.0942	12.17%	0.00%	0.00%	17.93%	0.00%
14	0.33%	3.50%	7.19%	0.0933	9.54%	0.00%	0.00%	16.27%	0.00%
15	0.34%	3.65%	7.48%	0.0923	6.91%	0.00%	0.00%	14.52%	0.00%

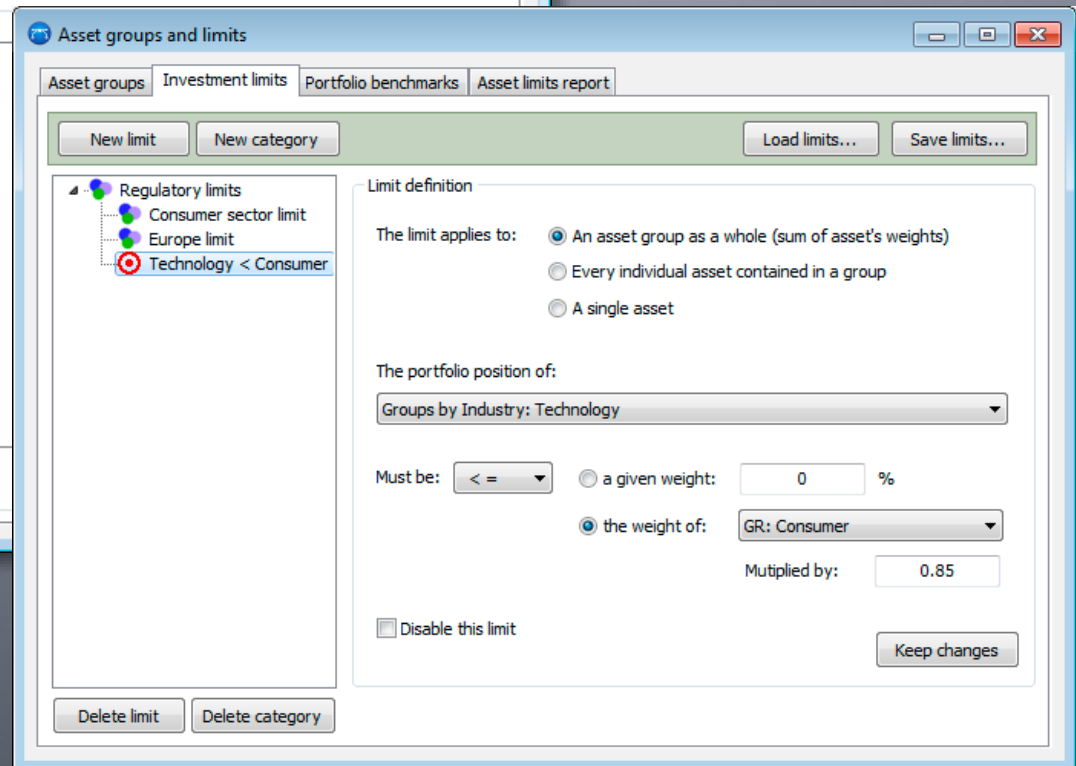
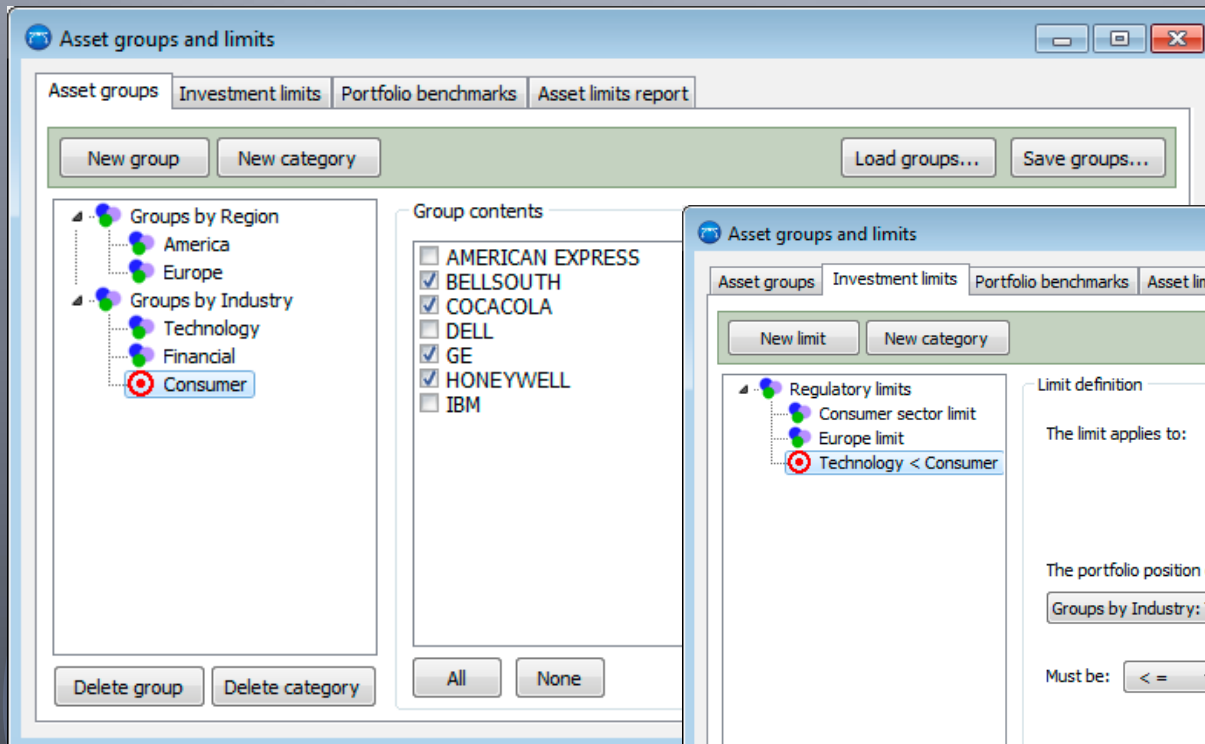
Frontier level of detail: 20 portfolios

Refresh



# Asset groups and investment limits

- Manage any number of asset group categories and investment limits
- Conveniently manage this information using MS Excel files.



# Portfolio benchmarks and turnover limits

- Previously saved portfolios can be used as benchmarks in order to find optimum positions that do not exceed certain turnover threshold (position differences).
- The turnover can be expressed either individually (for each asset) or globally (total turnover).
- Additional constraints on total portfolio risk or return can also be considered.

The screenshot shows a software window titled "Asset groups and limits" with four tabs: "Asset groups", "Investment limits", "Portfolio benchmarks", and "Asset limits report". The "Portfolio benchmarks" tab is active.

**Turnover limit**

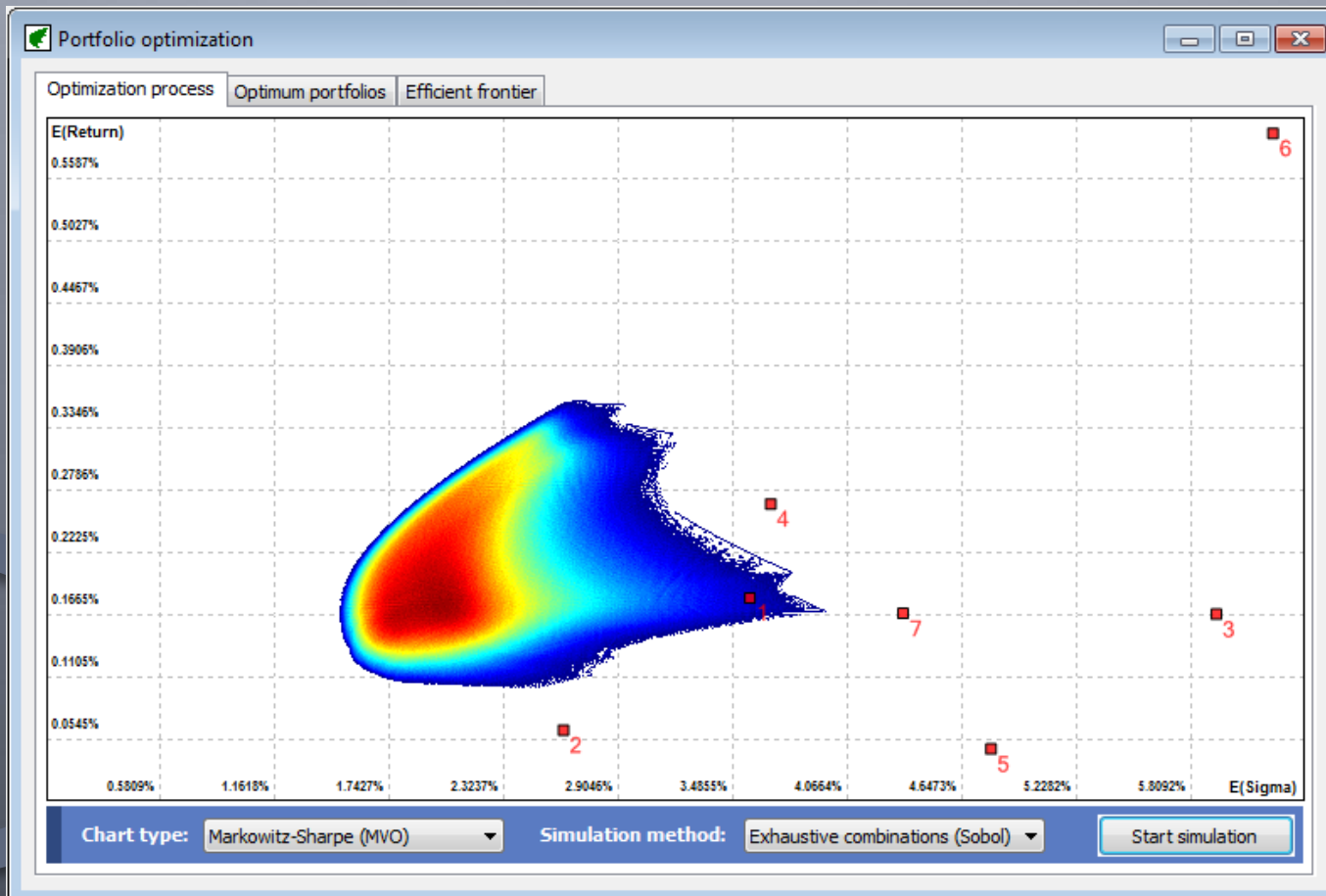
Limit **Individual** asset turnover to:  % relative to portfolio: **My Best Sharpe**

**Risk and Return limits**

	Minimum		Maximum	
<input type="checkbox"/> Limit portfolio Return to:	<input type="text" value="0"/> %	-	<input type="text" value="100"/> %	<input type="text" value="Per year"/>
<input checked="" type="checkbox"/> Limit portfolio Risk to:	<input type="text" value="0"/> %	-	<input type="text" value="25"/> %	<input type="text" value="Per year"/>

# The feasible area affected by constraints

- When constraints are entered, the feasible area automatically shrinks to reflect only portfolios that comply with all the limits.



# Risk-Factor Mapping

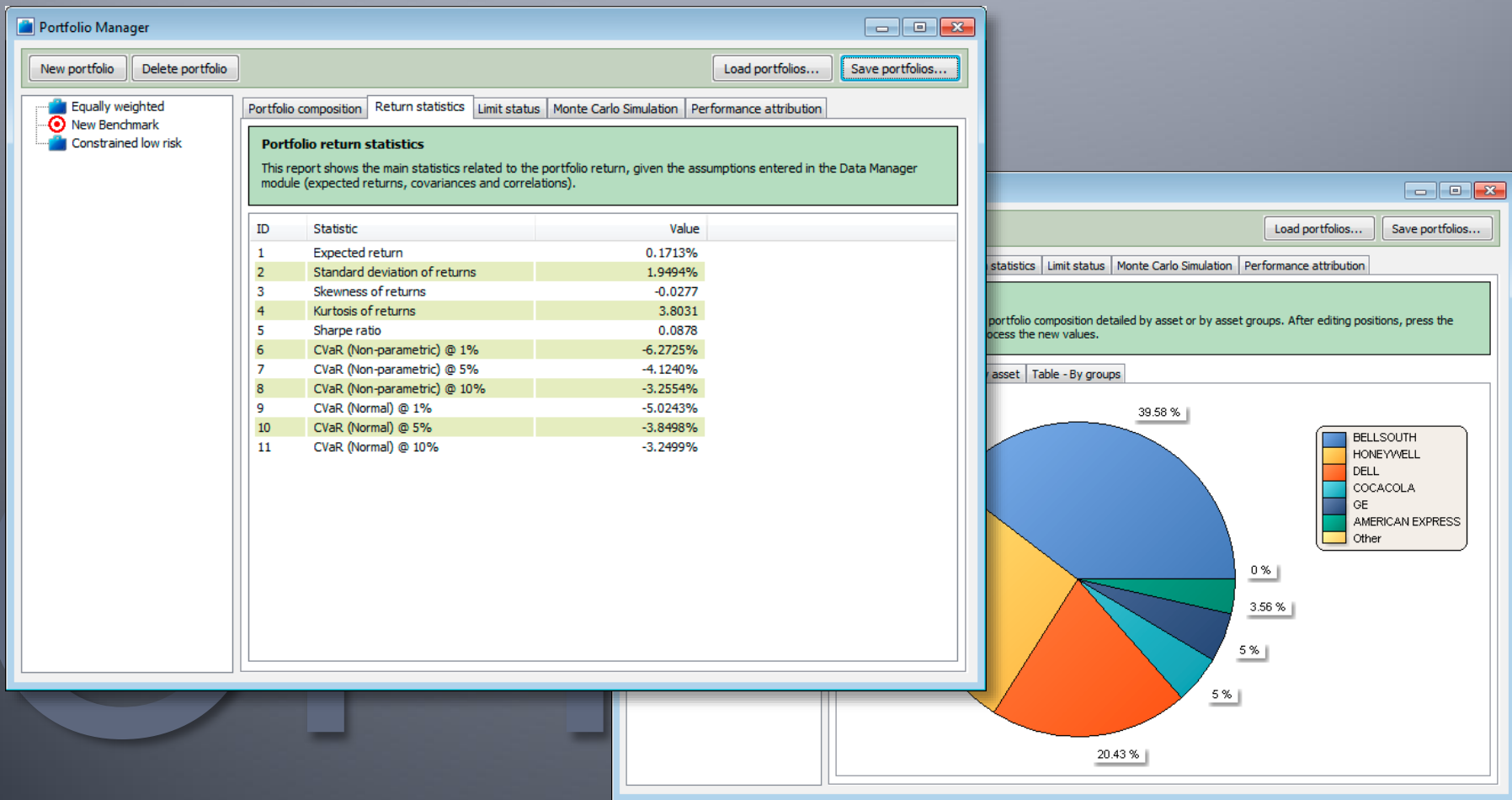
- In addition to investable assets, import data from risk-factors (e.g. interest rates, exchange rates, stock indices, inflation, etc.).
- Define the sensitivity of each asset relative to risk-factors.
- Risk-Factor mapping allows the user to work with multi-currency portfolios and include derivatives, complex and even illiquid assets.

The screenshot shows a software window titled "Manage Risk Factors" with two tabs: "Define Risk Factors" and "Map Risk Factors to Assets". The "Map Risk Factors to Assets" tab is active. Below the tabs is a green header box with the title "Risk factors mapping" and a descriptive paragraph: "Enter the coefficients that represent the sensitivity of each asset to changes in the corresponding Risk Factors. A coefficient of 1.2, for instance, would mean that a 10% increase in the risk factor would be associated to a 12% increase in the asset value." To the right of this text is a button labeled "Estimate asset statistics". Below the text is a table with 11 columns and 8 rows. The columns are labeled "Assets \ Risk Factors", "BANK OF", "COCACOLA", "WALMART", "BUENAVENTURA", "RATE\_0\_30", "RATE\_31\_180", "RATE\_181\_360", "RATE\_361\_1080", "RATE\_1081\_", and "USDPEN". The rows are labeled "BANK OF AMERICA", "COCACOLA", "WALMART", "BUENAVENTURA", "BOND 2031", and "BOND 2018". The table contains numerical coefficients, with some cells highlighted in yellow (positive sensitivity) and others in red (negative sensitivity). At the bottom of the window is a checkbox labeled "Use color highlighting" which is checked.

Assets \ Risk Factors	BANK OF	COCACOLA	WALMART	BUENAVENTURA	RATE_0_30	RATE_31_180	RATE_181_360	RATE_361_1080	RATE_1081_	USDPEN
BANK OF AMERICA	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
COCACOLA	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
WALMART	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BUENAVENTURA	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
BOND 2031	0.0000	0.0000	0.0000	0.0000	-0.0100	-0.2500	-0.6500	-2.1000	-8.9000	0.0000
BOND 2018	0.0000	0.0000	0.0000	0.0000	-0.0500	-0.1500	-0.4000	-1.1000	0.0000	0.0000

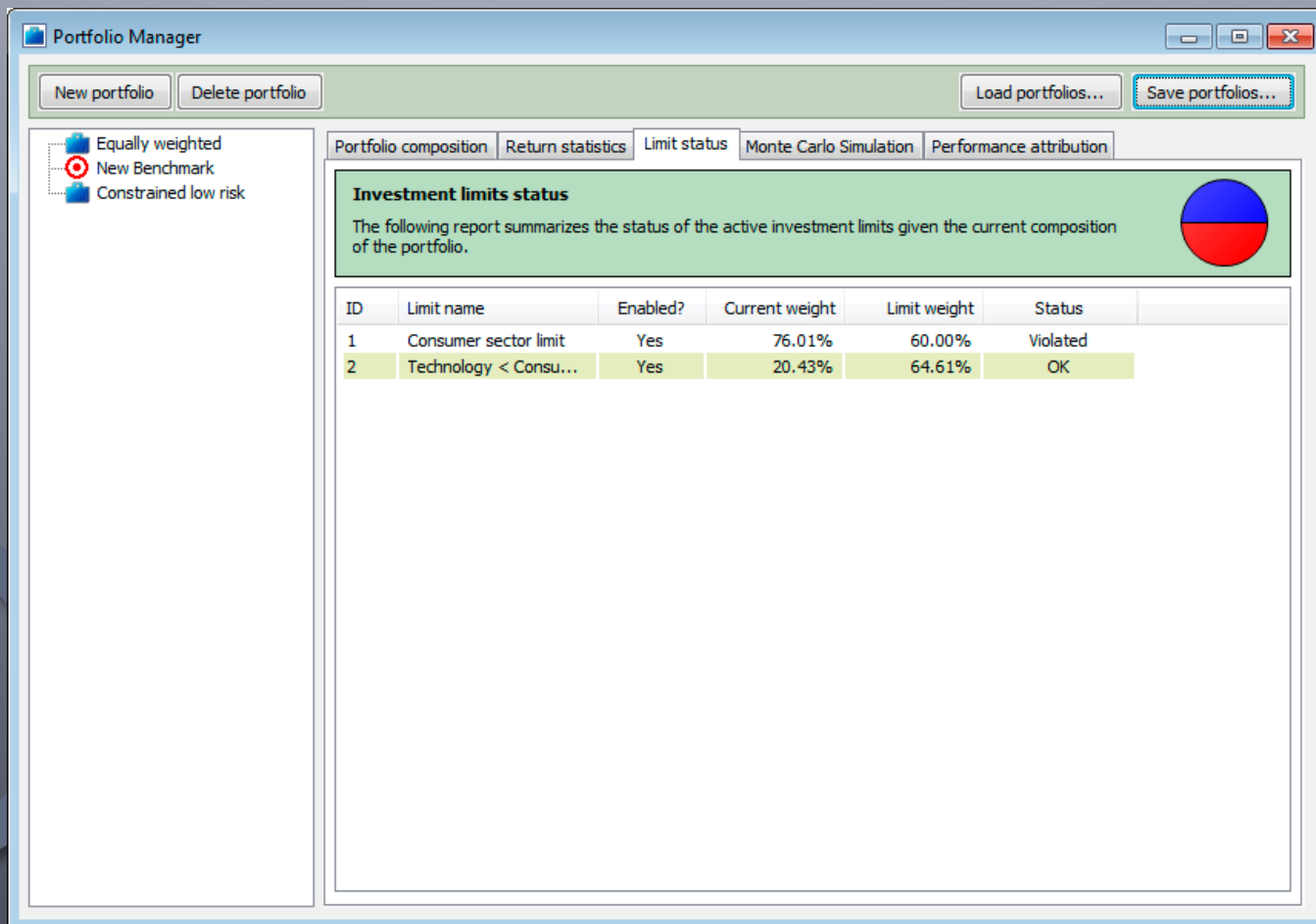
# Portfolio Manager

- The user can manage any number of portfolios inside a specialized interface.
- All optimum portfolios can be added interactively from the optimization window.
- Portfolios can be stored in and retrieved from MS Excel® files.



# Portfolio limits report

- The system automatically evaluates each investment constraint for all portfolios and report which limits are being met and which are being violated given the portfolio positions.



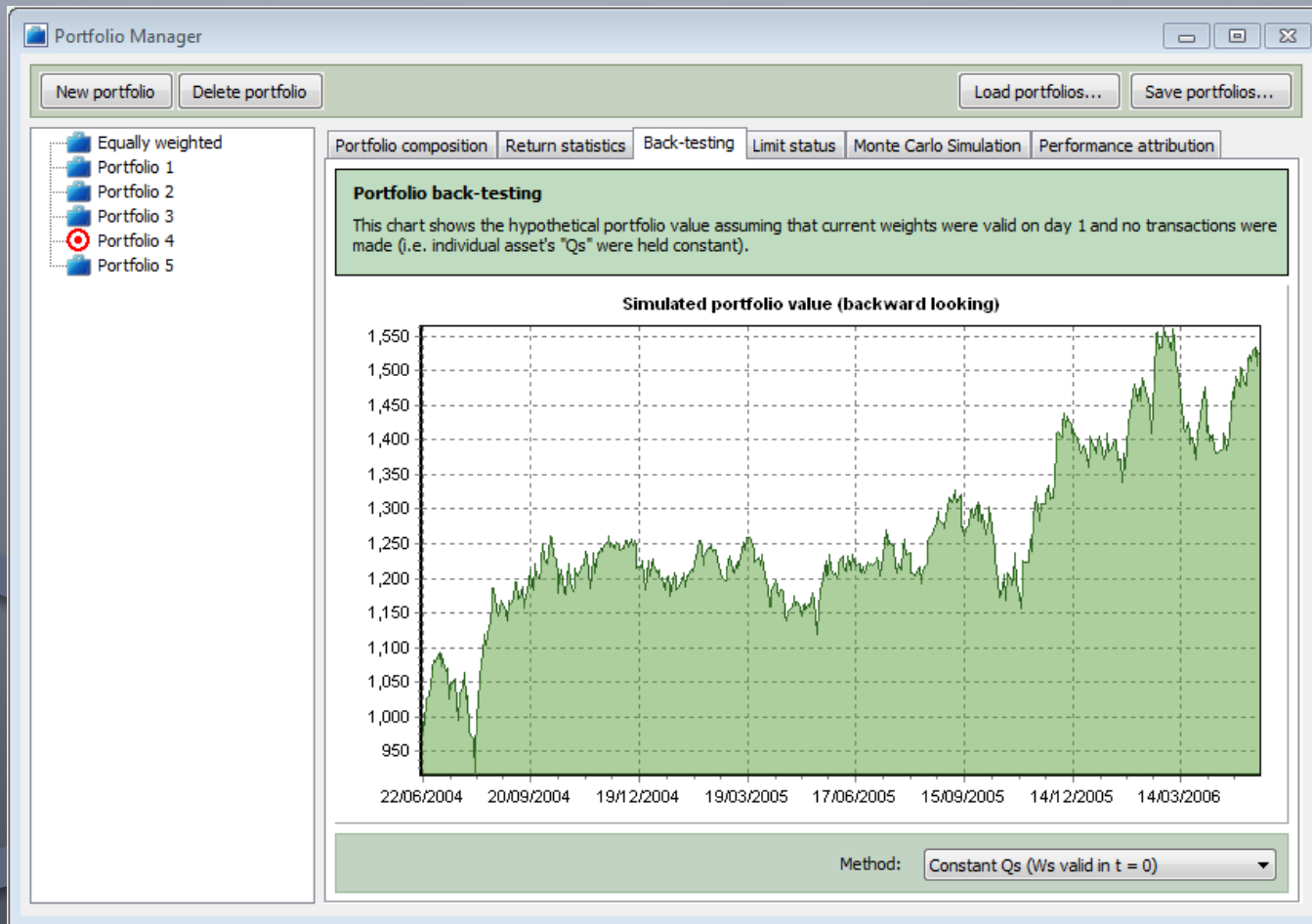
The screenshot displays the 'Portfolio Manager' application window. The interface includes a top toolbar with buttons for 'New portfolio', 'Delete portfolio', 'Load portfolios...', and 'Save portfolios...'. Below the toolbar, there are tabs for 'Portfolio composition', 'Return statistics', 'Limit status', 'Monte Carlo Simulation', and 'Performance attribution'. The 'Limit status' tab is active, showing a section titled 'Investment limits status' with a red and blue circular icon. The text below the title reads: 'The following report summarizes the status of the active investment limits given the current composition of the portfolio.'

ID	Limit name	Enabled?	Current weight	Limit weight	Status
1	Consumer sector limit	Yes	76.01%	60.00%	Violated
2	Technology < Consu...	Yes	20.43%	64.61%	OK

On the left side of the interface, there is a list of portfolio types: 'Equally weighted', 'New Benchmark' (which is selected with a red target icon), and 'Constrained low risk'.

# Portfolios Back-testing

- Employing transaction costs entered by the user, OptiFolio estimates the net return of an strategy after costs of rebalancing.



# Investor views

- The Views Manager allows the user to manage sets of assumptions about the future behavior of assets and their relative returns.
- This information can then be fed into the Black-Litterman model in order to produce improved investment strategies recommendations.

The screenshot shows the 'Investor Views' application window. The title bar includes a lightbulb icon and the text 'Investor Views'. Below the title bar, there are window control buttons (minimize, maximize, close). The main content area is titled 'Define Views' and 'Black-Litterman expected returns'. A green box contains the text: 'Investor Views - Black-Litterman Model. Each view establishes the an expected return for a portfolio with the given weights. Long and short positions can be combined in order to define a relative return portfolio (typically when the weights add up to zero). Strictly long weights can be used to define absolute expected returns.' Below this text are two buttons: 'New set of views' and 'New view'. On the left, a tree view shows a hierarchy: 'Principal' (expanded) with sub-items 'Tecnológicas' and 'Consumo'. On the right, a table displays the expected returns for various assets. The table has three columns: 'Asset', 'Tecnológicas', and 'Consumo'. The rows are: AMERICAN (0, 0), BELLSOUTH (0, 0), COCACOLA (0, 1), DELL (1, 0), GE (0, 0), HONEYWELL (0, 0), IBM (-1, 0), and Return (p/y) (0.05, 0.12). A note at the bottom states: 'Note: View's returns should be entered as annualized values (they will be converted to HP-returns using a simple interest transformation).'

Asset	Tecnológicas	Consumo
AMERICAN	0	0
BELLSOUTH	0	0
COCACOLA	0	1
DELL	1	0
GE	0	0
HONEYWELL	0	0
IBM	-1	0
Return (p/y)	0.05	0.12



# Black-Litterman modeling

- OptiFolio automates the application of the Black-Litterman Bayesian model and generates the adjusted expected returns for the investment assets. These returns can then be used to generate an improved set of efficient portfolios.

The screenshot shows a software window titled "Investor Views" with a sub-tab "Black-Litterman expected returns". The main content area is titled "Expected asset returns - Black-Litterman Model" and contains a table of data for seven assets. Below the table are several control elements: "Investor set of views" set to "Principal", "Market Portfolio" set to "Equally weighted", "Risk-aversion factor" set to "Low risk aversion [A=2]", and a button labeled "Use results as expected asset returns".

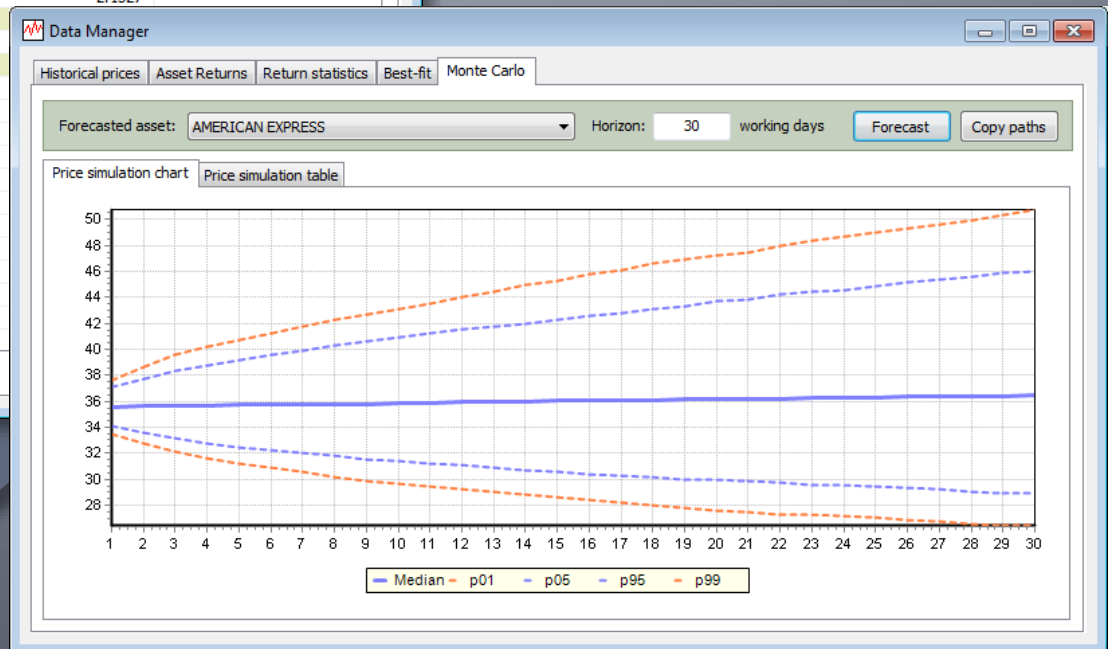
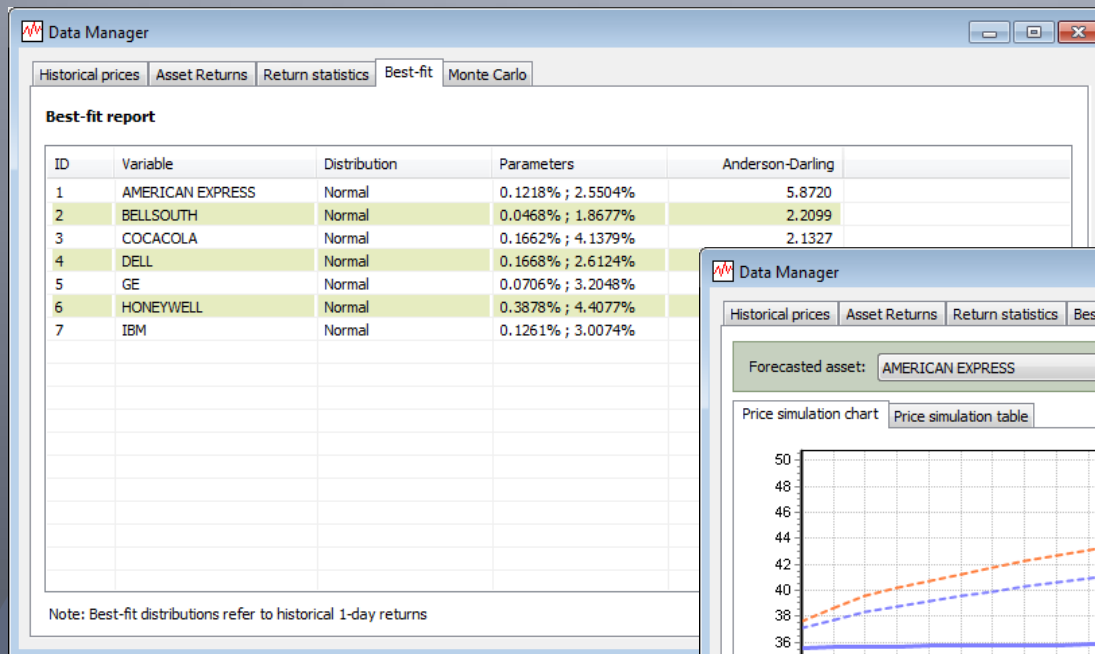
**Expected asset returns - Black-Litterman Model**  
The base returns for this model are Black's equilibrium returns (obtained as a result of a reverse optimization process). Each investor view adds some information to a Bayesian analysis that combines this new information with the prior returns in order to improve the quality of the estimation.

ID	Asset	Black's HP Return (1 day)	Black's p/y (Compound)	Black's p/y (Simple)	B-L Adjustment (1 day)	B-L HP Return (1 day)	B-L p/y (Compound)	B-L p/y (Simple)
1	AMERICAN EXPRESS	0.0480%	12.85%	12.09%	-0.0050%	0.0430%	11.43%	10.83%
2	BELLSOUTH	0.0234%	6.08%	5.91%	0.0004%	0.0238%	6.19%	6.01%
3	COCACOLA	0.1387%	41.79%	34.94%	-0.0493%	0.0894%	25.24%	22.52%
4	DELL	0.0776%	21.60%	19.57%	-0.0043%	0.0734%	20.30%	18.49%
5	GE	0.0863%	24.29%	21.75%	-0.0089%	0.0774%	21.53%	19.51%
6	HONEYWELL	0.1454%	44.23%	36.65%	-0.0395%	0.1060%	30.59%	26.70%
7	IBM	0.1028%	29.56%	25.91%	-0.0310%	0.0718%	19.83%	18.10%

Investor set of views:    
Market Portfolio:    
Risk-aversion factor:

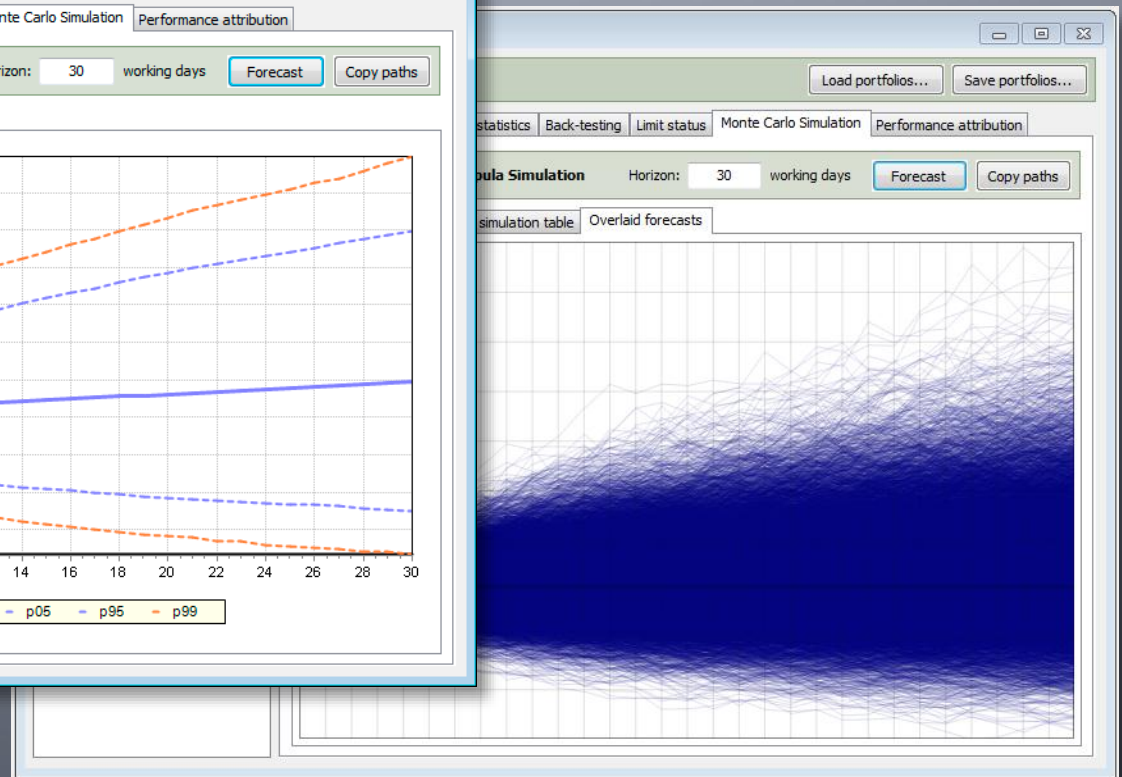
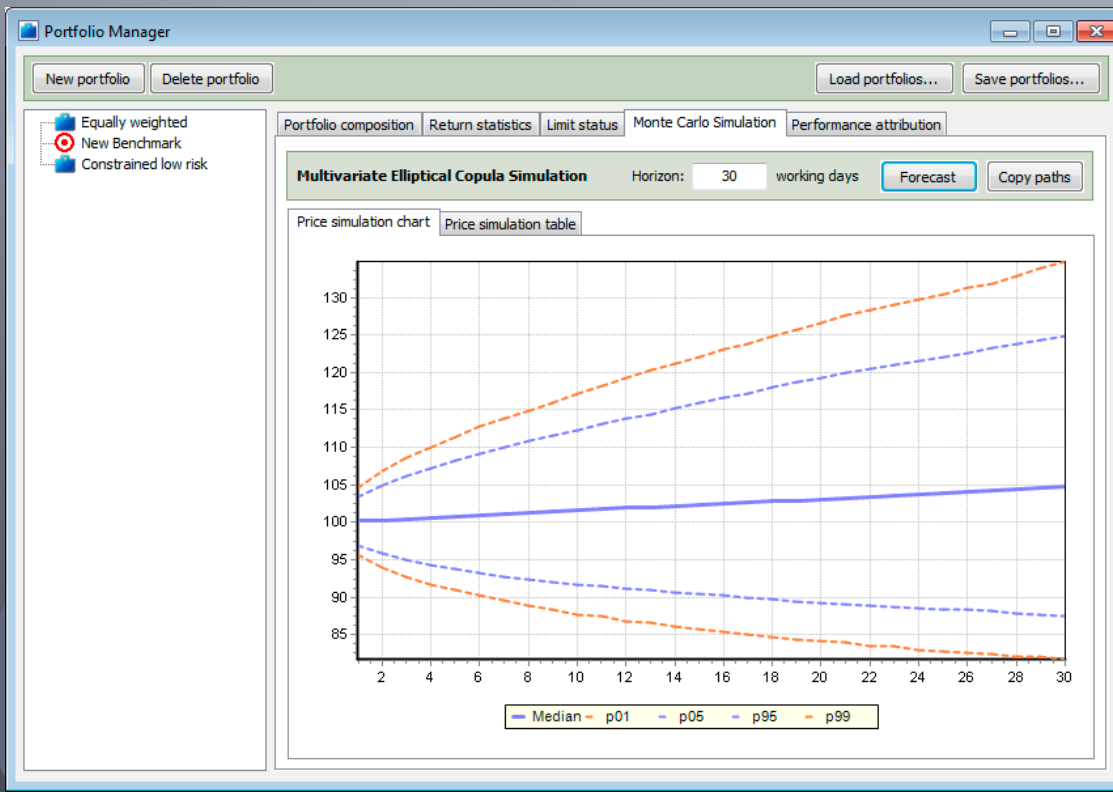
# Best-fitting probability distributions

- OptiFolio identifies the best distributions to represent asset returns for Monte-Carlo simulations. Data generation employs multi-variate copulas.



# Portfolio Monte-Carlo simulation

- Using multivariate elliptical copulas, future portfolio values can be forecasted for thousands of possible outcomes. The software reports key confidence intervals for the expected portfolio values.



# Performance attribution

- Applying the Brinson model, OptiFolio decomposes the return difference between the portfolio under analysis and any benchmark portfolio. Results show the return attributable to *Asset Allocation* and *Security Selection*, employing any asset grouping criteria.

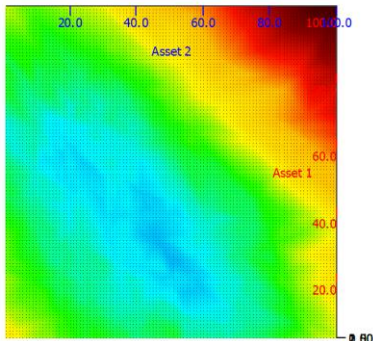
The screenshot displays the 'Portfolio Manager' application window. The 'Performance attribution' tab is active, showing a detailed table of results. The table includes columns for ID, Group name, W(Port), W(Bench), Ret(Port), Ret(Bench), Asset Alloc., Security Sel., Interaction, and Total. The data is as follows:

ID	Group name	W(Port)	W(Bench)	Ret(Port)	Ret(Bench)	Asset Alloc.	Security Sel.	Interaction	Total
1	Technology	21.19%	28.57%	72.28%	52.56%	-3.88%	5.63%	-1.46%	0.30%
2	Financial	23.80%	14.29%	-11.94%	-11.94%	-1.14%	0.00%	0.00%	-1.14%
3	Consumer	55.01%	57.14%	121.88%	91.39%	-1.95%	17.42%	-0.65%	14.82%
4	TOTAL	100.00%	100.00%	79.52%	65.54%	-6.96%	23.06%	-2.11%	13.99%

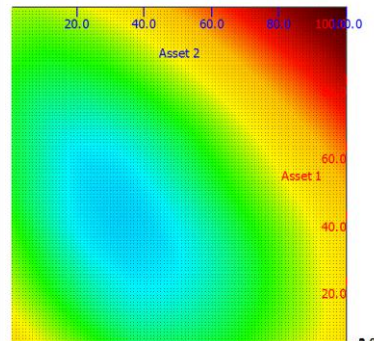
Below the table, the 'Analyze from date' is set to 18/05/2005 and the 'to date' is 19/05/2006. The 'Benchmark' is set to 'Equally weighted' and the 'Grouping' is set to 'Groups by Industry'.

# Experiment

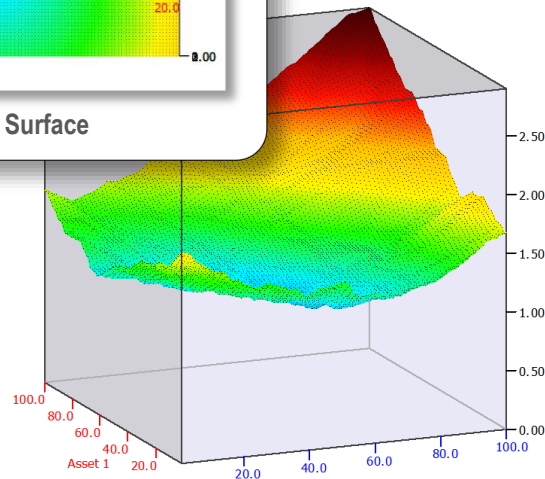
- Instead of analyzing specific market data, OptiFolio allows you to examine generic or random 3-assets portfolios.
- Explore the behavior of VaR and CVaR for unlimited sets of artificial data in order to discover common properties.



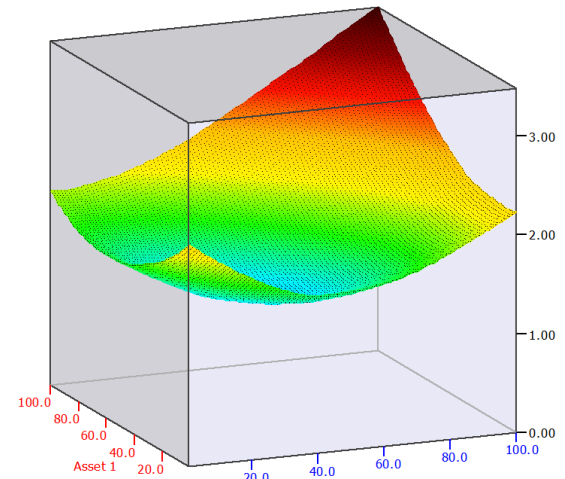
VaR Surface



CVaR Surface



VaR Surface



CVaR Surface

OPF

# Data sources

- Historical prices data can be imported from MS Excel® documents, delimited files or directly from the web.
- There is no predetermined limit to the number of assets or data points you can manage.

The screenshot shows a Microsoft Excel spreadsheet with a table of historical stock prices. The columns are labeled 'Date', 'S&P 500', 'AMERICAN EXPRESS', 'BELLSOUTH', 'COCACOLA', 'DELL', 'GE', and 'HONEYWE'. The rows contain dates from 21/06/2004 to 07/08/2004 and corresponding price values for each asset.

Overlaid on the spreadsheet is a dialog box titled 'Load historical prices from the web'. The dialog box contains the following information:

- Import prices for the following assets:**
  - 3M Company
  - MMM (Industrial Conglomerates)
  - Abbott Laboratories
  - ABT (Health Care Equipment & Services)
  - AbbVie
  - ABBV (Pharmaceuticals)
  - Accenture plc
  - ACN (IT Consulting & Other Services)
  - ACE Limited
  - ACE (Property & Casualty Insurance)
  - Activision Blizzard
  - ATVI (Home Entertainment Software)
- Data sample:**
  - From: 18/09/2015
  - To: 17/12/2015
  - Price frequency: Daily
  - Data source: Configure...
  - Clear data and get prices
- Buttons:** Add new..., Remove, Select: All, None
- Table of prices:**

Dates\Prices	3M	Abbott	AbbVie	Accenture	ACE	Activision	Adobe
18/09/2015	141.17	43.64	59.42	94.79	99.79	30.61	78.54
21/09/2015	140.50	43.65	61.24	98.05	100.63	31.11	81.42
22/09/2015	138.27	42.83	58.17	97.13	100.70	31.26	81.98
23/09/2015	138.53	42.50	57.90	97.82	100.87	31.33	84.92
24/09/2015	136.63	42.00	56.93	95.77	100.53	31.36	85.07
25/09/2015	139.62	42.23	57.84	98.36	102.89	31.71	84.71
28/09/2015	138.30	40.74	55.39	96.53	102.21	32.22	82.88
29/09/2015	138.62	39.26	53.10	96.09	100.83	31.25	80.52
30/09/2015	142.52	39.84	53.54	97.64	102.39	31.01	80.88
- Summary:** 64 prices for 7 assets

# OptiFolio

# Minimum requirements

OPF

Operating system	Microsoft Windows® XP or later.
Processor speed	2 Ghz or more recommended.
System memory	2Gb or more.
Video	1280 x 1024, 16-bit s color.
Connectivity	Internet connection available for license validation.
Other	Microsoft Excel® XP or later.

# OptiFolio Editions

# OPPF

Features \ Editions	Academic	Personal	Professional
Assets per portfolio	25	100	No limit
Investment constraints	7	50	No limit
MVO, CVaR optimization, Backtesting, Risk-Factors, Monte-Carlo simulation	✓	✓	✓
Support	Documentation	By eMail	By eMail & telephone
Audience	For students or professors only	For personal investment management	Investment consultants and fund managers





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