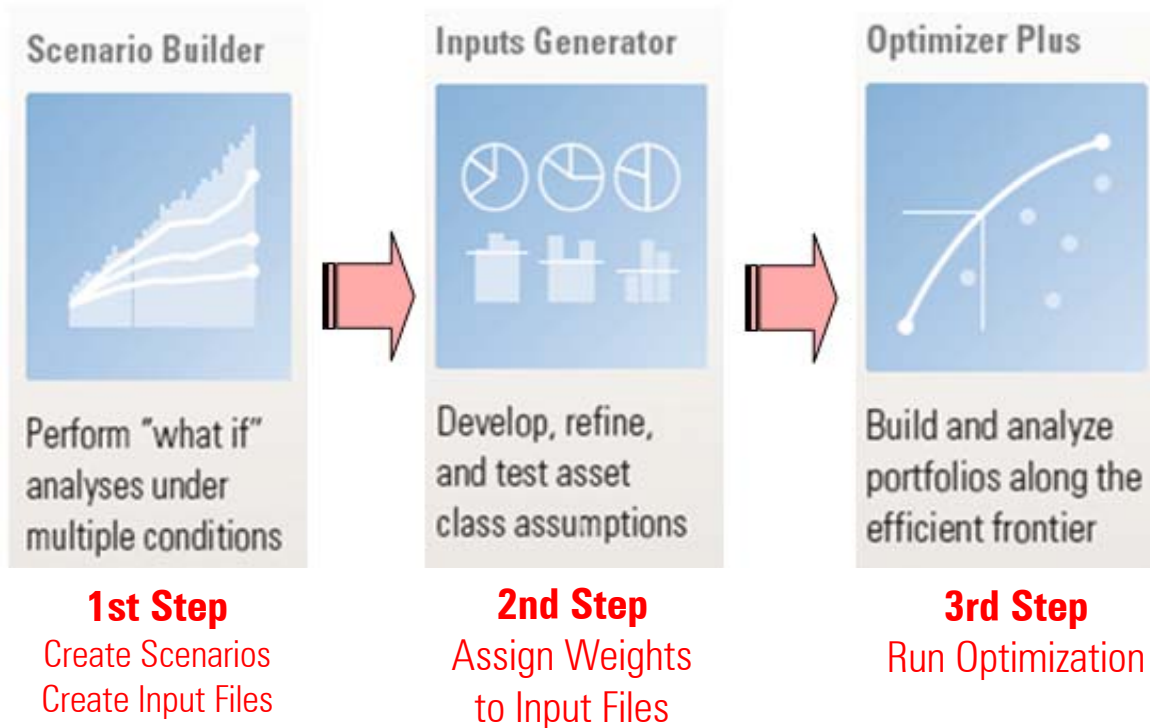

Morningstar EnCorr

Developing Probability-Weighted Optimization
Inputs

Definition

- ▶ Probability weighted inputs is the combination of two or more individual input files produced by user-assigned weights.
- ▶ Process
 - ▶ Input files are created in the scenario builder based on specific economic conditions.
 - ▶ Conditions are combined to create input files with the expectation for each condition to occur.
 - ▶ Result is a single estimate that combines both forecasting analysis and user expectations.

Process



Case Study

- ▶ The portfolio is composed of funds representing Equities, Bonds, Commodities, Alternatives, and Cash. To assess its current allocations and potentially propose a new target portfolio, the manager will identify historical trends of the US equity market impact on various asset classes.

Current Client Portfolio	Asset Mix
Equities	40%
S&P 500 TR	5
MSCI Japan NR USD	15
MSCI Europe NR USD	15
IA SBBI US Small Stock TR USD	5
Bonds	30%
IA SBBI US LT Govt TR USD	10
BarCap US Corporate High Yield TR USD	10
BarCap Gbl Infl Linked US TIPS TR USD	10
Commodities	10%
S&P GSCI TR	5%
London Fix Gold PM PR USD	5%
Alternatives	15%
FTSE NAREIT Equity REITs TR	10
Credit Suisse Tremont Hedge Fund USD	5
Cash	5%
IA SBBI US 30 Day TBill TR USD	5

Objective

- ▶ Determine the impact of the US Equity Market on Various Asset Classes from January 1998 to December 2008
- ▶ Questions to Answer
 - ▶ What asset classes performed best and worst during positive US Equity Markets
 - ▶ What asset classes performed best and worst during negative US Equity Markets.
 - ▶ Based on these results, what weights should be assigned to each scenario as to the probability of each condition occurring in the future

Settings

- ▶ US Equity Market
 - ▶ DJ US Total Full Cap TR USD, representing the broadest index for the US equity market.
- ▶ Asset Classes
 - ▶ Equities, bonds, commodities, alternatives, and cash
- ▶ Condition Criteria defined by three scenarios:
 - ▶ Less than or equal to 0%
 - ▶ Less than or equal to - 4.5%
 - ▶ Greater than or equal to 6.0%

Total Period Correlation

► From January 1998 to December 2008

	BarCap Gbl Infl Linked US TIPS TR USD	BarCap US Corporate High Yield TR USD	Credit Suisse Tremont Hedge Fund USD	FTSE NAREIT Equity REITs TR	IA SBBI US 30 Day TBill TR USD	IA SBBI US LT Govt TR USD	IA SBBI US Small Stock TR USD	London Fix Gold PM PR USD	MSCI Europe NR USD	MSCI Japan NR USD	S&P 500 TR	S&P GSCI TR	DJ Wilshire 5000 Full Cap TR USD
DJ Wilshire 5000 Full Cap TR USD	0.00	0.64	0.60	0.48	0.06	-0.24	0.79	0.05	0.85	0.56	0.99	0.17	1.00
S&P 500 TR	-0.00	0.60	0.52	0.46	0.09	-0.24	0.69	0.02	0.84	0.55	1.00	0.14	0.99
MSCI Europe NR USD	0.05	0.62	0.64	0.45	0.06	-0.20	0.67	1.00	0.54	0.84	0.21	0.85	0.85
IA SBBI US Small Stock TR USD	0.01	0.63	0.68	0.50	-0.02	-0.20	1.00	0.11	0.67	0.45	0.69	0.18	0.79
BarCap US Corporate High Yield TR USD	0.30	1.00	0.54	0.62	-0.01	-0.03	0.63	0.13	0.62	0.41	0.60	0.22	0.64
Credit Suisse Tremont Hedge Fund USD	0.13	0.54	1.00	0.32	0.11	-0.14	0.68	0.20	0.64	0.38	0.52	0.37	0.60
MSCI Japan NR USD	0.17	0.41	0.38	0.27	-0.04	-0.07	0.45	0.26	0.54	1.00	0.55	0.28	0.56
FTSE NAREIT Equity REITs TR	0.30	0.62	0.32	1.00	-0.00	-0.05	0.50	0.19	0.45	0.27	0.46	0.14	0.48
S&P GSCI TR	0.28	0.22	0.37	0.14	0.05	-0.05	0.18	0.28	0.21	0.28	0.14	1.00	0.17
IA SBBI US 30 Day TBill TR USD	0.02	-0.01	0.11	-0.00	1.00	-0.07	-0.02	-0.07	0.06	-0.04	0.09	0.05	0.06
London Fix Gold PM PR USD	0.33	0.13	0.20	0.19	-0.07	0.20	0.11	1.00	0.14	0.26	0.02	0.28	0.05
BarCap Gbl Infl Linked US TIPS TR USD	1.00	0.30	0.13	0.30	0.02	0.70	0.01	0.33	0.05	0.17	-0.00	0.28	0.00
IA SBBI US LT Govt TR USD	0.70	-0.03	-0.14	-0.05	-0.07	1.00	-0.20	0.20	-0.20	-0.07	-0.24	-0.05	-0.24

Total Period Performance

- ▶ From January 1998 to December 2008
 - ▶ Gold Market = Top Performer
 - ▶ Japanese Market = Worst Performer

	N Periods	Geometric Mean (%)	Standard Deviation (%)
London Fix Gold PM PR USD	132	10.49	18.53
IA SBBI US LT Govt TR USD	132	8.84	10.98
BarCap Gbl Infl Linked US TIPS TR USD	132	6.53	6.45
Credit Suisse Tremont Hedge Fund USD	132	6.31	7.85
IA SBBI US Small Stock TR USD	132	5.11	24.73
FTSE NAREIT Equity REITs TR	132	4.87	21.32
IA SBBI US 30 Day TBill TR USD	132	3.37	0.52
MSCI Europe NR USD	132	2.65	18.80
S&P GSCI TR	132	2.46	26.69
BarCap US Corporate High Yield TR USD	132	2.14	10.15
S&P 500 TR	132	1.02	16.28
MSCI Japan NR USD	132	0.86	19.93

Condition Criteria I (Scenario Builder)

- ▶ Negative Condition Where Value Is $\leq 0\%$
 - ▶ US Long Term Government Market = Top Performer
 - ▶ US Small Cap Equity Market = Worst Performer

Display

- Summary Statistics
- Returns
- Correlations
- Comparison
- By Series
- By Statistic

Probability Weighted Inputs

Negative

Table: Default Table

Holding Period: Year

Sorted by: Geometric Mean (%)

	N Periods	Geometric Mean (%)	Standard Deviation (%)
IA S&P US LT Govt TR USD	56	17.40	11.93
BarCap Gbl Infl Linked US TIPS TR USD	56	8.75	7.56
London Fix Gold PM PR USD	56	7.20	20.60
IA S&P US 30 Day TBill TR USD	56	3.34	0.51
S&P GSCI TR	56	-4.81	27.93
Credit Suisse Tremont Hedge Fund USD	56	-8.04	6.11
BarCap US Corporate High Yield TR USD	56	-15.72	9.70
FTSE NAREIT Equitu BEITs TR	56	-24.59	19.18
MSCI Japan NR USD	56	-29.01	13.97
MSCI Europe NR USD	56	-36.47	11.00
S&P 500 TR	56	-38.02	8.12
IA S&P US Small Stock TR USD	56	-43.15	11.43

Set Condition Criteria

New Condition

Label: Negative

Drawdown Condition

Select dates for which...

Return of...

Change(from previous period) in Return of...

Select Dates for which...

DJ Wilshire 5000 Full Cap TR USD

\leq (Less Than or Equal To)

Value 0.0000 %

Series

Average Return for Previous _____ periods

Save to Database OK Cancel Help

Condition Criteria II (Scenario Builder)

- ▶ Negative Condition Where Value Is $\leq -4.5\%$
 - ▶ US Long Term Government Market = Top Performer
 - ▶ US Small Cap Equity Market = Worst Performer

Display

- Summary Statistics
- Returns
- Correlations
- Comparison
- By Series
- By Statistic

Probability Weighted Inputs
Negative5

Table:

Holding Period:

Sorted by: Geometric Mean (%)

	N Periods	Geometric Mean (%)	Standard Deviation (%)
IA SBBI US LT Govt TR USD	19	34.36	17.03
London Fix Gold PM PR USD	19	14.02	27.11
BarCap Gbl Infl Linked US TIPS TR USD	19	10.21	10.96
IA SBBI US 30 Day TBill TR USD	19	3.18	0.54
Credit Suisse Tremont Hedge Fund USD	19	-20.29	7.50
S&P GSCI TR	19	-29.52	24.94
BarCap US Corporate High Yield TR USD	19	-35.56	10.63
FTSE NAREIT Equity REITs TR	19	-44.01	21.11
MSCI Japan NR USD	19	-48.78	8.60
S&P 500 TR	19	-62.91	4.65
MSCI Europe NR USD	19	-63.92	7.21
IA SBBI US Small Stock TR USD	19	-67.45	7.59

Set Condition Criteria

New Condition

Label:

Drawdown Condition

Select dates for which...

Return of...

Change(from previous period) in Return of...

Select Dates for which...

Value %

Series

Average Return for Previous periods

Condition Criteria III (Scenario Builder)

- ▶ Positive Condition Where Value Is $\geq 6.0\%$
 - ▶ US Large Cap Equity Market = Top Performer
 - ▶ US Long Term Government Market = Worst Performer

The screenshot displays the Morningstar Scenario Builder interface. On the left, a table lists various market indices with their performance metrics. The 'S&P 500 TR' row is highlighted in red, indicating it is the top performer. The 'IA SBBI US LT Govt TR USD' row is also highlighted in red, indicating it is the worst performer. The 'Set Condition Criteria' dialog box is open on the right, showing a new condition named 'Positive5' with a value of 6.0000%.

	N Periods	Geometric Mean (%)	Standard Deviation (%)
S&P 500 TR	15	118.93	7.92
IA SBBI US Small Stock TR USD	15	113.01	24.97
MSCI Europe NR USD	15	94.30	27.87
MSCI Japan NR USD	15	50.04	27.03
Credit Suisse Tremont Hedge Fund USD	15	18.65	11.61
BarCap US Corporate High Yield TR USD	15	17.85	10.19
FTSE NAREIT Equity REITs TR	15	14.25	14.91
London Fix Gold PM PR USD	15	7.51	11.19
IA SBBI US 30 Day TBill TR USD	15	3.46	0.55
BarCap Gbl Infl Linked US TIPS TR USD	15	1.61	6.00
S&P GSCI TR	15	-2.98	26.94
IA SBBI US LT Govt TR USD	15	-4.72	9.53

Set Condition Criteria

New Condition

Label: Positive5

Drawdown Condition

Select dates for which...

Return of...

Change(from previous period) in Return of...

Select Dates for which...

DJ Wilshire 5000 Full Cap TR USD

\geq (Greater Than or Equal To)

Value 6.0000 %

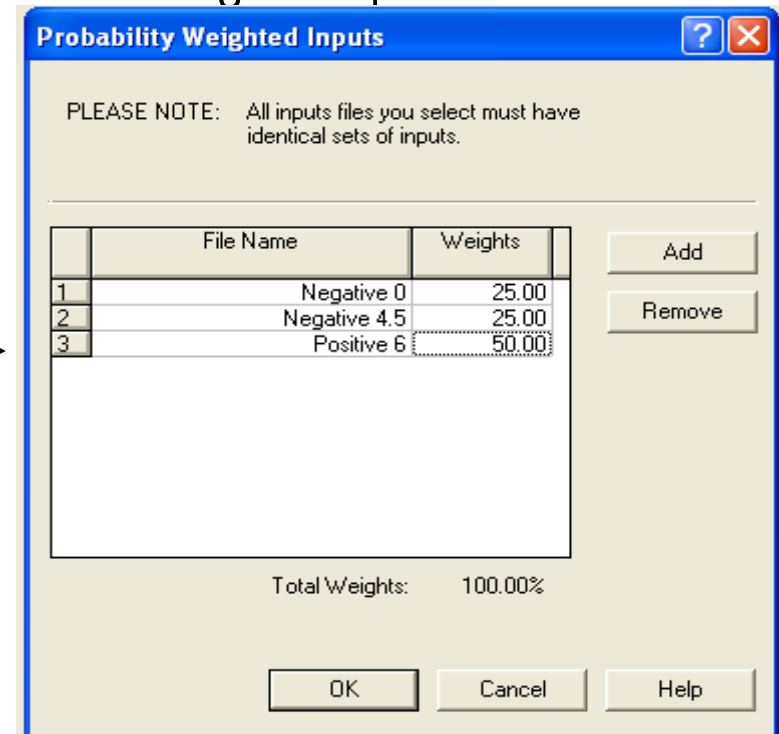
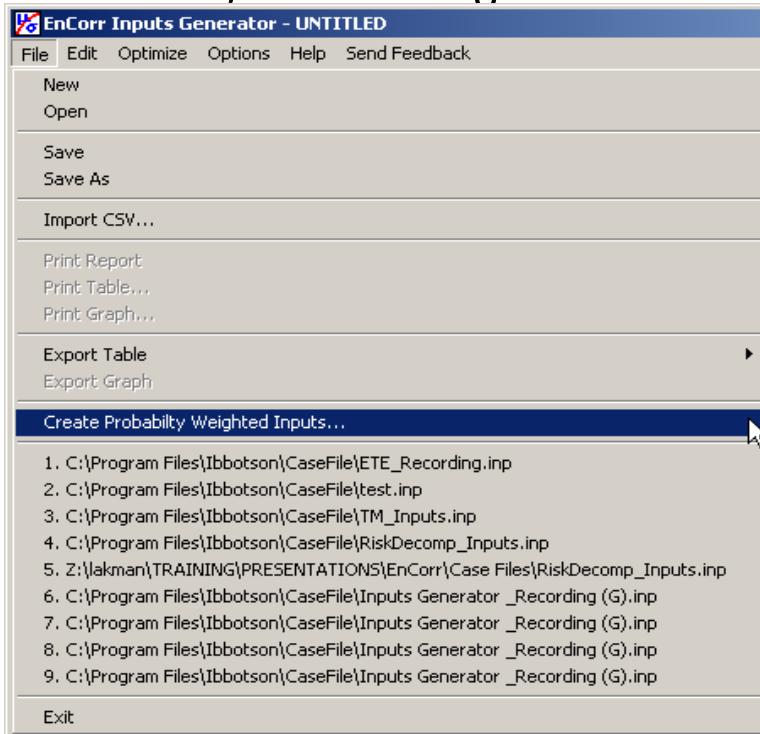
Series

Average Return for Previous periods

Save to Database OK Cancel Help

Probability Weighted Inputs (Inputs Generator)

- ▶ Belief that the probability of each condition occurring in the future is high. To protect the client's portfolio during potential down markets in the future, more weight will be assigned to negative periods.



Example of Probability Weighted Inputs

► Input Generator Help

Probability Weighted Inputs - Example

As an example, assume you are planning to optimize with 5 asset classes. You have 3 sets of inputs one for each of three possible market conditions: declining, flat, and rising.

	Expected Returns	Standard Deviations	Correlation Matrix	Probability of Market Condition
Declining Market (Inputs file 1)	E(r) for assets A,B,C,D,E	σ for assets A,B,C,D,E	Correlations between assets A,B,C,D,E	30.00
Flat Market (Inputs File 2)	E(r) for assets A,B,C,D,E	σ for assets A,B,C,D,E	Correlations between assets A,B,C,D,E	50.00
Rising Market (Inputs File 3)	E(r) for assets A,B,C,D,E	σ for assets A,B,C,D,E	Correlations between assets A,B,C,D,E	20.00

Next, you want to create one estimate that combines these forecasts according to the assigned probability for each market condition occurring. You can then use the option to Create Probability Weighted Inputs File to combine the estimates together into one inputs file for use in the EnCorr Optimizer.

	Expected Return	Standard Deviation	Correlation Matrix
Probability Weighted Inputs File	Probability Weighted E(r) for assets A,B,C,D,E	Probability Weighted σ for assets A,B,C,D,E	Probability Weighted Correlations between assets A,B,C,D,E

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