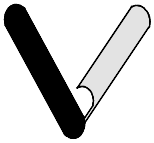
OCCAM Financial Technology



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OCCAM Application Note 4

Using *POW!* for Backtesting

describing the example workbook *ExampleBacktest.xls*

One application of POW! Frontier Automation is Strategy Backtesting. Backtesting is a way of answering the question "What would have our past performance have been like if our investment strategy had been to …?". A backtest program uses historical data to answer this question and, to the extent that past behaviour is predictor of future, indicates whether the proposed strategy is a good one or not[1].

Examples of investment strategies that can be evaluated using backtesting include all those where:

- a set of return forecasts is generated by some model or process,
- there is a rule prescribing a certain level of foreign currency hedging, or
- tracking errors are maintained using a risk model that is periodically updated

To demonstrate how POW! Frontier can be used to perform backtesting, we have created a simple example in the Excel workbook *ExampleBacktest.xls* which is distributed as an example with POW! Frontier. The macro code is contained in the file *ExampleBacktestCode.xla* which is automatically loaded at the same time as the workbook. Note that POW! Frontier Wizard needs to be installed in order to use this workbook.

A. The Investment Strategy in the example

A backtest program calculates the performance of a portfolio moving forward though time in a stepwise fashion. The operation at each step has two parts:

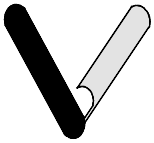
Decisions - applying the strategy using the data that would have been available at that time to determine the portfolio that would have been selected.

Consequences - calculating what returns the selected portfolio would have achieved.

The decision process in the example is that, at the beginning of each quarter, a new set of return forecasts for the assets (in this case a selection of Salomon Indices) is received. The POW! optimiser is used to select a new optimal portfolio which has the minimum tracking error for a 1% relative return (as calculated using the current set of forecasts), the portfolio is immediately rebalanced and the assets held, with returns reinvested, for the entire quarter.

Historical returns are used to calculate the portfolio's subsequent performance each quarter and also the weights at the end of the quarter – these change because returns are reinvested and so the weight of the high return assets increases relative to those with lesser returns. The end quarter weights are then used as the initial holdings for the next quarter.

[1] Backtesting could be an alternative to the Monte Carlo technique which uses randomised simulated data instead of historic. However, the function that generates the simulated data for the Monte Carlo will, at some level, rely on the same historical observations as the backtest.



This is a simple example and a more 'realistic' backtest might vary other parameters of the optimisation from quarter to quarter including:

- the risk model parameters i.e. standard deviations, correlations and possibly, betas[2]
- constraints
- the benchmark
- initial holdings

B. Layout of the backtest workbook

ExampleBacktest.xls has been created from a standard POW! optimisation workbook and retains a full set of optimisation worksheets (*U.Specific*, *U.Main* etc.) and so can still be used for single optimisations in the normal way, so that one can investigate the results at any one quarter in the backtest.

The optimisation workbook has been converted to perform backtesting by adding a POW! Automation macro, written in Visual Basic, which runs in a loop, once for each quarter, calculating the decision and consequence stages as described above. Four new worksheets have been added to store the inputs to the backtest and also the results each quarter. They are:

BTForeRets – Return forecasts at each quarter

These forecasts are read in turn and passed to the optimiser. They are currently set to be the average return over preceding months but of course may be changed to fit any other forecasting theory the user may wish to consider.

BTHistRets – Historic returns at each quarter

These are actual historic returns for these assets and are used to calculate the returns achieved.

BTStartWeights – Portfolio weights, risk estimates and return forecasts at the start of the quarter.

This sheet is shown in figure 1 below. The controls in rows 4 and 5 can be used to change the efficient point that is selected at each stage so that each portfolio has a fixed risk or return value. In some cases there may be no feasible portfolio matching the selection criterion so an alternative portfolio is required. The drop-down menu in cell J5 can be set so that either the minimum risk or maximum return portfolio is selected when this happens.

BTEndWeights – Portfolio weights at the end of the quarter and achieved returns.

To run the backtest, click on the 'Run the backtest…' button at the top of any of the four backtest sheets. The status line will show the progress of the backtest and figures will appear in *BTStartWeights* and *BTEndWeights* as the test proceeds.

Excel charts can be created from the backtest results in the usual way. *WeightsCharts* shows the variation in the portfolio starting weights over the backtest interval. *ReturnsGraph* shows the cumulative returns for the benchmark and backtest portfolio, as forecast and as actually achieved.

[2] One reason for varying the risk model each quarter is to avoid the pitfall of using a risk model which is estimated over the same interval as the backtest is being run.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		*POW!* Universe:	Sample Backtest	Run the backtest...					File:	ExampleBacktest2.xls				
2		Portfolio:	Maserati						File:	ExampleBacktest2.xls				
3		Report:	Backtest Results: Optimal Portfolios immediately after rebalancing											
4		Date:	November 1998				Required Frontier Point:		1.00% As	Return	RBM			
5							If required point unobtainable:			Minimise risk				
6														
7		Quarters		Forecast Returns, Risk Estimates and Psi						Portfolio weights at start of Quarter				R00
8		From	To	Return RBM	Tracking Error	Return Absolute	Risk Absolute	Psi	Required Point Found?	French Eqs	German Eqs	US Eqs	UK Eqs	Dutch Eqs
9		Jul-93	Oct-93	1.00%	0.19%	11.44%	8.34%	5.4	Yes	0.01%	0.87%	9.67%	3.88%	5.45%
10		Oct-93	Jan-94	1.00%	0.17%	22.02%	8.36%	5.9	Yes	0.00%	0.47%	9.40%	4.17%	6.28%
11		Jan-94	Apr-94	1.00%	0.21%	27.38%	8.42%	4.8	Yes	0.00%	0.00%	9.10%	4.98%	6.21%
12		Apr-94	Jul-94	1.00%	0.20%	11.02%	8.33%	5.0	Yes	0.00%	0.06%	9.46%	4.70%	5.28%
13		Jul-94	Oct-94	1.00%	0.30%	10.95%	8.37%	3.4	Yes	0.00%	0.00%	9.50%	4.19%	5.81%
14		Oct-94	Jan-95	1.00%	0.34%	5.97%	8.31%	2.9	Yes	0.00%	0.00%	9.48%	4.79%	6.09%
15		Jan-95	Apr-95	1.00%	0.44%	12.05%	8.47%	2.3	Yes	0.00%	0.00%	10.66%	3.78%	4.70%
16		Apr-95	Jul-95	1.00%	0.15%	40.21%	8.39%	6.7	Yes	0.00%	0.00%	10.20%	4.97%	4.75%
17		Jul-95	Oct-95	1.00%	0.35%	21.80%	8.58%	2.7	Yes	0.00%	0.45%	10.85%	3.99%	5.27%

Figure 1 – The BTStartWeights Worksheet

C. Possible Enhancements

This example shows one very simple and specific thing that POW! Frontier Automation can do, the portfolio selection rule is not complex and the data set used is very small. Using POW! Automation with Visual Basic or C++ and possibly a database engine to store and manipulate a larger volume of data, it would be possible to extend this backtest example to a any number of more sophisticated portfolio selection rules working across in a large universe of investible assets, while still retaining a flexible and user-friendly output format. The macro code used for this backtest example is provided with POW! Frontier Automation.

Development with POW! Automation is very rapid: it took an admittedly experienced user of Excel and VB about a day to set up this example. For details on how this software works, see our product description 'POW! Automation' available from www.occamsrazor.com.