

The calibration of trading strategies

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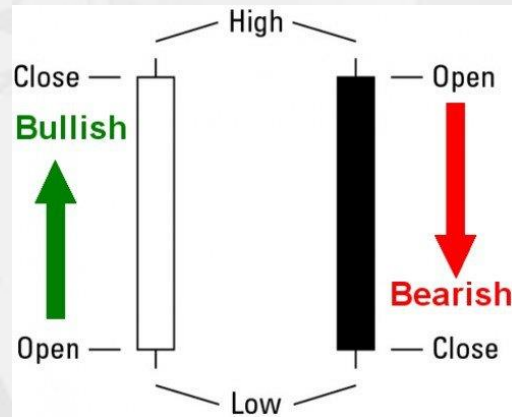
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Fundamental vs. Technical analysis

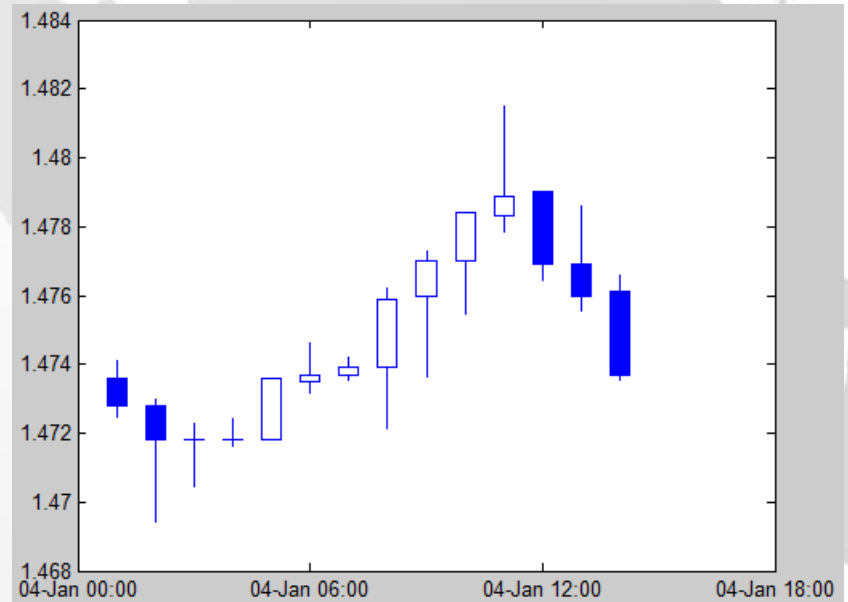
- fundamental analysis: based on financial statements, market predictions, economic analysis ...
- technical analysis: based purely on the data and three assumptions
 - the market discounts everything
 - price moves in trends
 - history tends to repeat

Market Data



- Open, High, Low, Close Price
- Candlestick Chart: used to visualize price movements

	1	2	3	4	5
1	1.4736	1.4741	1.4724	1.4728	7.3633e+05
2	1.4728	1.4730	1.4694	1.4718	7.3633e+05
3	1.4718	1.4723	1.4704	1.4718	7.3633e+05
4	1.4718	1.4724	1.4716	1.4718	7.3633e+05
5	1.4718	1.4736	1.4718	1.4736	7.3633e+05
6	1.4735	1.4746	1.4731	1.4737	7.3633e+05
7	1.4737	1.4742	1.4735	1.4739	7.3633e+05
8	1.4739	1.4762	1.4721	1.4759	7.3633e+05
9	1.4760	1.4773	1.4736	1.4770	7.3633e+05
10	1.4770	1.4784	1.4754	1.4784	7.3633e+05
11	1.4783	1.4815	1.4778	1.4789	7.3633e+05
12	1.4790	1.4790	1.4764	1.4769	7.3633e+05
13	1.4769	1.4786	1.4755	1.4760	7.3633e+05
14	1.4761	1.4766	1.4735	1.4737	7.3633e+05



Technical Indicators

- Trend Indicators: catch the main movement of the market
 - pair of long and short EMA
 - $\text{shortEMA} > \text{longEMA} \Rightarrow$ market in up-trend $\Rightarrow$ go long
 - $\text{shortEMA} < \text{longEMA} \Rightarrow$ market in down-trend $\Rightarrow$ go short



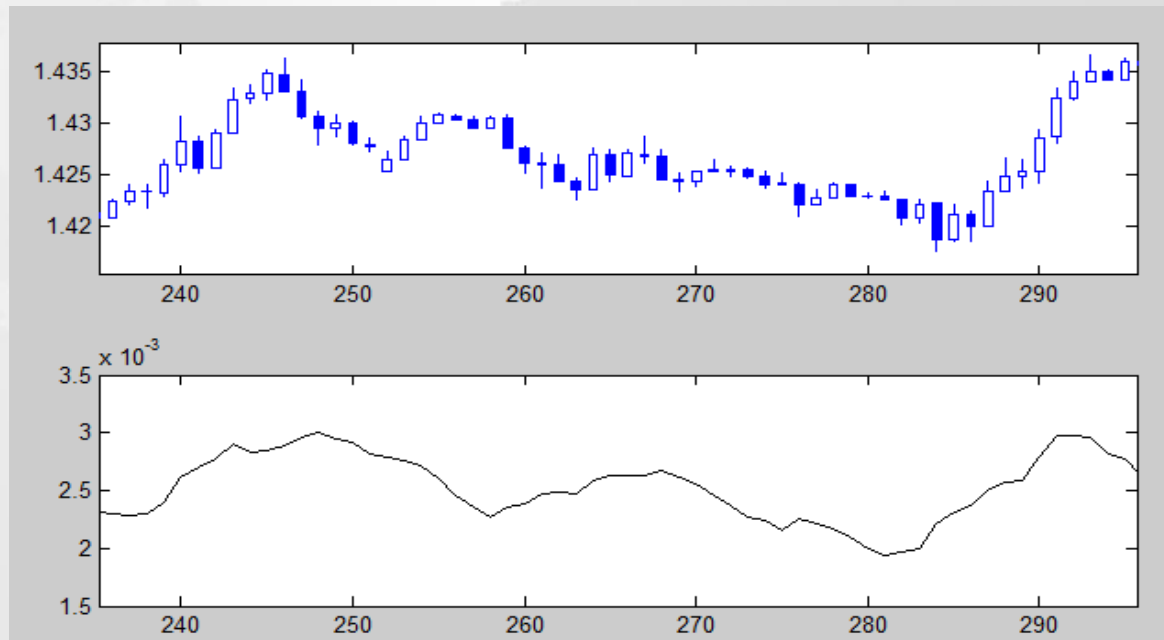
Technical Indicators

- Momentum Indicators: evaluate the power of the trend
 - Relative Strength Index (RSI) – values from 0 to 100
 - RSI > 70 – market is overbought and may soon go down
 - RSI < 30 – market is oversold and may soon retrace up



Technical Indicators

- Volatility Indicators: give information about the size of price movements
 - Average True Range (ATR)
 - gives the information about the average price movement during one bar

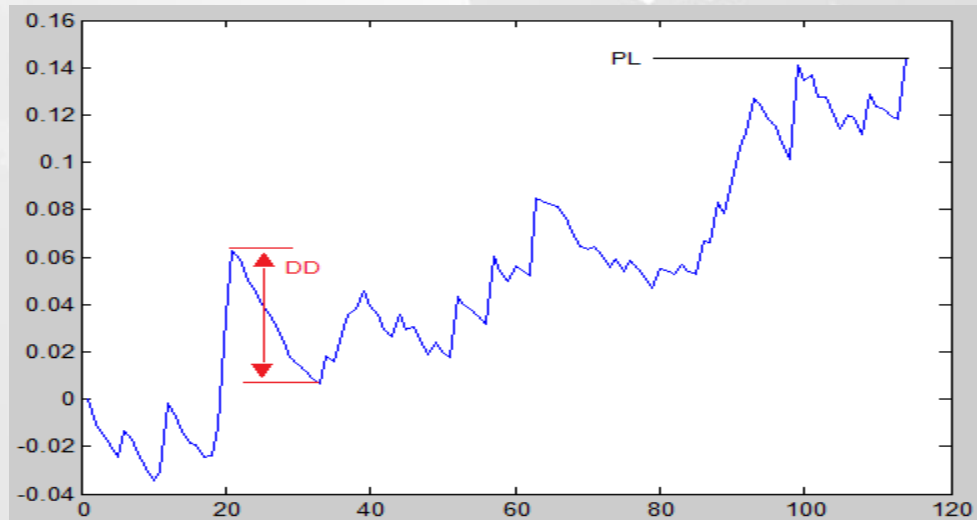


Trading system

- set of rules we provide to the algorithm in order to determine
 - when to enter the position, which type of position
 - how many contracts do we want to buy
 - when to stop the position if the market goes against us (Stop Loss)
 - when to exit winning position because we get our aim (Take Profit)
 - when to exit position because the trend is reversing
- depends on the set of parameters
 - number of periods in MA
 - parameters in other Indicators
 - value of Stop Loss, Take Profit

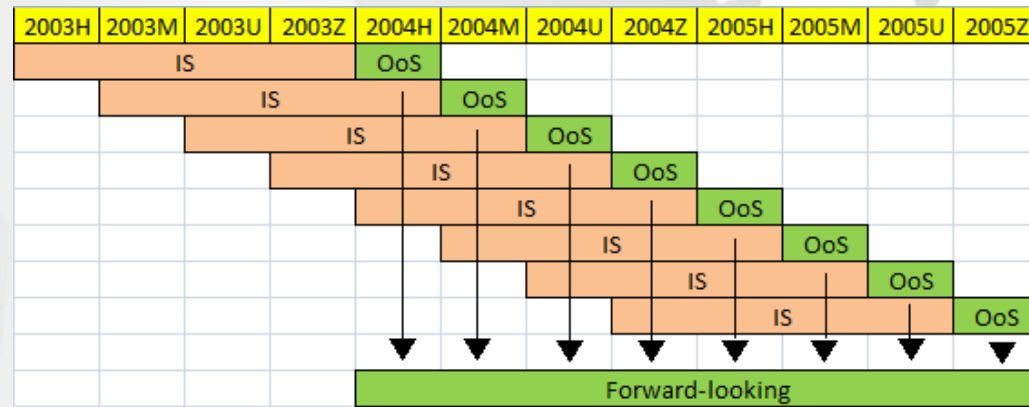
Historical Backtest

- evaluates the quality of trading system on past data
- simulates as if we were trading throughout the historical period
- with the chosen trading strategy and its parameters
- inputs – data, parameters of the trading system
- outputs – trades executed on historical data, equity curve (EC)
- not completely 'real' simulation of live trading - slippage



Forward-looking analysis

- In sample (IS):
 - we run historical backtest on these data in order to find 'good' parameters
 - trades are not realistic, as we already know the data a priori
- Out of sample (OoS):
 - we work with this data as if we don't know them
 - we simulate trading in these data with the parameters that performed well in IS
- Forward-looking: we get the trades from unseen data by shifting IS after some time and collecting all trades executed in all OoS contracts, ration between IS and OoS around 4-6 to 1



Calibration of the model

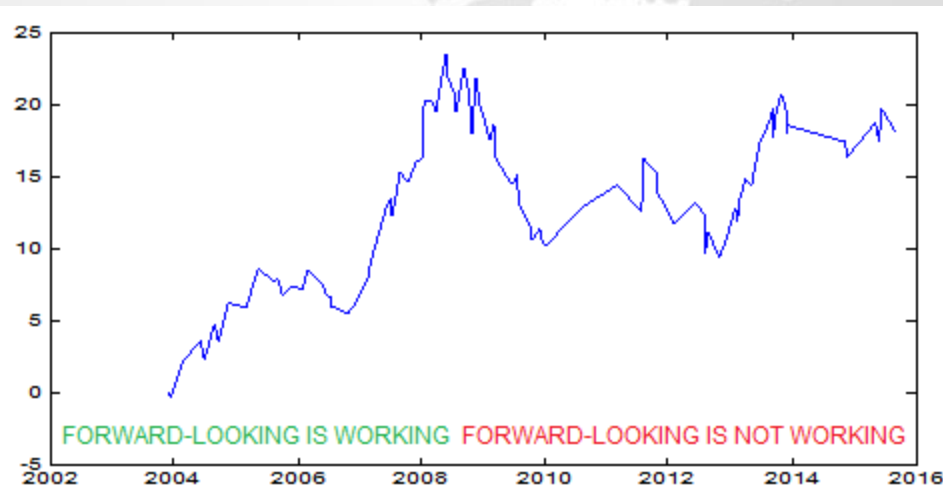
- process of finding the parameters which maximize the score of objective function, which evaluate the quality of trades executed in IS
- objective function takes into account:
 - Profit & Loss
 - Maximum DD
 - slope of EC (consistently good trades vs. few good trades and a lot of bad ones)
 - number of trades: more trades = more slippage

Genetic Algorithm

- problem: possibly huge number of parameters to optimize, cannot evaluate score in each point of parameter space
- solution: using Genetic algorithm, corporate evolution principles to find the extreme of the objective function
- iterative process, starts with random population
- crossover: two members of (i-1)-th generation produce their random crossover
- mutation: member suffers random mutation
- probability to be chosen to crossover/mutation is based on the score of each member
- can be speed-up using parallel or GPU computing

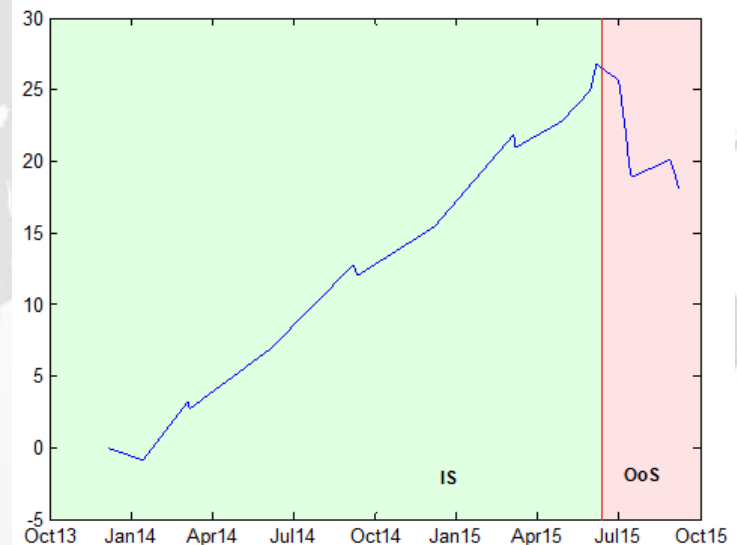
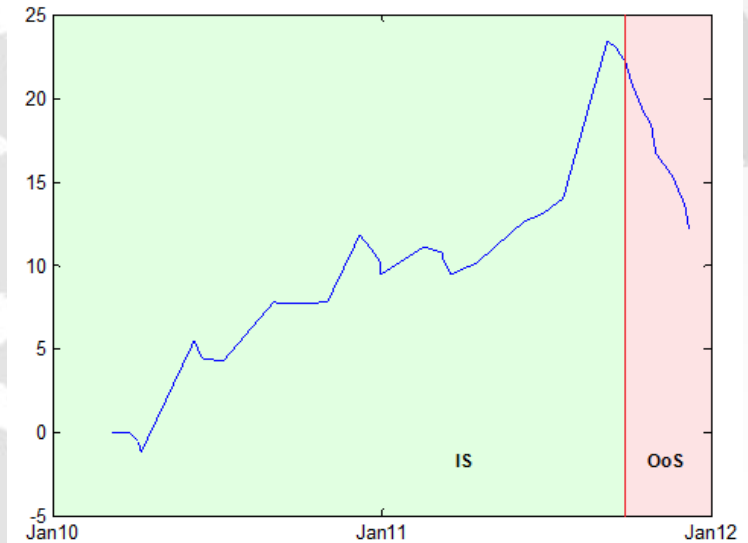
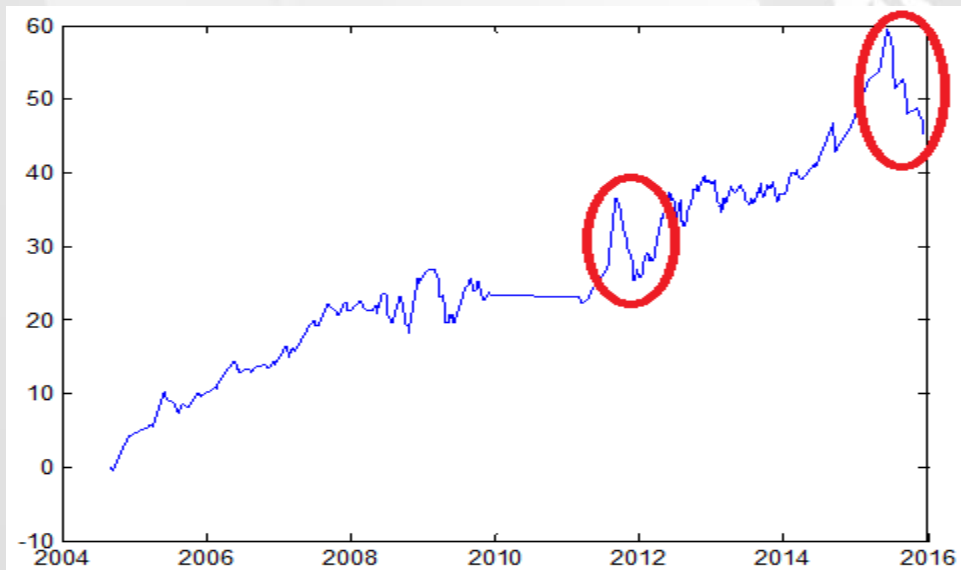
Problems

- Forward-looking EC grows for some time and then it stops growing anymore
- What happened in 2009?
- Did the market change the structure?
- Is there some correlation between the score of objective function in IS and the EC in OoS?
- Did we over fit the strategy?



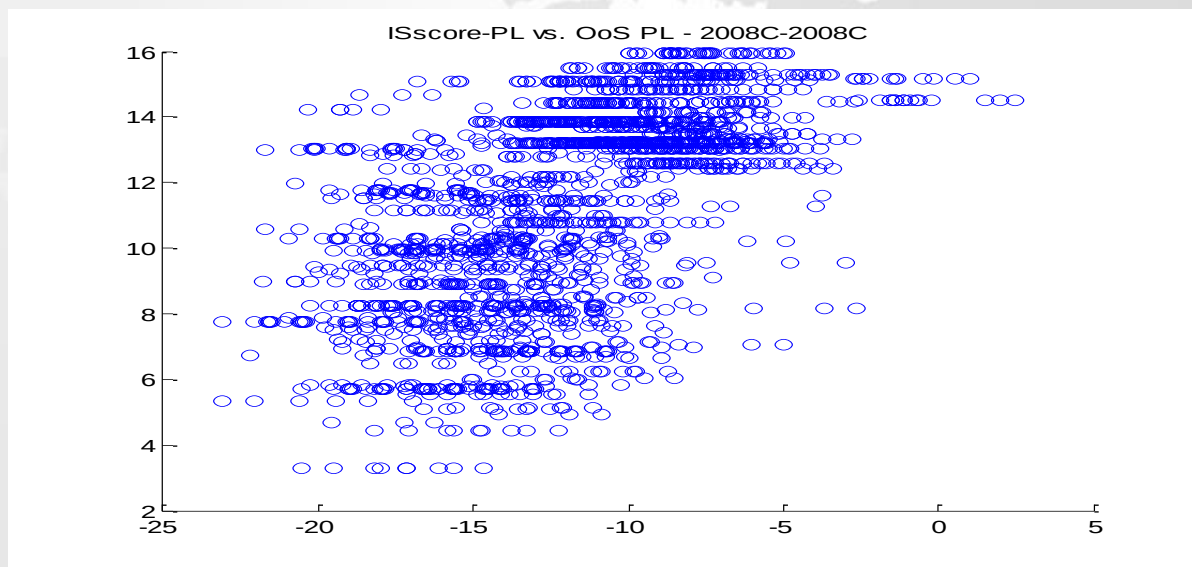
Predicting power of IS data

- can we predict the potential behaviour in OoS?
- NO!
- examples of unpredictable turn of events in OoS
- far worse than any reasonable quantile of MC-generated probability distribution



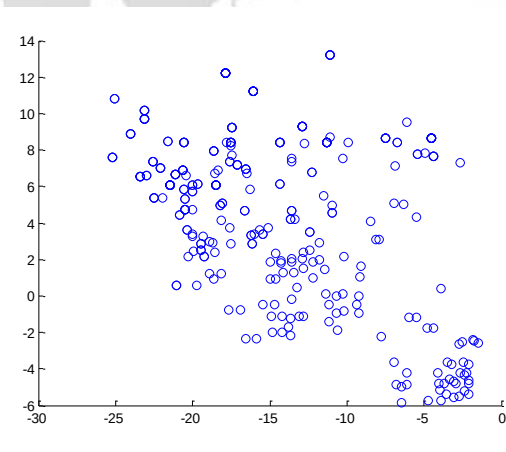
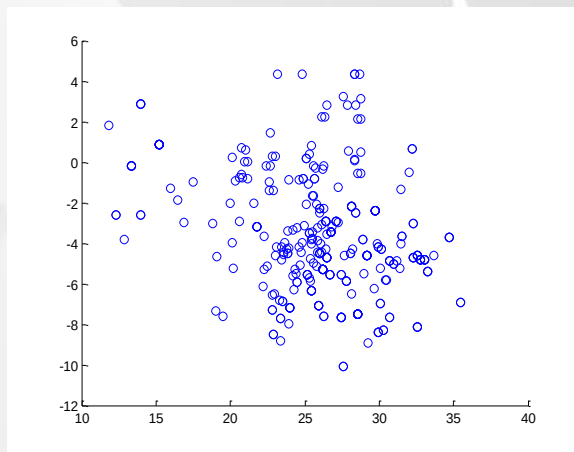
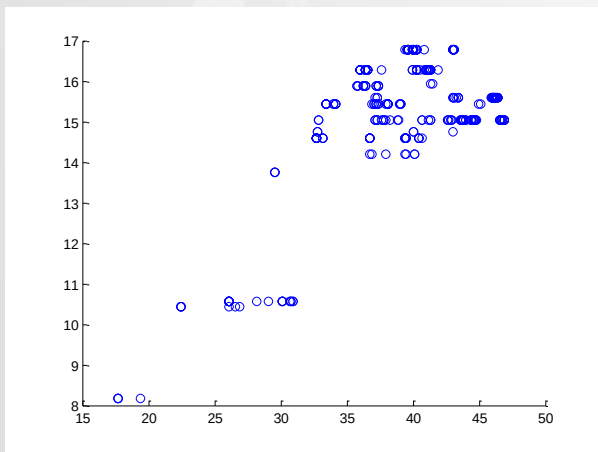
Correlation between IS and OoS

- we chose the sample of parameters and computed the correlation between score in IS and the PL in OoS
- low/none correlation means that
- good correlation means that the calibration is done properly and the trading strategy is robust



Correlation between IS and OoS

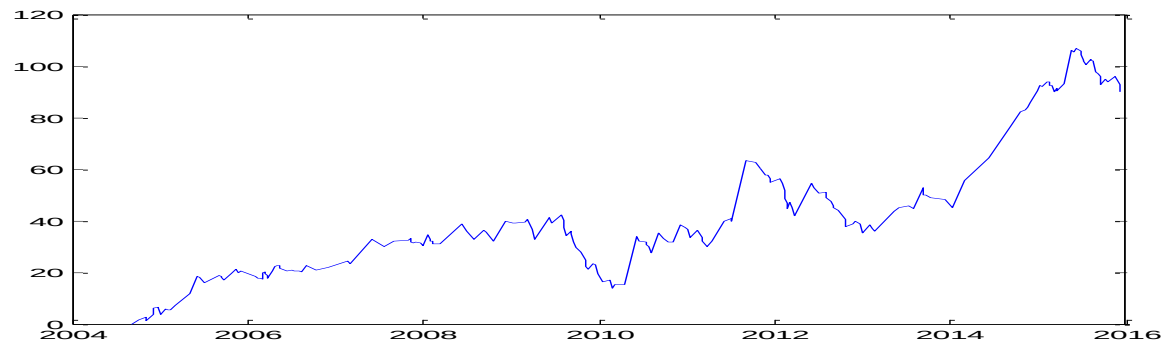
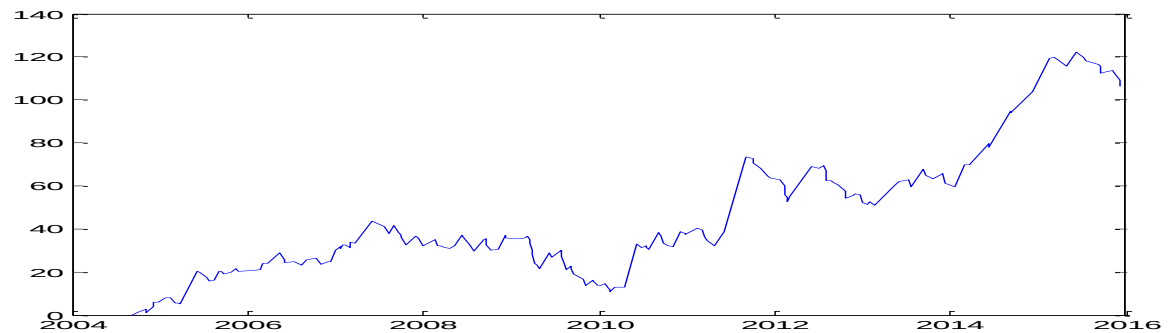
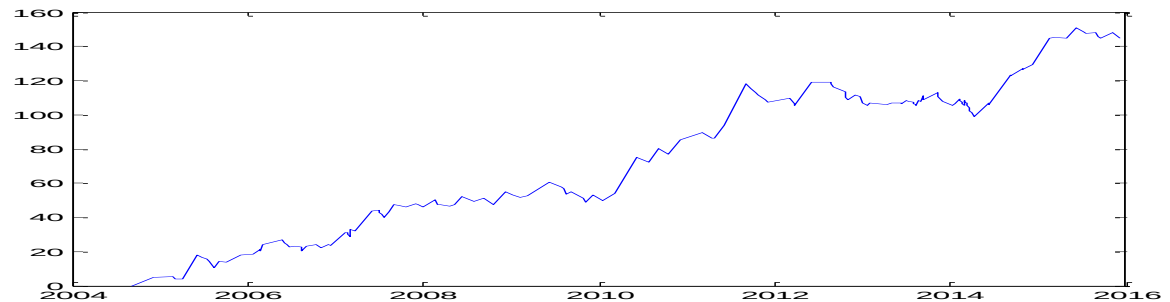
- results for FGBL, Daily TF, 4 contracts IS, 1 contract OoS
- MA based signal generator producing number between 0 and 100, optimizing level necessary to enter/close the trade, symmetric case for long/short trades => we optimize 2 parameters
- average correlation between IS and OoS – 0.16
- independently on the type of objective function used



Good/Random/Bad strategies

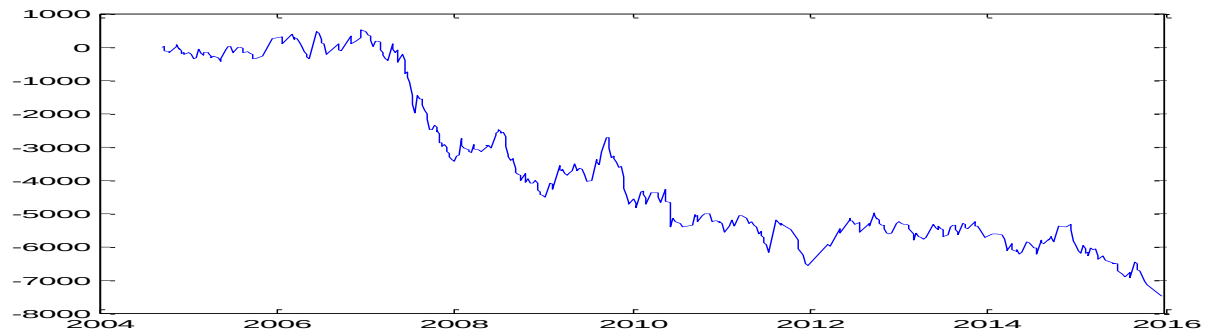
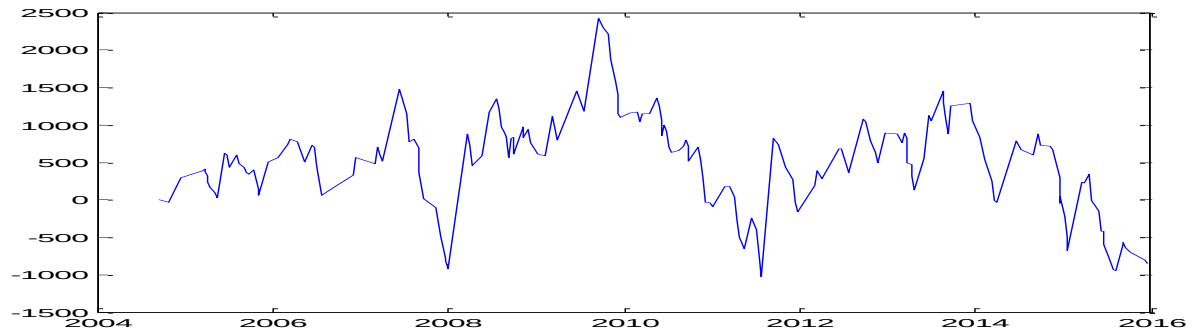
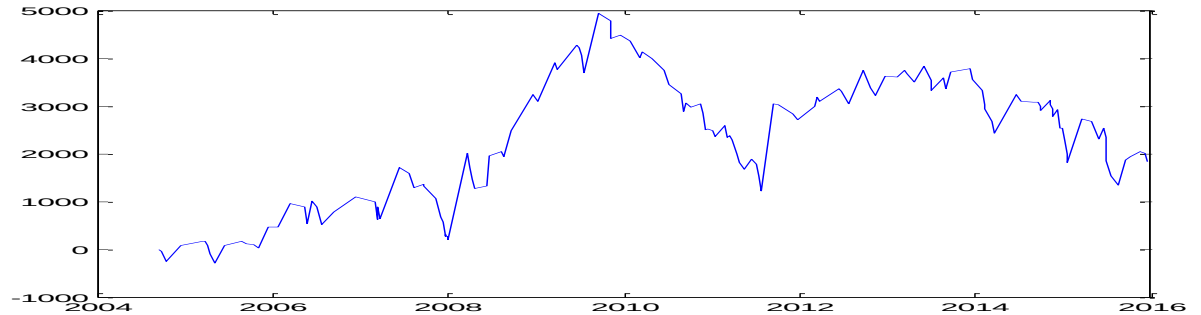
- FGBL daily TF
- 6 contracts IS
- 2 contracts OoS

- If the market is trending, trend-following trading strategy with virtually any parameters performs reasonably well
- Choosing the best parameters provides a small edge in comparison with random parameters



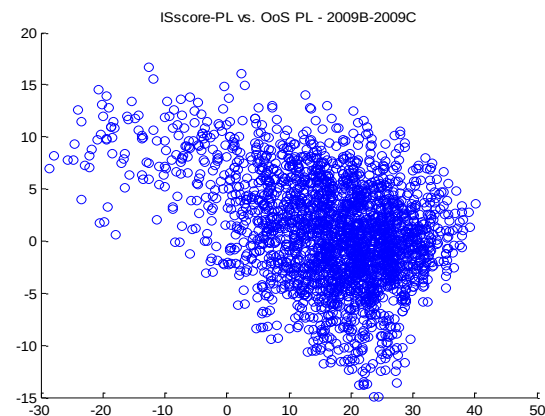
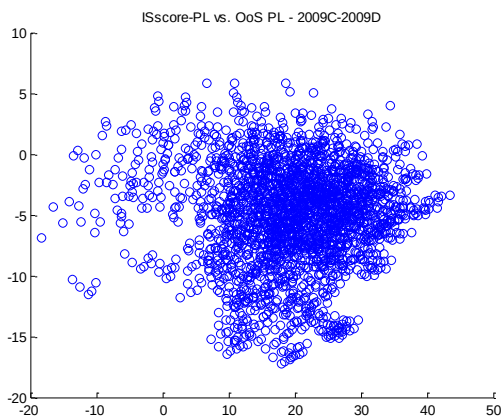
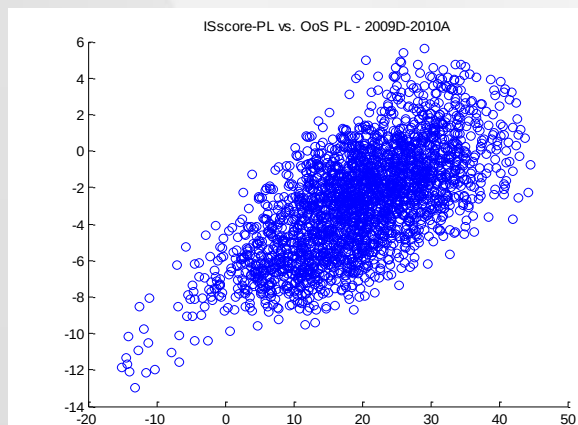
Good/Random/Bad strategies

- FESX daily TF
 - 6 contracts IS
 - 2 contracts OoS
-
- Market is not trending sufficiently for our strategy
 - Optimizing of parameters reduces our losses



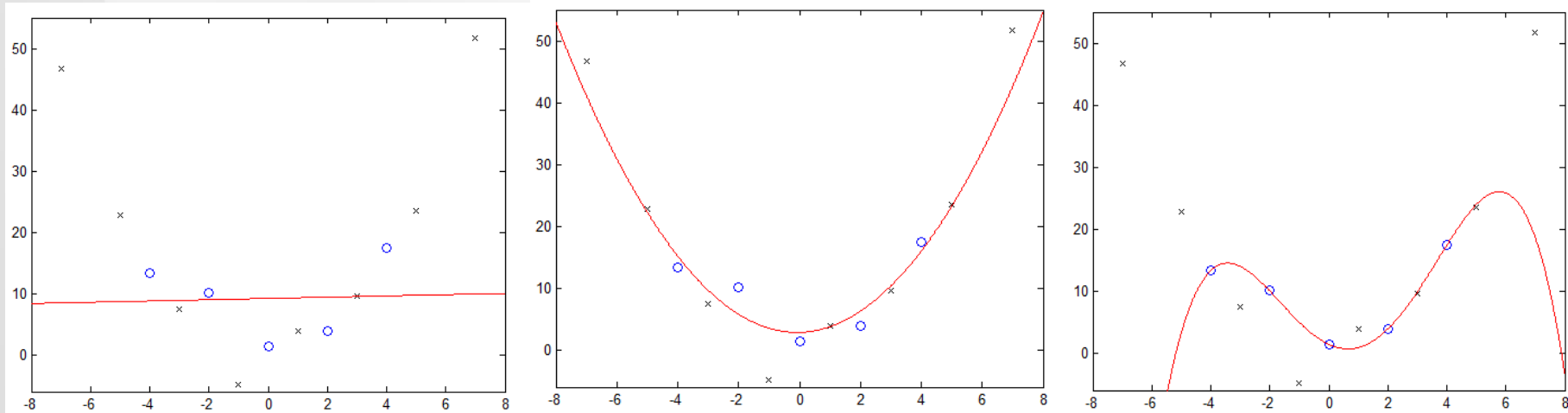
Correlation between IS and OoS

- results for GBPAUD, 2hour TF, 6 contracts IS, 2 contract OoS
- average correlation between IS and OoS – 0.00
- we optimize enter/close level of long and short trades independently => we optimize 4 parameters
- independently on the type of objective function used



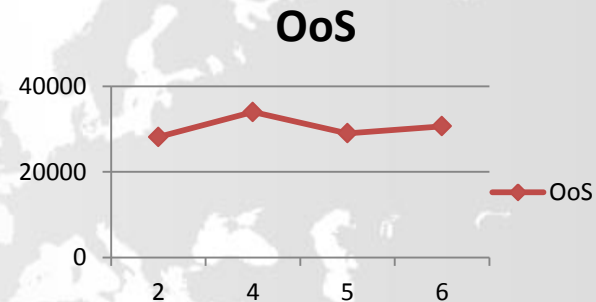
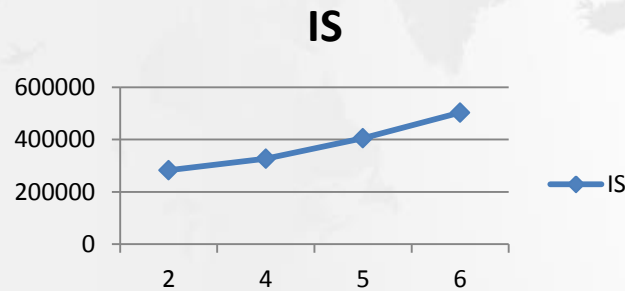
Over-Fitting

- Optimal complexity – number of parameters which describe the data in a robust way
- Less parameters (underfitting) – fail to describe the data properly
- More parameters (overfitting) – fit the noise of the data, good performance on IS data, worse performance on OoS data



Over-Fitting

- GBPUSD, daily TF, 4 contracts IS, 1 contract OoS, period 2003D-2010D



- GBPUSD, 2hour TF, 4 contracts IS, 1 contract OoS, period 2003D-2010D

