The calibration of trading strategies

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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
Technical Indicators

- Trend Indicators: catch the main movement of the market
  - pair of long and short EMA
  - shortEMA>longEMA => market in up-trend => go long
  - shortEMA<longEMA => market in down-trend => 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