When Backtests Meet Reality

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When Backtests Meet Reality

Agenda

- Backtest performance vs live performance
- Which deviation is tolerable?
- The „Cold Blood Index“
Hypothetical trading strategy

- Profit factor: 1.5
- Out-of-sample backtest:

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Hypothetical trading strategy
Profit factor reality check
(with shuffled price curves):
Trading it live

- $5000 initial capital
- Result after 6 weeks: $2200 loss

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Half capital gone - what now?

Pull out in panic?
Or go on in cold blood?
Reasons for bad live results

- Bad luck => Go on
- Too short trade period => Go on
- Market change => Pull out
- Backtest was biased => Pull out
- Backtest was overfitted => Pull out
- Backtest Profitfactor was random => Pull out
Determining market changes

- Lower trade volume
- Lower or higher volatility
- Higher mean reversion half-life
- Flatter frequency spectrum
- More randomness (Shannon entropy)
- etc. etc.

Problem: The nature of a market change is normally unknown.
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Determining backtest bias

- Put data aside for final test
  Problem: Data is rare and valuable

- Do not optimize
  Problem: Won’t do for most strategies

- White’s Reality Check
  Problem: Impractical for most strategies
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- Compare live drawdown with backtest
- Establish a drawdown tolerance limit
- If limit exceeded: pull out

Determining bad luck
Limit = Worst drawdown

\[ E(t) < C + G \frac{t}{y} - D \]

- \( E \) = Current account equity = $2800
- \( C \) = Initial account capital = $5000
- \( G \) = Backtest profit = $38000
- \( t \) = Live trading period = 6 weeks
- \( y \) = Backtest period = 300 weeks
- \( D \) = Backtest max drawdown = $4000

\[(5000 + 38000 \times 0.02 - 4000 = 1760)\]

The problem: Drawdown depth increases with time...
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Limit = Time-adjusted drawdown

$$E(t) < C + G \frac{t}{y} - D \sqrt{\frac{t + l}{y}}$$

$E = \text{Current account equity} = \$2800$

$C = \text{Initial account capital} = \$5000$

$G = \text{Backtest profit} = \$38000$

$t = \text{Live trading period} = 6 \text{ weeks}$

$y = \text{Backtest period} = 300 \text{ weeks}$

$D = \text{Backtest max DD depth} = \$4000$

$l = \text{Backtest max DD length} = 15 \text{ weeks}$

$(5000 + 38000*0.02 - 4000*0.26 = 4720)$

The problem: Uses only $G$ and $D$ from the whole backtest; gives a limit, but no quantitative parameter
A more precise pull-out indicator:

- Calculates the drawdown probability
- Analyzes the complete backtest curve
- Considers drawdown duration
„Cold Blood Index“ Algorithm

1. Determine length $l$ and depth $D$ of the currently worst drawdown.
2. Place a window of size $l$ at the start of the first equity curve.
3. Determine the equity difference $D'$ from end to start of the window. Increase a counter $C$ when $D' > D$.
4. Move the window forward by 1 day.
5. Repeat steps 3 and 4 until the window arrived at the end of the equity curve. Count the steps with a counter $S$.
6. Repeat steps 3-5 with a set of shuffled curves. Calculate the mean $N$ of all $C$-values.
Cold Blood Index

Sampling window

![Graph showing sampling window with labels l and D']
Algorithm, part 2

We now got the following numbers:

- \( N \) – number of all sections of length \( l \) in all backtest curves with a drawdown similar or worse than \( D \).
- \( S \) – number of all sections of length \( l \) in all backtest curves.
- \( T \) - number of all sections of length \( l \) in the live trading curve.

When pulling \( T \) balls from a basket of \( S \) balls of which \( N \) are red, how likely is it to NOT get at least one red ball?
Ways of picking $T$ balls:

\[
\binom{S}{T} = \frac{S!}{T! (S - T)!}
\]

Ways of picking no reds:

\[
\binom{S - N}{T} = \frac{(S - N)!}{T!(S - N - T)!}
\]

Probability of no reds in $T$ balls:

\[
P = \frac{(S - N)! (S - T)!}{S! (S - N - T)!}
\]
1 - P = \frac{(S - N)! (S - T)!}{S! (S - N - T)!}

- \(P\) – Probability of the current drawdown
- \(N\) – number of all sections of length \(l\) in all backtest curves with a drawdown similar or worse than \(D\).
- \(S\) – number of all sections of length \(l\) in all backtest curves.
- \(T\) - number of all sections of length \(l\) in the live trading curve
Cold Blood Index

Drawdown right at start ($T = 1$):

$$P = 1 - \frac{(S - N)! \ (S - 1)!}{S! \ (S - N - 1)!} = \frac{N}{S}$$

Our hypothetical strategy:

$N = 135, S = 1500$  $\Rightarrow$  $P = 9\%$
Cold Blood Index

When CBI fails

- Too short backtests ($S < T$)
- Reinvesting in backtest
- Drawdown already encountered
- Drawdown not normalized
CBI Practical Use Example

- When the system is in a drawdown:
- Calculate CBI every day
- System stops automatically when CBI < 5%
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