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LEADERS IN IDEAS AND SOLUTIONS

Automating Robustness Analysis of Trading Strategy Development Processes

DBA research by Edwin Stang

May 2021: Work in Progress

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Agenda

1. Idea
2. Development Progress
3. Expression Language
4. Possible uses
5. Signal vs Breakout Strategies

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1. Idea

- Automate Trading Strategy Development
- Formalise Decision Points
  - Strategy, Portfolio, Risk & Money Management
- Simulate a Team of Random Developers
  - Evolutionary Machine Learning
- Automated Longitudinal Study
  - Walk-Forward-Analysis
- Measure Robustness of the Process
  - Monte Carlo Significance Test

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2. Development Progress

- Working on Platform since 2009
  - Modular Architecture, designed for Reuse and Flexibility; Ideal Basis for Research
- Extend with ML Features in DBA
  - Explainable AI
  - Expression Language for Decision Points
  - High Performance Backtesting Engine

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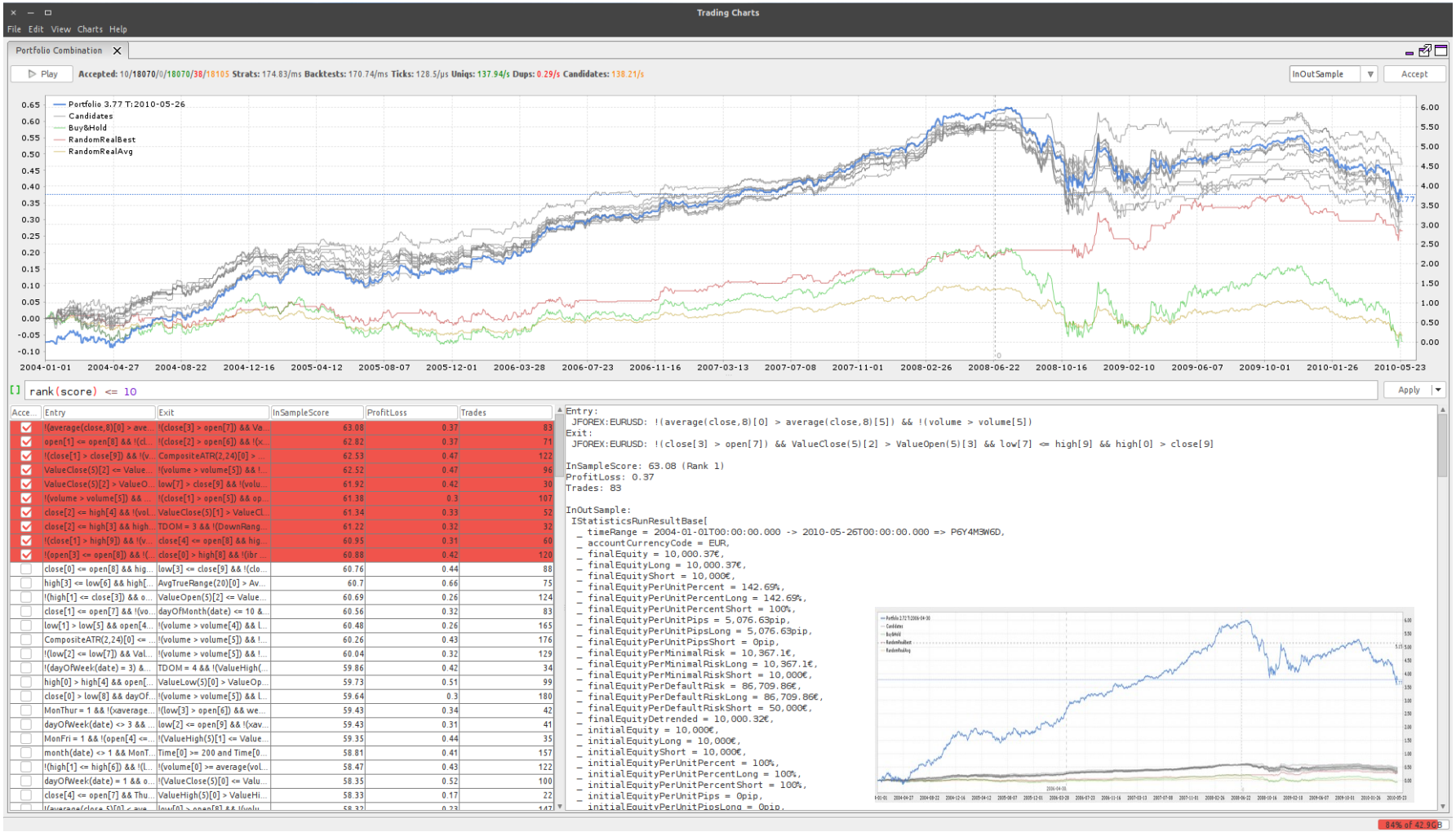
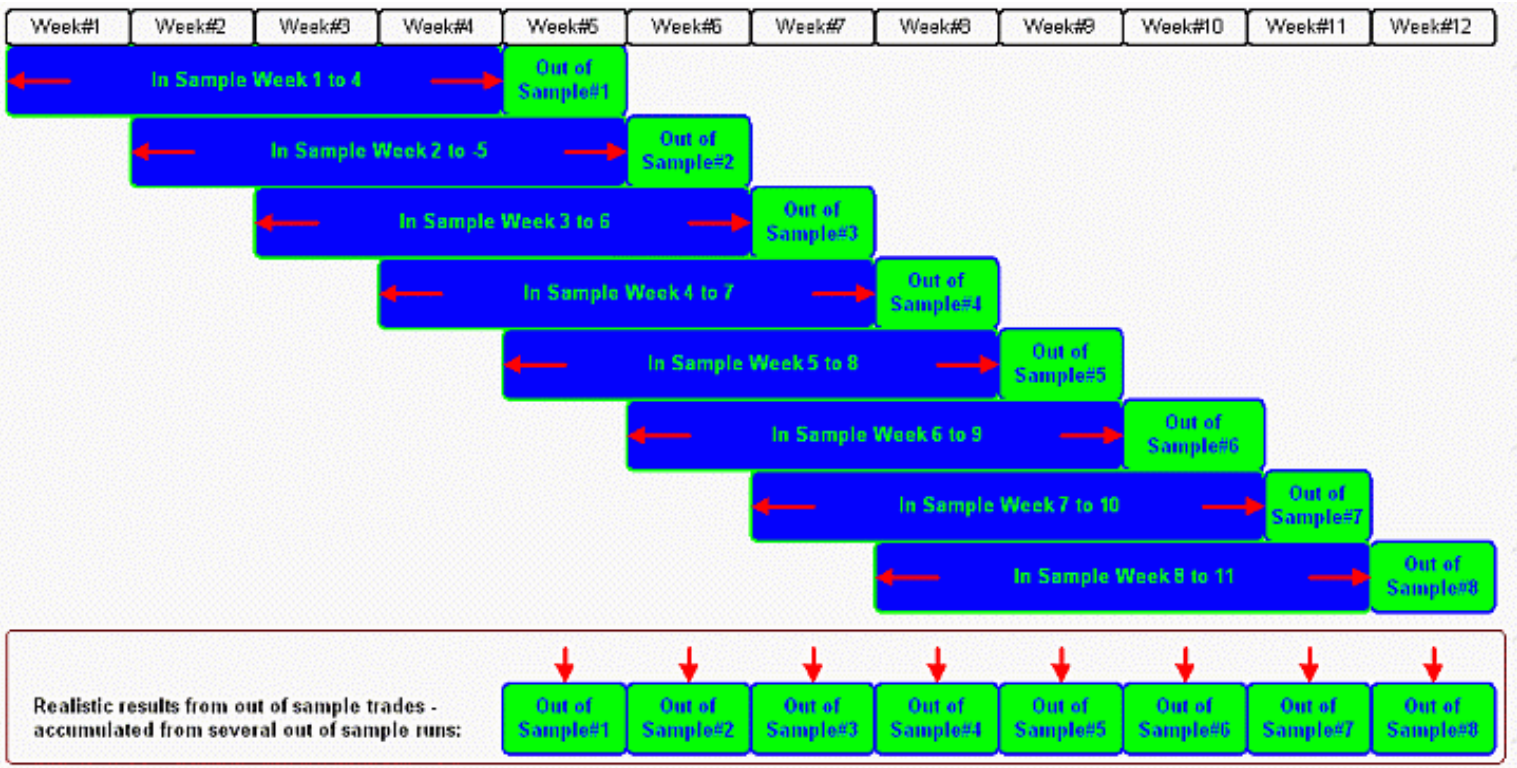
2.6. Portfolio Selector



2.7. Walk Forward Analysis

- Automated through Optimisation Workflows
- Alternative: Cross-Validation Variations



Source: https://blackwellglobal.com/mt4-walk-forward-optimisation/

2.8. Monte Carlo Simulation

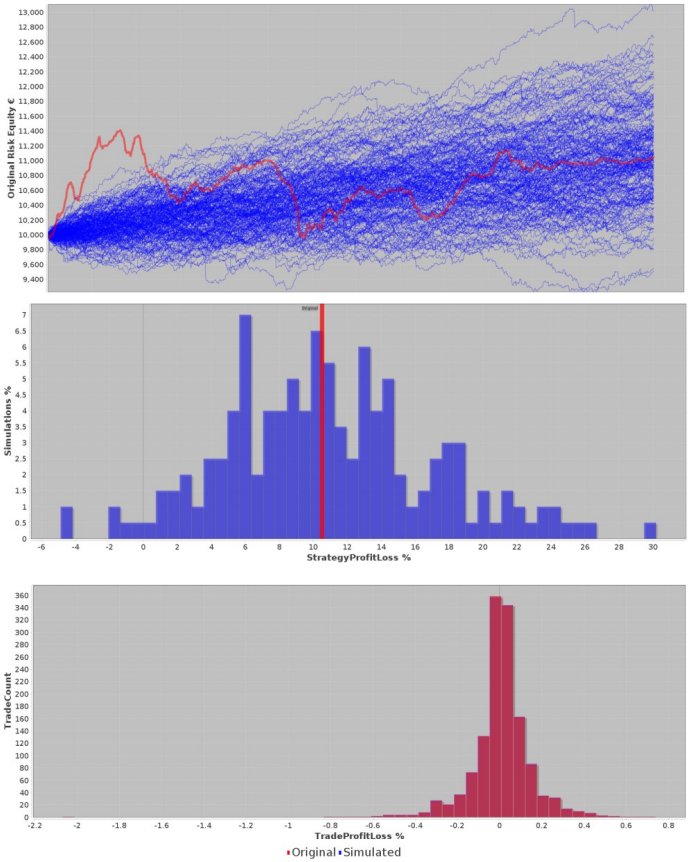
- Repeat Walk Forward Analysis ‘x’ Times
- Confidence Levels for Significance Test
- Does the **Process** mitigate **Randomness**?

Monte Carlo Simulation

with randomized and recurring orders in 200 simulations, showing each with Original Risk Equity and Minima

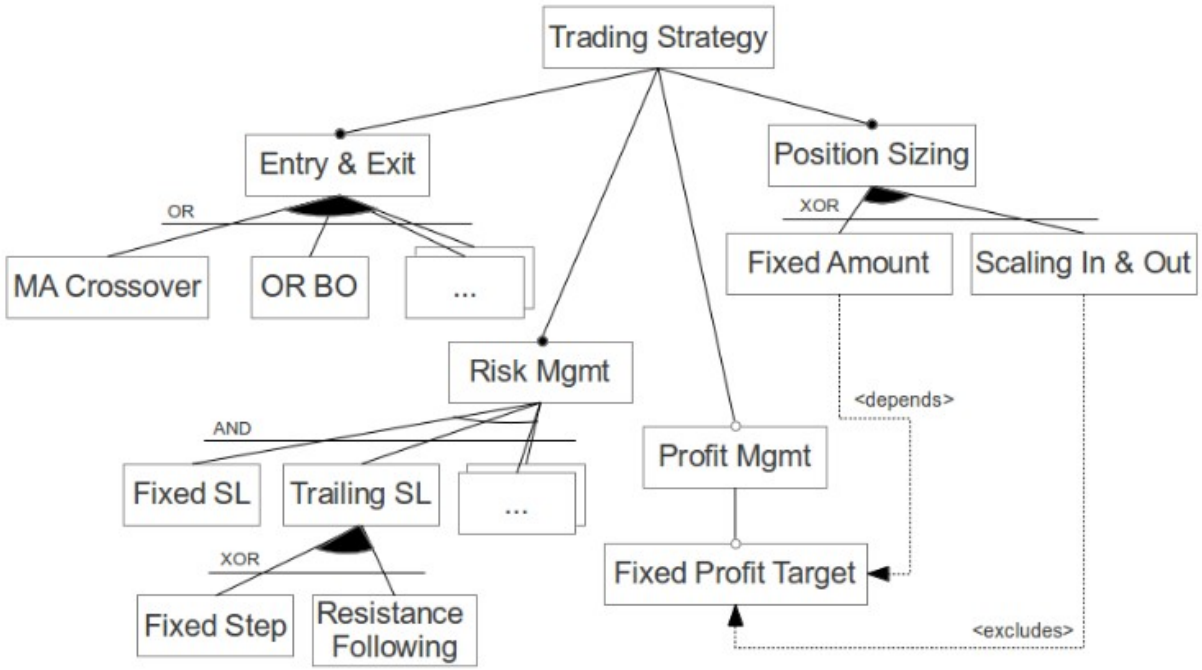
OriginalMaxDrawdown:	1,456.37€ (-12.76%) 1,515.6€ (-12.92%)	NewMaxDrawdownAvg:	435.23€ (- 437.32€ (-
OriginalProfitLossSum:	1,052.05€ (+10.52%) 1,391.6€ (+13.92%)	NewProfitLossSumAvg:	1,090.66€ 1,427.35€
OriginalAPPT:	0.77€ (+0.0077%) 1.01€ (+0.01%)	NewAPPTAvg:	0.79€ (+0. 1.04€ (+0.

Confidence Level	MaxDrawdown	ProfitLossSum	Expect
1%	189.23€ (1.77%) 196.51€ (1.79%)	2,666.35€ (+26.66%) 3,257.88€ (+32.58%)	1.94€ 2.37€
2%	193.95€ (1.9%) 204.76€ (1.88%)	2,459.3€ (+24.59%) 2,937.1€ (+29.37%)	1.79€ 2.14€
5%	225.97€ (2.14%) 231.62€ (2.22%)	2,203.26€ (+22.03%) 2,630.04€ (+26.3%)	1.6€ (+ 1.91€
25%	301.44€ (2.83%) 350.42€ (2.99%)	1,447.03€ (+14.47%) 1,845.28€ (+18.45%)	1.05€ 1.34€
50%	383.03€ (3.79%) 432.21€ (3.74%)	1,043.13€ (+10.43%) 1,373.65€ (+13.74%)	0.76€ 1€ (+0
75%	502.25€ (4.88%) 493.08€ (4.83%)	620.84€ (+6.21%) 970.72€ (+9.71%)	0.45€ 0.71€
95%	706.32€ (6.72%) 723.01€ (6.53%)	155.33€ (+1.55%) 355.87€ (+3.56%)	0.11€ 0.26€
98%	870.41€ (8.34%) 878.36€ (7.92%)	-111.74€ (-1.12%) 137.97€ (+1.38%)	-0.08€ 0.1€ (+
99%	1,022.21€ (9.04%) 879.57€ (8.38%)	-199.03€ (-1.99%) -61.53€ (-0.62%)	-0.14€ -0.04€



3. Expression Language

- Extract Decision Points from Trading Strategies
- Formalise them into Expressions



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3.2. Decision Points I

- **Bar Preprocessors**:
  - Time[1 DAY|UTC-7] - Timeshift, Detrend
  - Renko[atr(20)*0.5] - Session, SkipFlat
  - Oversampling, Random - OrnsteinUhlenbeck
- **Entry**: ema(25) > ema(5) && rsi(2) > 20
  - Variants: Long, Short, LongShort, ShortLong
- **Exit**: !entry || stopLoss(range(atr(14)*2)

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3.2. Decision Points II

- **Order Type**: Market, Limit[atr(14)*2], Stop[pips(20)]
  - Embed: <entry> && enterLongAtLimit(range(atr(14)*2))
- **Money Management / Position Sizing**:
  - FixedAmount, TurtleRisk%, FixedFractional%, EquityRisk%, Markowitz, OptimalF, SecureF(maxDD%)
- **Equity Curve Trading**:
  - lossTradesToday < 3 && equityRiskPercent < 30

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3.2. Decision Points III

- **Strategy/Portfolio Selection**:
  - rank(os_sharpeRatio) <= 10 && profitLoss > 0
- **Nested Optimisation**:
  - ema(optimise(start=20, min=5, max=50, step=5)) > ema(5)
- **Robustness Checking**:
  - whitesRealityCheckProbabilityOfLuckPercent < 5
  - parameterStabilityPercent > 50
  - walkForwardEfficiencyPercent > 50

4. Possible Uses

- Compare Strategy Types against each other:
  - Trend Following vs Mean Reversion
  - Signal vs Breakout
- Compare Machine Learning Techniques:
  - Evolutionary: Differential Evolution, Harmony Search, Symbiotic Organisms, Extreme Learning
  - Other: Support Vector Machines, (Deep) Neural Networks, etc
- Compare Robustness Techniques:
  - Whites Reality Check, Monte Carlo, Cross Validation, Walk Forward Analysis

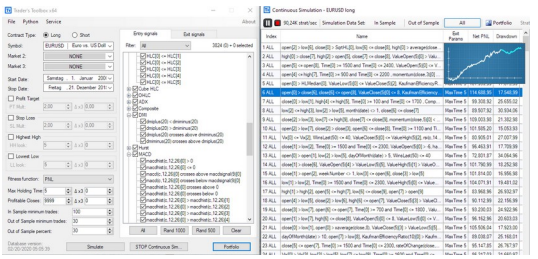
4.2. Generator Performance

- Daily Data with Signal Strategies
  - 140k to 1.6 million Backtests per Second
  - with 12 Cores
- Speed and RAM usage Depending on
  - Time Range
  - how many Simulated Trades happen (Breakout slower)
  - Granularity: Ticks, Renko, Volume, 5 Mins, Daily, ...
- **Allows Testing Processes, not just Strategies**
  - 4-8 Times Faster than Fastest Alternative
  - Alternatives offer only Entry/Exit Decision Points in Cross Sectional Studies without Significance Test

5. Signal vs Breakout Strategies

- Signal Strategies
  - Entry: enterLongAtMarket(Signal1 && Signal2 && Signal3 && Signal4)
  - Exit: exit(Signal5 && Signal6 && Signal7 && Signal8)
  - Inspired by BuildAlpha

    (Source: https://www.buildalpha.com/)



- Breakout Strategies
  - Entry: FilterLong && enterLongAtStop(LongPriceLevel + Volatility * Factor) || FilterShort && enterShortAtStop(ShortPriceLevel - Volatility * Factor)
  - Exit: exitOnClose
  - Inspired by BetterTraderAcademy

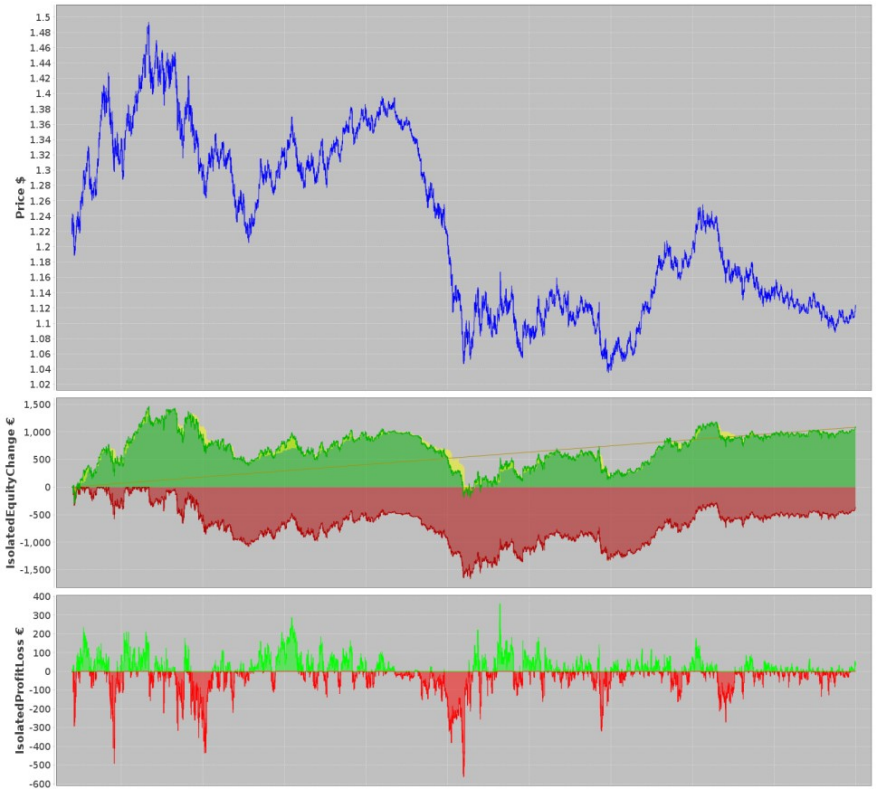
    (Source: https://www.bettertraderacademy.com/)

5.1. Test Setup

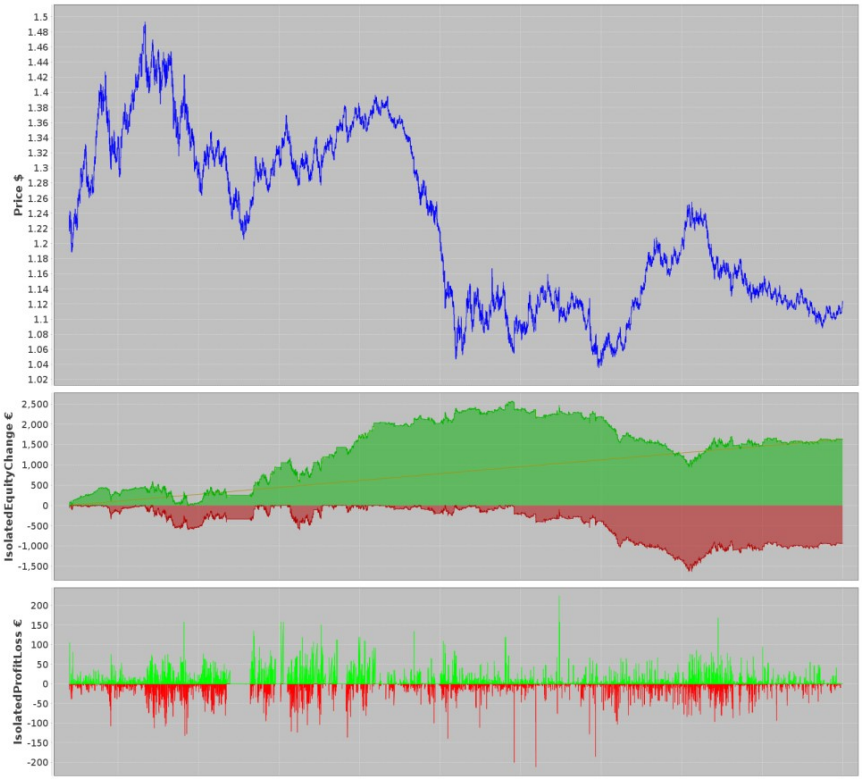
- **Foreign Exchange Market**: EURUSD
- **Commission:** Dukascopy Broker
  (Source: https://www.dukascopy.com/swiss/english/about/fee-schedule/)
- **Bars**: Daily → Time[1 DAY|UTC]
- **Order Types**: [Market] vs [Stop, Limit, StopLimit, MarketIfTouched]
- **Positions**: [Long] vs [Long || Short]
- **Money Management**: FixedAmount(minLot)
- **Strategy Filter**: rank(inSampleProfitLoss) <= 10
- **Walk Forward Analysis**:
  - 6 Years IN Samples; 1 Year OUT Samples
  - 10 Steps from 2010 to 2020

5.2. Test Results: Equity

Signal



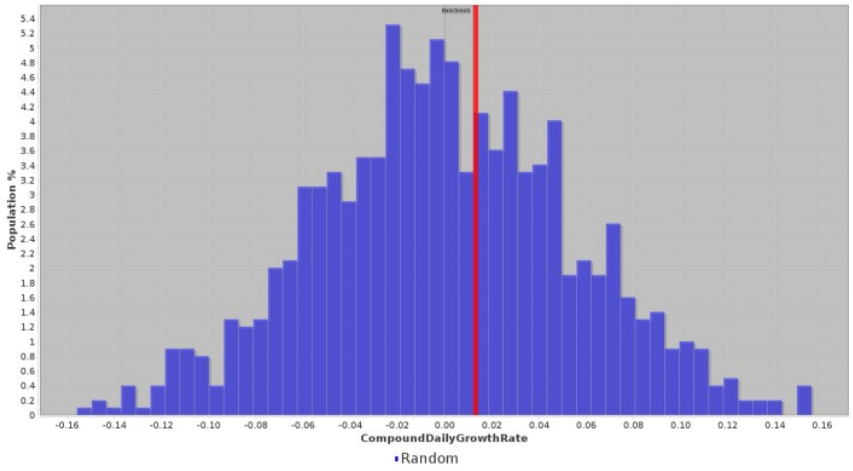
Breakout



5.4. Test Results: Whites Reality

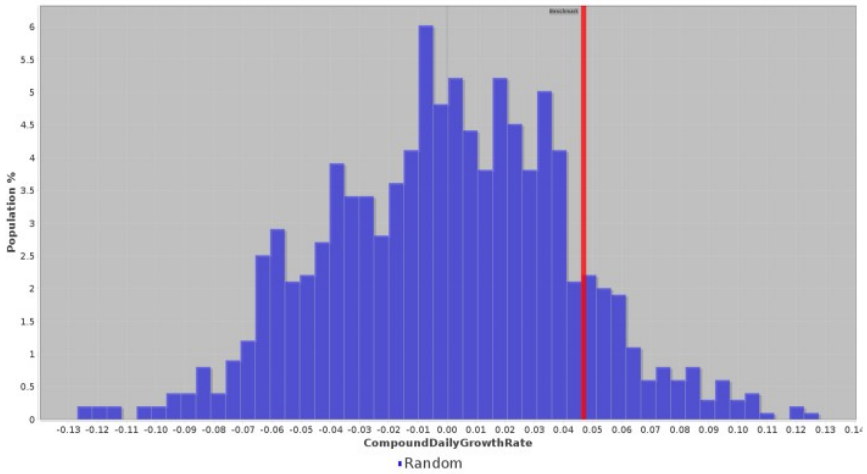
Signal

BenchmarkCDGR::	0.01318‰
ProbabilityOfLuck:	39.86%
DataMiningBias:	16.58%
MedianRandomCDGR::	0.002185‰
ProbabilityOfNonLuck:	60.14%



Breakout

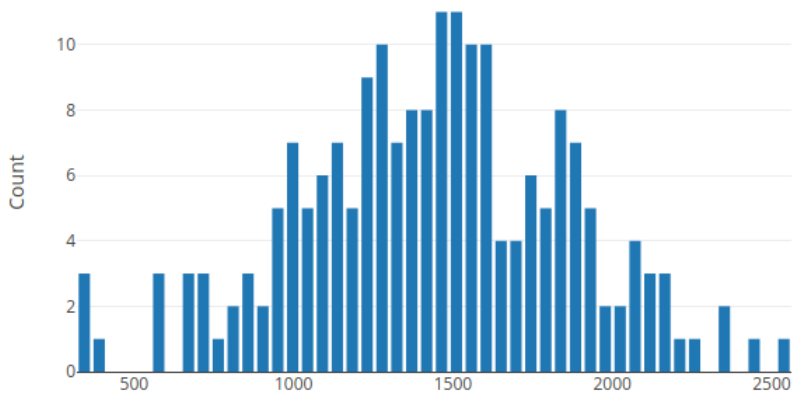
BenchmarkCDGR::	0.04696‰
ProbabilityOfLuck:	11.65%
DataMiningBias:	16.94‰
MedianRandomCDGR::	0.0007953‰
ProbabilityOfNonLuck:	88.35%



5.5. Test Results: Stability

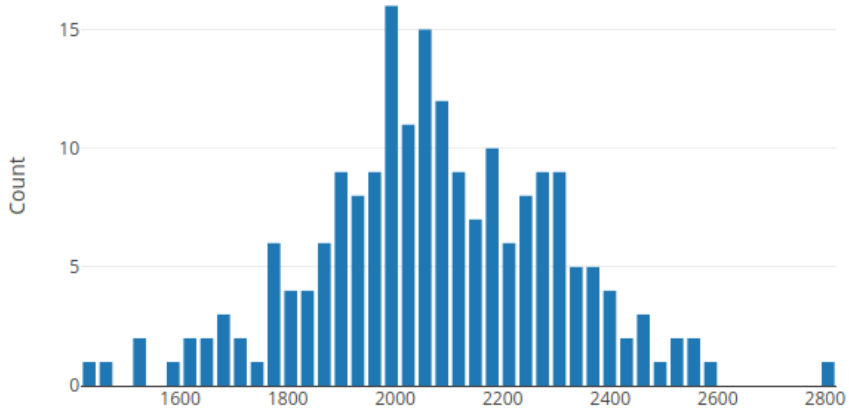
200 Runs

Signal



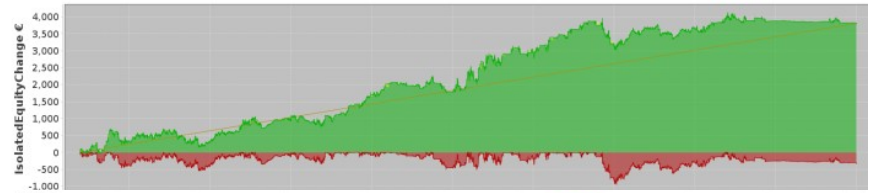
Confidence Level	66.ProfitLoss
1%	2528.84000
2%	2343.97000
5%	2173.51000
25%	1739.11000
50%	1452.83000
75%	1159.93000
95%	714.87000
98%	568.97000
99%	362.11000
Avg	1439.32300
Range	2335.25000
IQ-Range	579.18000

Breakout



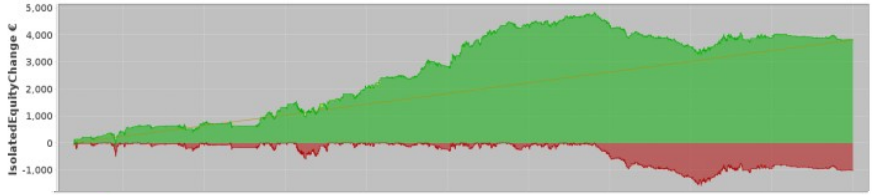
Confidence Level	66.ProfitLoss
1%	2811.01000
2%	2550.84000
5%	2466.10000
25%	2249.46000
50%	2062.98000
75%	1942.70000
95%	1684.96000
98%	1576.65000
99%	1513.90000
Avg	2078.13455
Range	1562.26000
IQ-Range	306.76000

5.6. Breakout Order Types



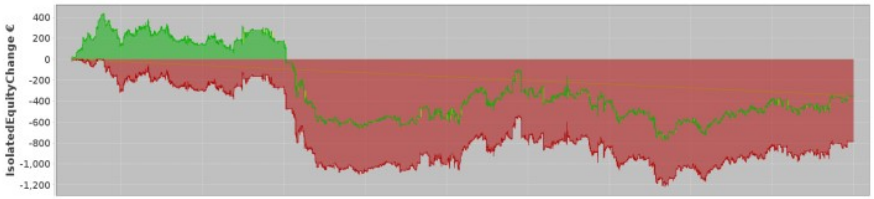
[Stop]

WalkForwardEfficiency:	119.1%
SymmetricalEfficiency:	131.14%



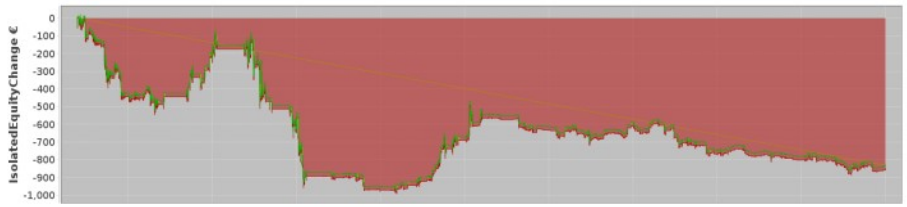
[Limit]

WalkForwardEfficiency:	93.08%
SymmetricalEfficiency:	117.81%



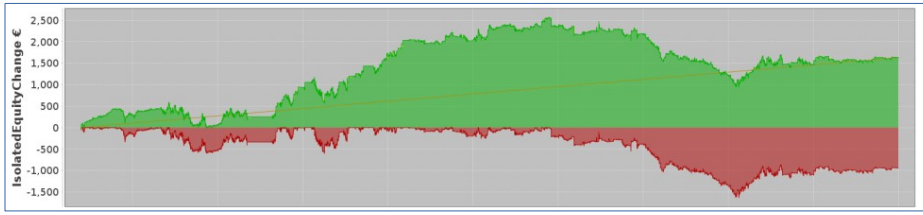
[StopLimit]

WalkForwardEfficiency:	-16.82%
SymmetricalEfficiency:	-18.06%



[MarketIfTouched]

WalkForwardEfficiency:	-60.76%
SymmetricalEfficiency:	-113.29%



[Stop, Limit, StopLimit, MarketIfTouched]

WalkForwardEfficiency:	43.4%
SymmetricalEfficiency:	74.11%

Next Research Question:

Which process can reduce false positives without human bias?

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Thank You for Your Attention!

Further Questions?

(Unattributed Images are Created by the Presenter, partially Sourced from previous Works)