Algorithmic Trading Risk Management

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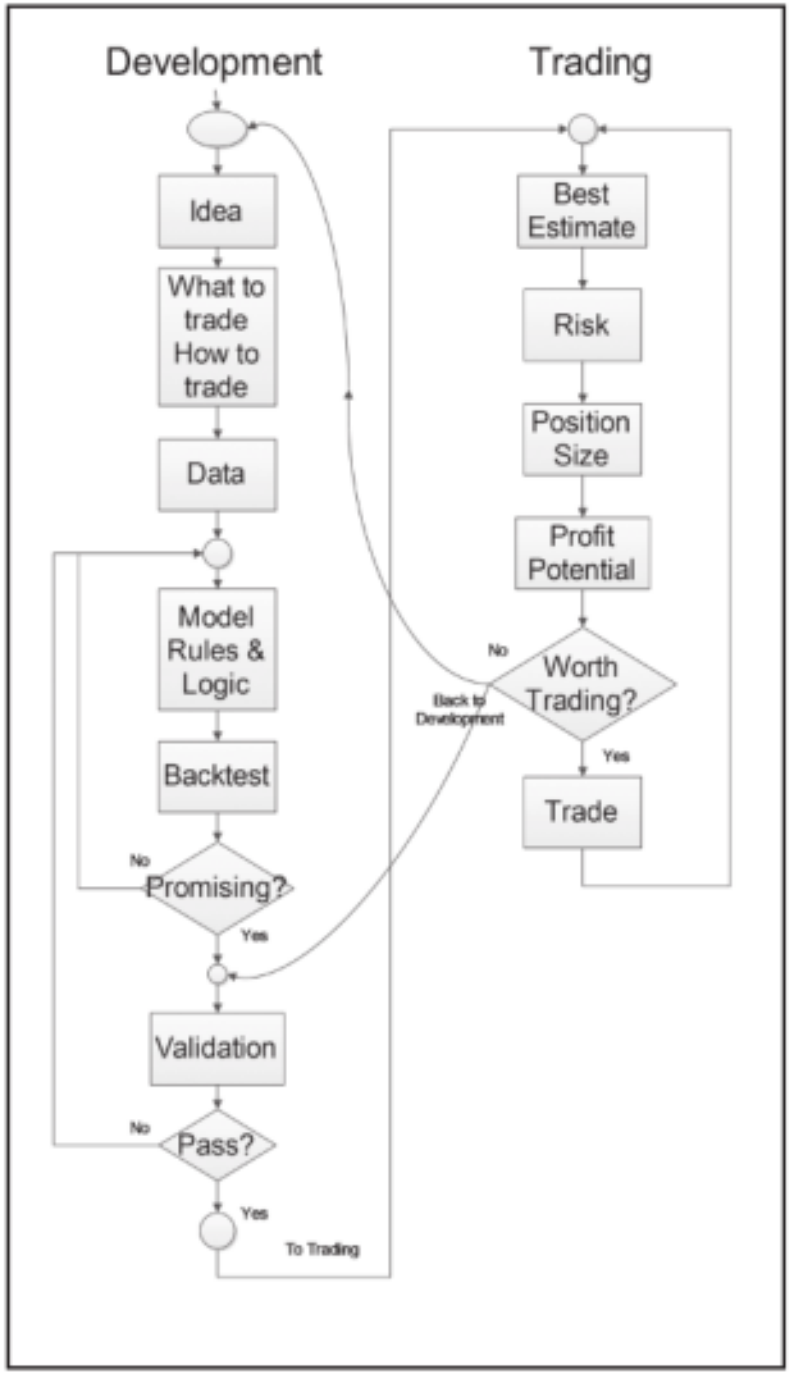
The Big Picture

1. Design a model
2. Verify the model
3. Monitor the performance
   - Risk Normalized Account Growth.
   - Maximum Safe Position Size.
   - Performance decay → Development



The Goal of Risk management

- Results:
  - Projecting confidence in models.
  - Filtering or ranking the models
  - Performance report
- Desired outcome:
  - Returns that compensate for risk
  - Safe position sizes that lead to good returns

Challenges

- Monitoring the continuity of patterns
- Estimation of position size accounting for holding drawdown within exogenous risk tolerance
- Recognize system breakdown and stop loss (Managing position size)

Position Size

- Should not be implemented in the trading model. If both signal and position size are in the same model, any bad trade is amplified.
- Solution: Fixed position size, Dynamic position size in management model.

Problems in Trading Model

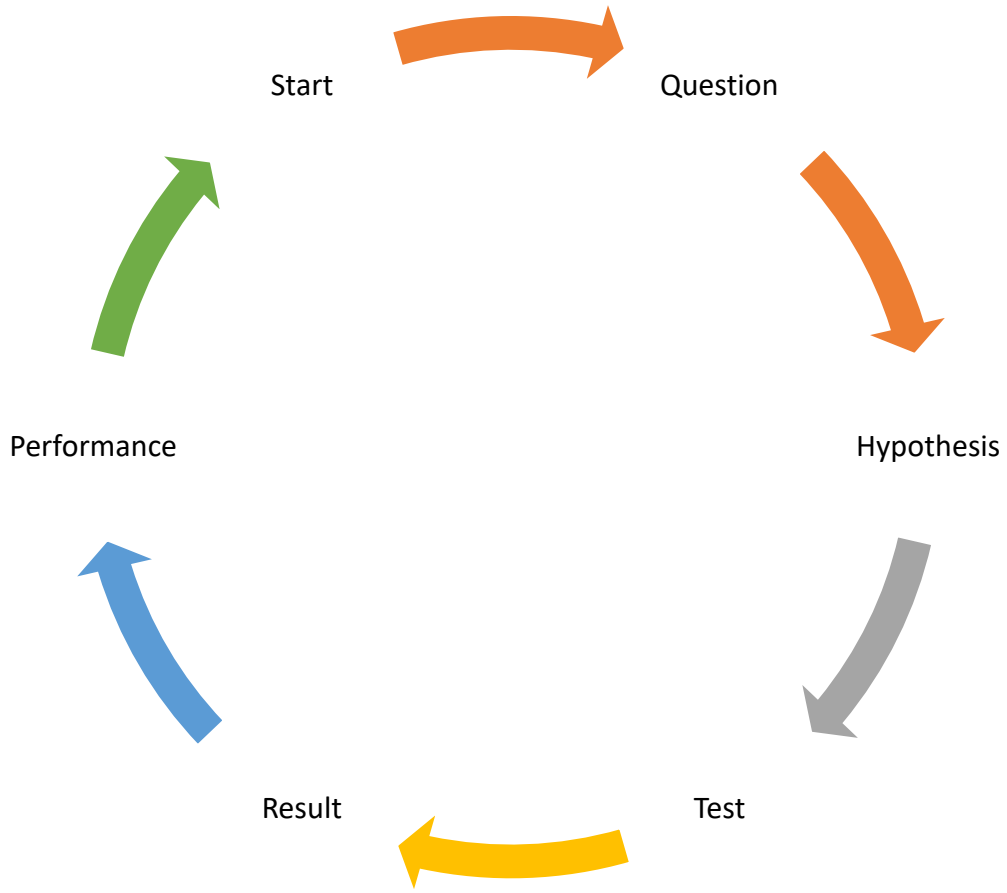
- Financial Data is nonstationary
- Models finding patterns cannot find stationary patterns in long terms
- Model should constantly be trained for short term patterns.
- Thus, data and trading model should stay synchronized. If synchronized, drawdowns are low, gains steady and model is profitable.
- When unsynchronized, model is unprofitable, gains are sporadic and drawdowns are high.

Back-testing summary format

Trade Performance Summary			
Strategy: ---			
Total Net Profit	---	Profit Factor	---
Gross Profit	---	Gross Loss	---
Total Number of Trades	---	percent profit	---
Wining Trades	---	Losing Trades	---
Even Trades	---		
Avg. Trade Net Profit	---	Ratio Avg. Win: Avg. Loss	---
Avg. Winning Trade	---	Avg. Loss Trade	---
Largest Winning Trade	---	Largest Losing Trade	---
Max. Consecutive Wining Trades	---	Max. consecuting Losing Trades	---
Avg. Bars in Wining Trades	---	Avg. Bars in Losing Trades	---
Avg. Bars in Total Trades	---		
Max. Shares/Contracts Held	---	Account Size Required	---
Return on Initial Capital	---	Annual Rate of Return	---
Return Retracement Ratio	---	RINA Index	---
Trading Period	---	Percent of Time in the Market	---
Max. Equity Run-up	---		
Max. Drawdown (Intra-day Peak to Valley)	---	**Max. Drawdown (Trade Close to Trade Close)**	---
Value	---	Vlaue	---
Net Profit as % of Drawdown	---	Net Profit as % of Drawdown	---
Max. Trade Drawdown	---		

- Of course this is just a template and we have to put our own criteria for algo performance based on the back-test

What people do in Academia?



- Question: Does BTC spot predicts BTC future?
- Hypothesis: The Spread between the BTC and BTC future is stationary. (or not)
- Test: Dicky-Fuller, Hurst exponent, variance-ratio
- Performance: if the performance decayed, do the process again.

Small Quant and Big Quant

- Small Quant Firms:
  - Smaller Markets
  - Unconventional Markets (like Crypto)
  - Less Liquid Assets (Higher Risk)
  - Restricted Leverage
  - Low Risk Management
  - Built-in Risk Management
- Big Quant Firms:
  - Big Markets
  - HFT & FT
  - Highly Liquid Assets
  - Leveraged
  - Low Latency
  - Higher Technology
  - Access to more info
  - High Risk Management

Why Backtesting?

- Filtering proposed strategies
- Implementing market specific phenomena like transaction cost, latency, liquidity
- Optimizing the model (though this is bias maker)
- Verifying that the model implemented correctly.

Backtesting Biases

- Note: Always consider backtesting as the upper bound of the performance.

1. Optimization Bias (Curve fitting, data-snooping bias)
2. Look-Ahead Bias
3. Survivorship Bias
4. Cognitive Bias

Optimization Bias

- We add or adjust the parameters until the backtest shows good performance. Once we run the trading strategy, we see bad performance.
- Hard to eliminate since we need high amount of params.
- Solution:
  - Minimize the features, Maximize the data points
  - Be aware that old data points may belong to prior regime
  - Preform Sensitivity Analysis: varying params and see the param surface, thus, good params should show smooth param surface
  - Thus: multi-dimensional optimization for trading algorithms on test data

Look-Ahead Bias

- When training data and test data are overlapped. If we are running the backtest chronologically and we reach time point N, then look-ahead bias occurs if data is included for any point N + k, where k > 0.
- Why?
  - Technical Bugs
  - Parameter Calculation: Optimizing parameters based on training and test data. Param optimization should only use training data.
  - Maxima/Minima: Using features like high-low prices. These features are only known when the period ends, so they carry look-ahead bias. We should always lag them.

Survivorship Bias

- Only choosing the assets that didn’t default in the past.
- It’s like look-ahead bias since we are choosing the assets that we know will survive in the future, for the backtesting.
- Solutions:
  - Use Survivorship Bias Free Datasets
  - Use More Recent Data

Cognitive Bias

- When the asset price is upward trending, risk seems easy to tolerate when the return is high.
- However, in reality, when the drawdown occurs, it is psychologically hard to tolerate.
- Thus, the trader will terminate the program after a big drawdown.