ELEC 7080 Algo Trading and HFT

WONG Nga Yan Dorothy

Park Seo Hye, Sarah

Ho Kam Tim, Steven

Li Zhilin (Camille)

Introduction of the project

Introduction and Motivation of Research

- Traditional Approach of Investing
  - Fundamental change in macro economy & Technical
  - Correlation exploitation

- Case Study
  - S&P500 constitutes
  - Hybrid of macro factors and technical Indicators as Features

- Multiple Trading Strategies could be derived...
  - Core-Satellite approach for Alpha capturing
  - Enhanced performance with beta strategies
  - Correlation in shorter term
  - Benchmark to Open/Close/Intraday

Feature Selection - VIX

Exhibit 8: VIX has been hitting lower levels at each SPX high recently - perhaps similar to 1998-9

Closing SPX and VIX on each date when the SPX hit a new all-time high (log-scale X-axis)

Source: Goldman Sachs Global Investment Research, Bloomberg
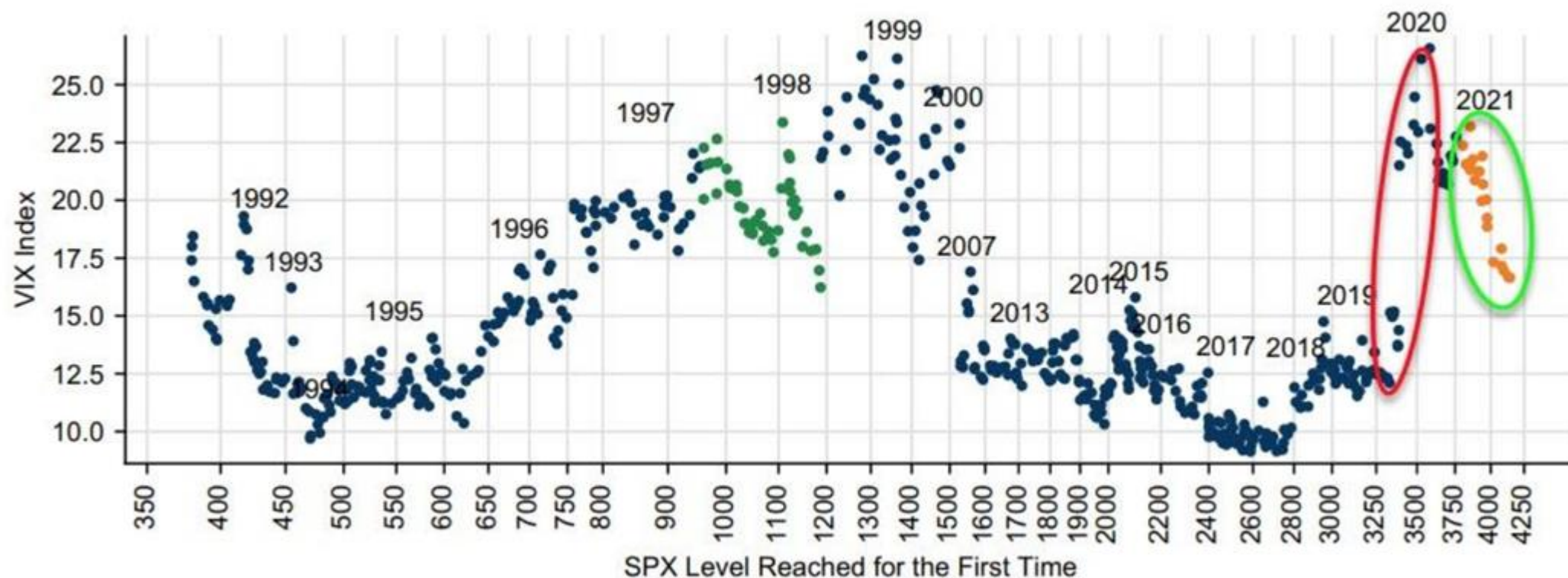
Feature Selection – 5 and 10 years yield
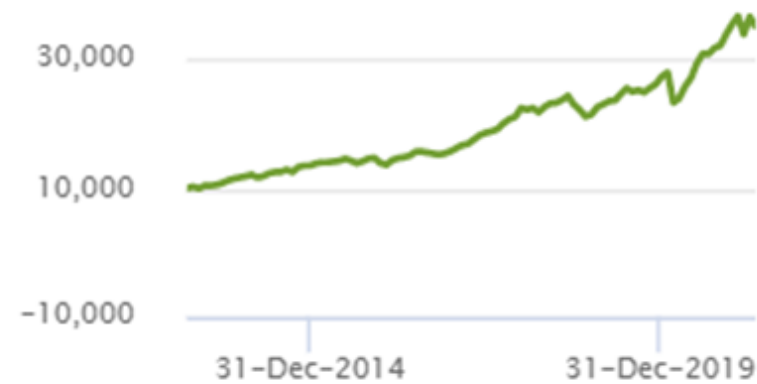

Fed funds rate & Dow Jones index between 1968 & 1976

Feature Selection – MTUM and VALU

iShares MSCI USA Momentum Factor ETF (MTUM)

Net Assets as of May 21, 2021	$13,933,846,799
Number of Holdings ❶ as of May 20, 2021	124
P/B Ratio ❶ as of May 20, 2021	10.21
P/E Ratio ❶ as of May 20, 2021	48.67

iShares S&P 500 Value ETF (VALU)

Net Assets as of May 21, 2021	$22,921,294,453
Number of Holdings ❶ as of May 20, 2021	433
P/B Ratio ❶ as of May 20, 2021	2.76
P/E Ratio ❶ as of May 20, 2021	25.19

Feature Selection – DXY

Pre-trade Analysis

https://elec7080.herokuapp.com/

Six Aspects of Pre-trade Analysis

Macroeconomics

Market

Technical

Fundamentals

News

Analysts/ KOLs

Prediction Model

Core Id

- Use Prediction Model to acquire predicted next day's return
- Give suggestions on the parameters

•**Regression Models**

Pros:

- Easy to explain, know the data better
- Efficient in training and fine tune

Cons:

- Limited performance
- More suitable for data with linear relationship

Linear Regression

Kernel Regression

Robust Regression

Train → Train model

Validation → Select stocks Trading signal

Test → Back-testing

Long-short Strategy

Long-short Strategy

- **Stock Selection Criteria**

Predicted result of the validation set

MAE

MSE

STD

→ Criteria

- **Trading Signal**

Predicted return rate

Everyday

Obeys standard normal distribution

$$\frac{\Delta S}{S} = \mu \Delta t + \sigma \epsilon \sqrt{\Delta t}$$

Predicted return rate standard deviation
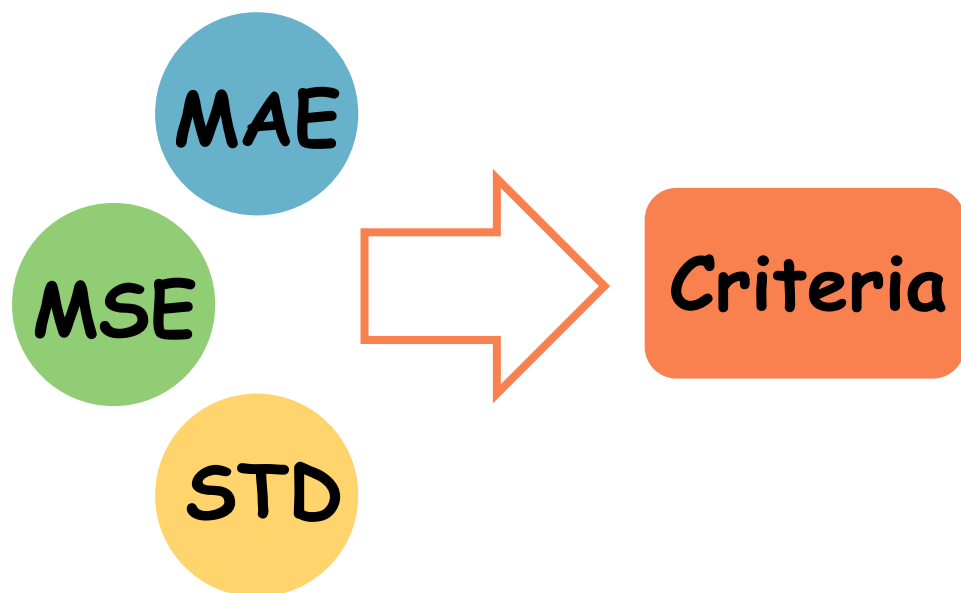
where:

S = the stock price

ΔS = the change in stock price

μ = the expected return

σ = the standard deviation of returns

ϵ = the random variable

Δt = the elapsed time period

Expectation of predicted return rate

shock $(\sigma \varepsilon \sqrt{\Delta t})$

shock $(\sigma \varepsilon \sqrt{\Delta t})$

drift$(\mu \Delta t)$

drift$(\mu \Delta t)$

$\Delta S = S_{t-1}(\mu \Delta t + \sigma \varepsilon \sqrt{\Delta t})$

# Long-short Strategy

- **Decide Market Trend**

  - The "1" is a black crossing. Thus, we regard it as a bearish signal.
  - The "2" is a golden crossing. Thus, we regard it as a bullish signal.
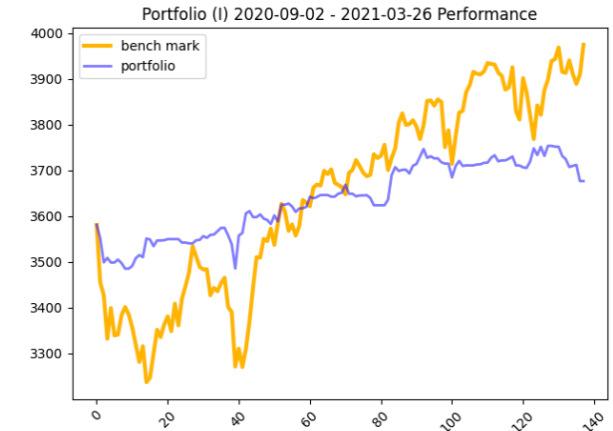
Long-short Strategy

• **Strategy Construction**

- Reduce Volatility

- Stop Loss & Take Profit Point

- Trade at Next Day's Adequate Price

- Daily Bases

- Transaction Cost

Portfolio (I) 2020-09-02 - 2021-03-26 Performance
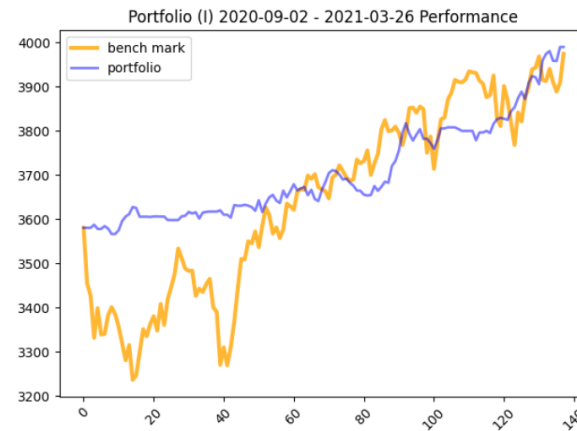
Kernel Model

Start Date: 2020-09-02	End Date: 2021-03-26
Trading days	137
Annual Return	20.806%
Sharp Ratio	3.33
Max Draw Down	-1.556%

Portfolio (I) 2020-09-02 - 2021-03-26 Performance

Robust Regression

Start Date: 2020-09-02	End Date: 2021-03-26
Trading days	137
Annual Return	3.487%
Sharp Ratio	0.316
Max Draw Down	-2.787%

Long-short Strategy

- **Back-testing:** Different Time Period

Portfolio (I) 2020-09-02 - 2020-11-04 Performance
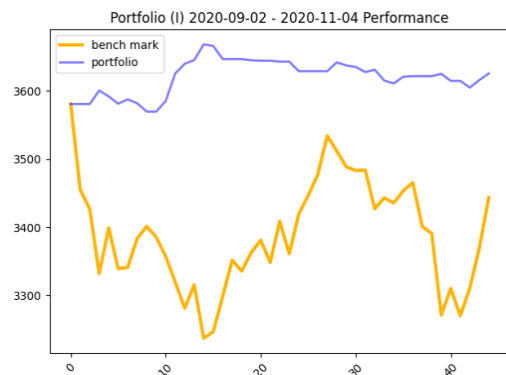
Start Date: 2020-11-04	End Date: 2021-
Trading days	54
Annual Return	20.703%
Sharp Ratio	2.82
Max Draw Down	-1.564%

Portfolio (I) 2021-01-28 - 2021-03-26 Performance
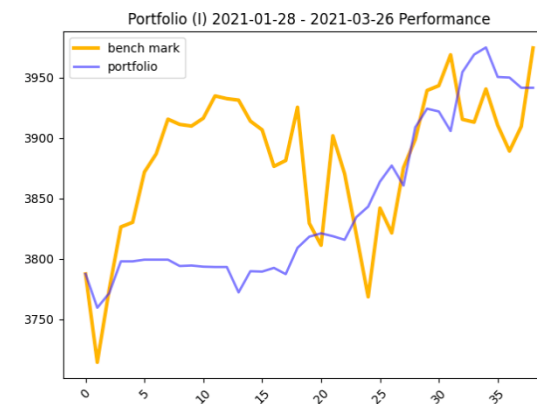
Start Date: 2020-09-02	End Date: 2021-11-04
Trading days	44
Annual Return	7.356%
Sharp Ratio	1.26
Max Draw Down	-1.748

Portfolio (I) 2020-11-05 - 2021-01-28 Performance
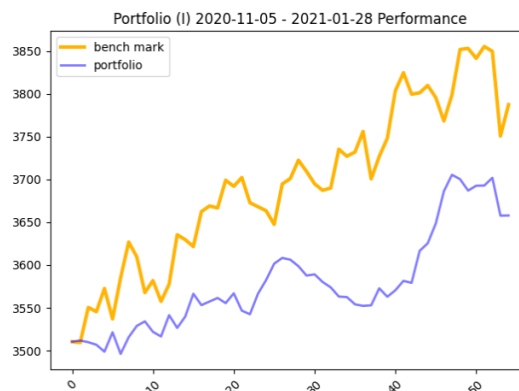
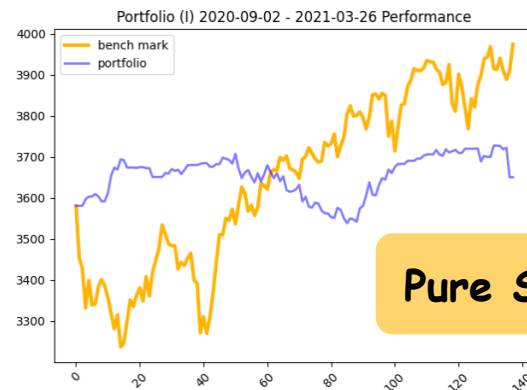| Start Date: 2020-01-28	End Date: 2021-03-26
Trading days	38
Annual Return	29.631%
Sharp Ratio	4.43
Max Draw Down	0.844%

Long-short Strategy

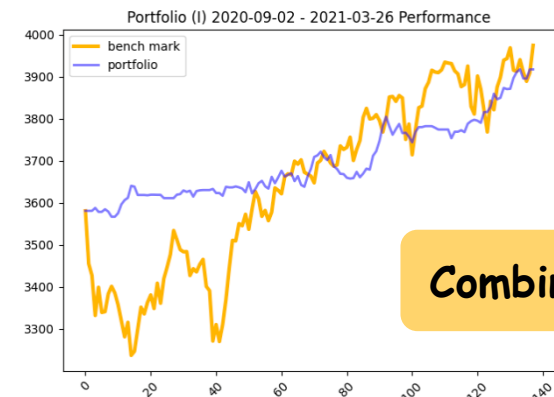- **Back-testing:** Different Long Short Position Rate
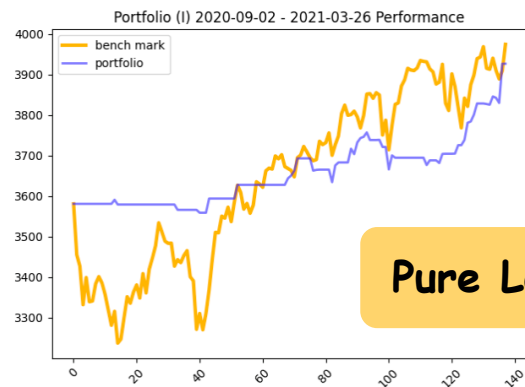
Pure Long

Start Date: 2020-09-02	End Date: 2021-03-26
Trading days	137
Annual Return	17.616%
Sharp Ratio	2.64
Max Draw Down	-2.465%

Pure Short

Start Date: 2020-09-02	End Date: 2021-03-26
Trading days	137
Annual Return	3.573%
Sharp Ratio	0.347
Max Draw Down	-4.671%

Combination

Start Date: 2020-09-02	End Date: 2021-03-26
Trading days	137
Annual Return	17.147%
Sharp Ratio	2.85
Max Draw Down	-1.736%

Long-short Strategy

- **Back-testing:** Different Aggressiveness

Neutral
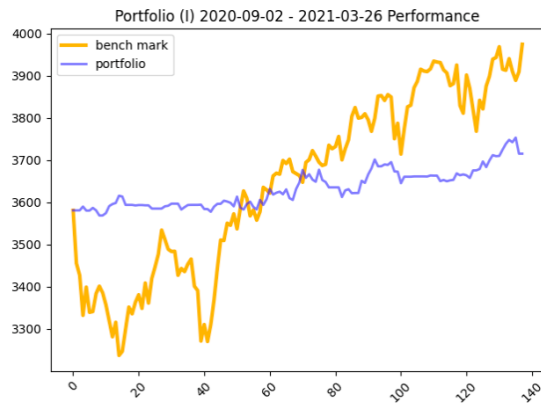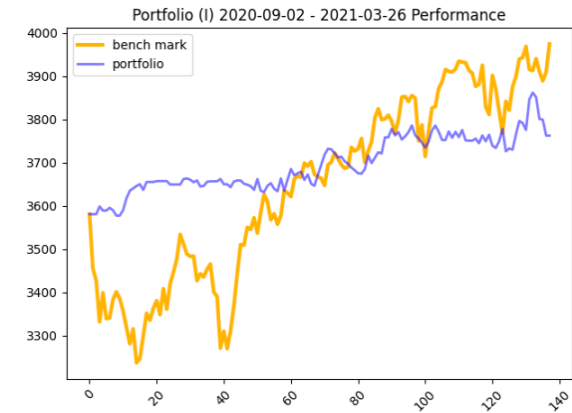
Portfolio (I) 2020-09-02 - 2021-03-26 Performance

Start Date: 2020-09-02	End Date: 2021-03-26
Trading days	137
Annual Return	6.885%
Sharp Ratio	1.09
Max Draw Down	-1.776%

Aggressive

Portfolio (I) 2020-09-02 - 2021-03-26 Performance

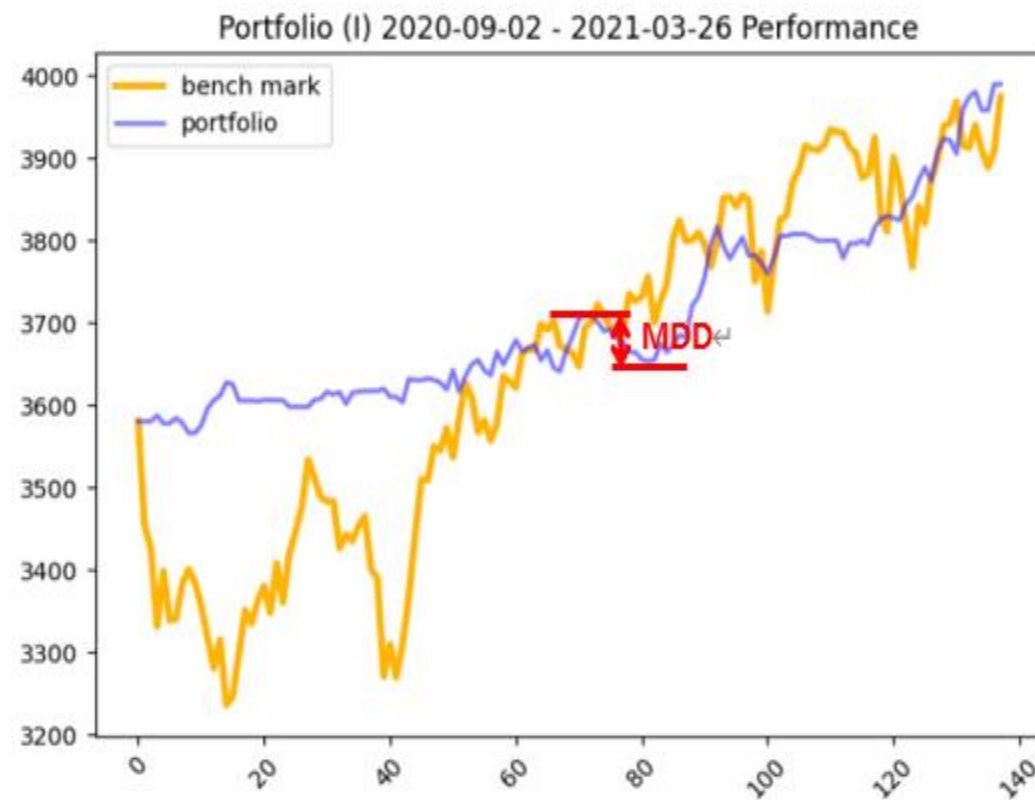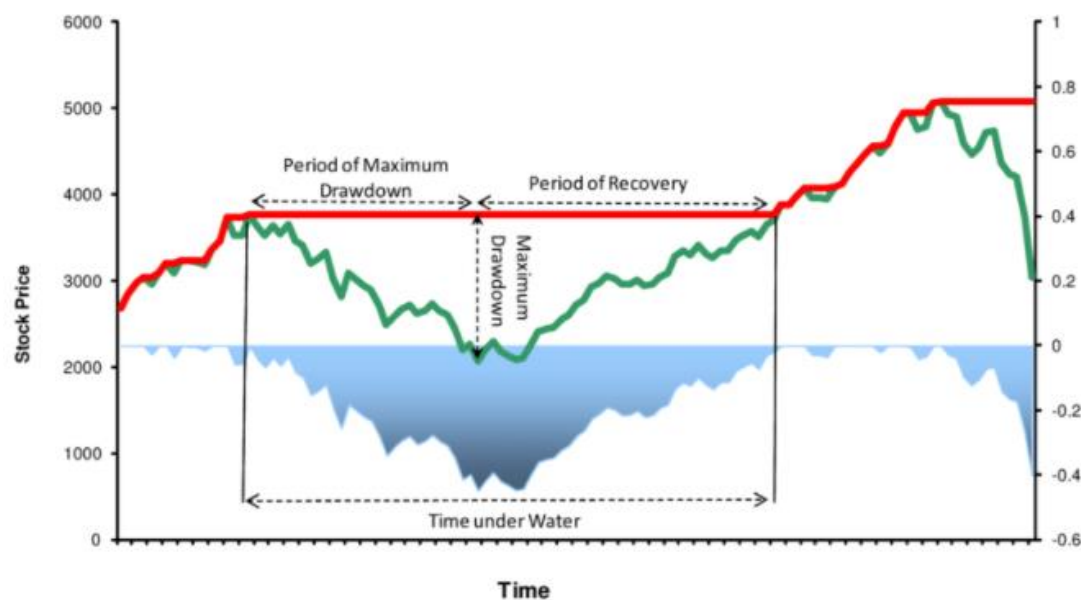| Start Date: 2020-09-02	End Date: 2021-03-26
Trading days	137
Annual Return	9.297%
Sharp Ratio	1.13
Max Draw Down	-2.609%

Risk Management
&
Potential
Improvement

Risk Management

Maximum Drawdown   =   -1.56%

$$MDD = \frac{Trough\ Value - Peak\ Value}{Peak\ Value}$$

Risk Management

Sharpe Ratio   =   3.33   Calmar Ratio   =   13.3

$$Sharpe\ Ratio = \frac{R_p - R_f}{\sigma_p}$$

where:

R_p = return of portfolio

R_f = risk-free rate

σ_p = standard deviation of the portfolio's excess return

$$Calmar\ Ratio = \frac{Annualized\ Return\ (R_p)}{|MDD_p|}$$

where:

R_p = Annualized return of portfolio

MDD_p = Maximum drawdown of portfolio

Potential Improvements

➢ Use better quality *intraday data* i.e. data in minutes, seconds

➢ Develop intraday *algo trading strategies* based on different benchmark

➢ *Hedging* with different financial products - futures, options

➢ *Rolling basis* training, validating, testing

Thank You