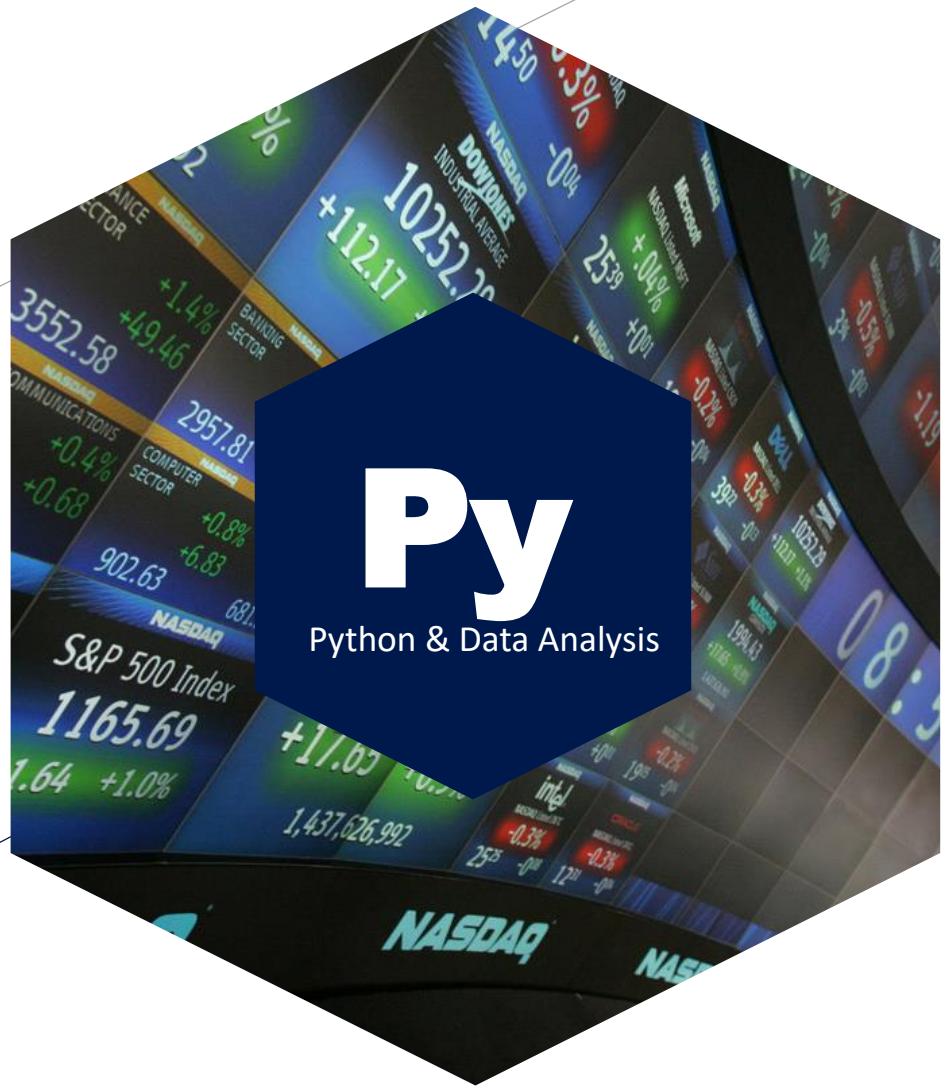
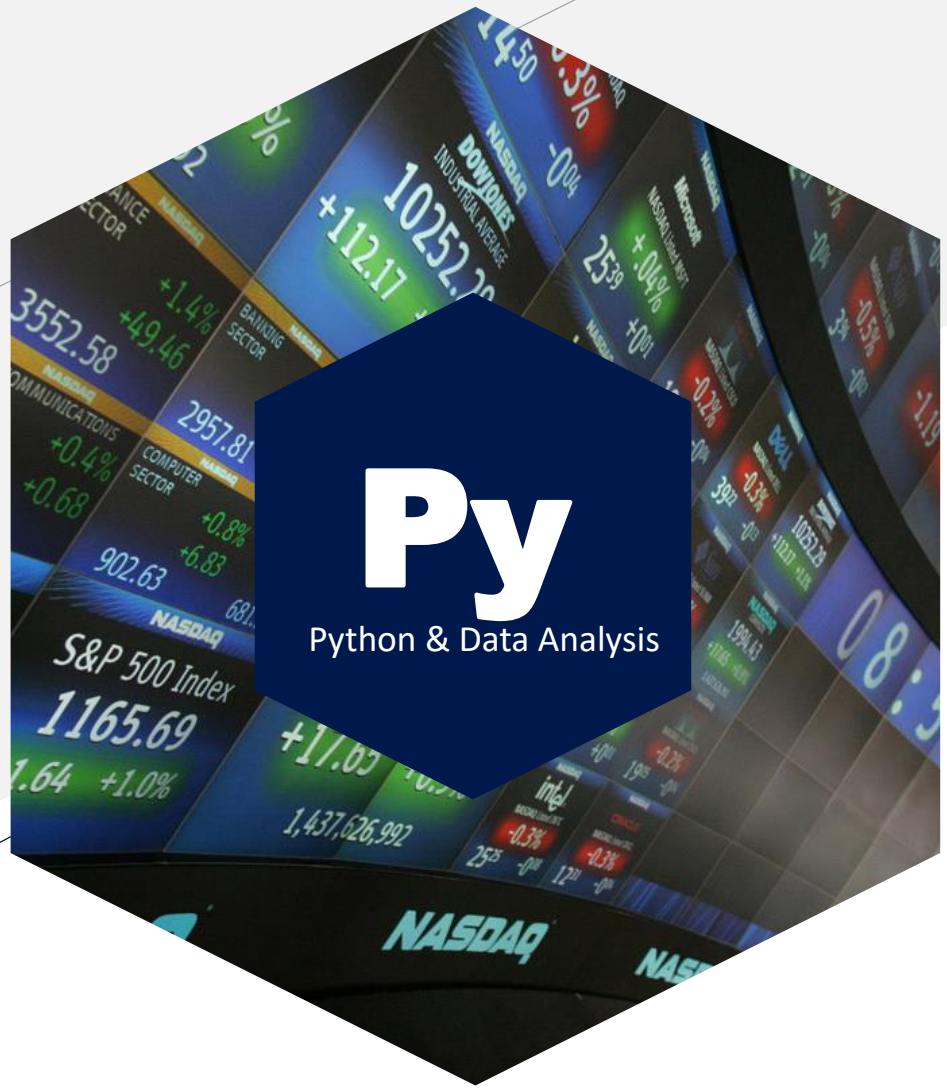


Quantitative Stock Selection based on **Multi-Factor Model**

迟贺元



Group Member.

Stu. ID	Name
1610006	迟贺元
1611980	郝若馨
1612428	张翰文
1612435	胡濒午

Section One

The Process of Multi-Factor Model

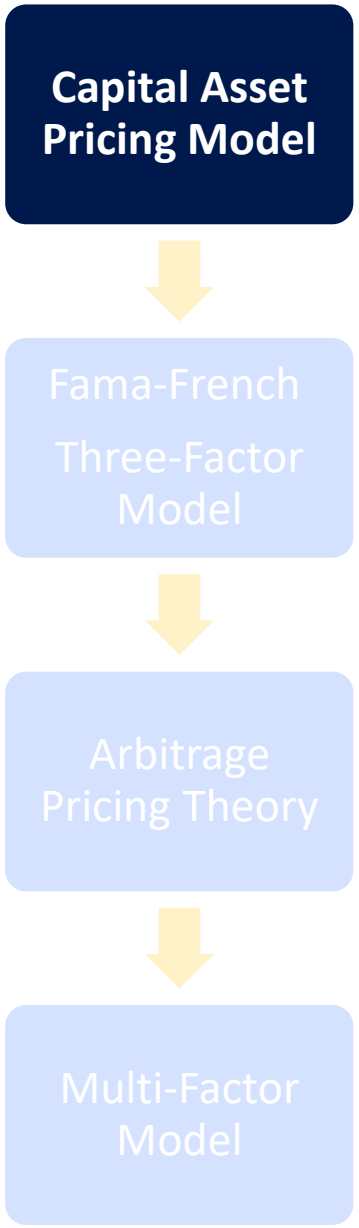
The Process of Multi-Factor Model

Capital Asset Pricing Model

$$E(R_i) = R_f + \beta_{iM} \cdot E\left(R_M - R_f\right)$$

where

$$\beta_{iM} = \mathrm{Cov}(R_i, R_M) \,/ \mathrm{Cov}(R_M)$$



The Process of Multi-Factor Model

Fama-French Three-Factor Model

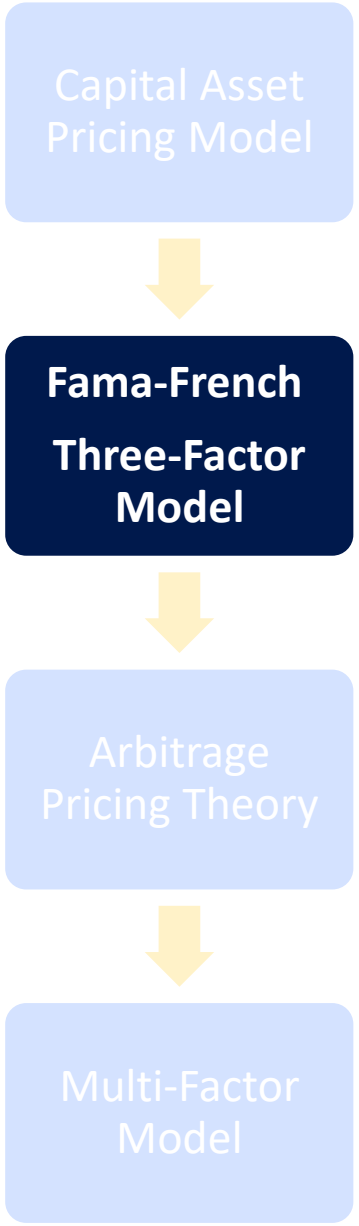
$$E(R_i) - R_f = \beta_{iM} \cdot E(R_M - R_f)$$

$$+b_s \cdot SMB$$

Small [market capitalization]
Minus **B**ig

$$+b_v \cdot HML$$

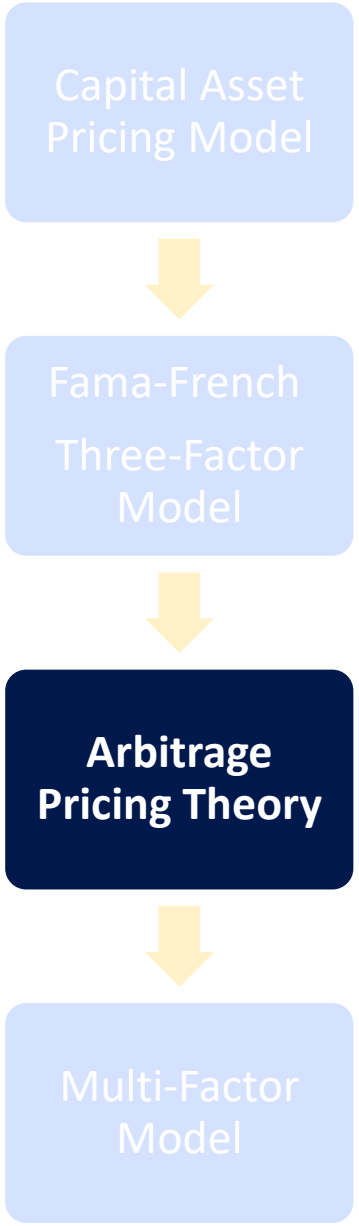
High [book-to-market ratio]
Minus **L**ow



The Process of Multi-Factor Model

Arbitrage Pricing Theory

$$R_j = a_j + b_{j1}F_1 + b_{j2}F_2 + \cdots + b_{jn}F_n + \epsilon_j$$



The Process of Multi-Factor Model

Arbitrage Pricing Theory

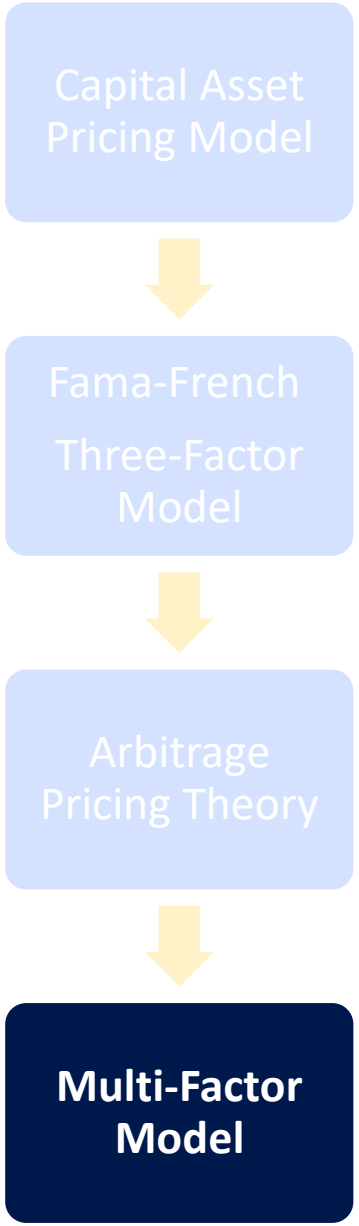
Factor

$$E(R_M - R_f),\ HML,\ SMB,\ P/E,\ P/S\ \cdots$$

Fitting

OLS，LASSO，Machine Learning ⋯

$$R_j = a_j + b_{j1}F_1 + b_{j2}F_2 + \cdots + b_{jn}F_n + \epsilon_j$$



The Process of Multi-Factor Model

Arbitrage Pricing Theory

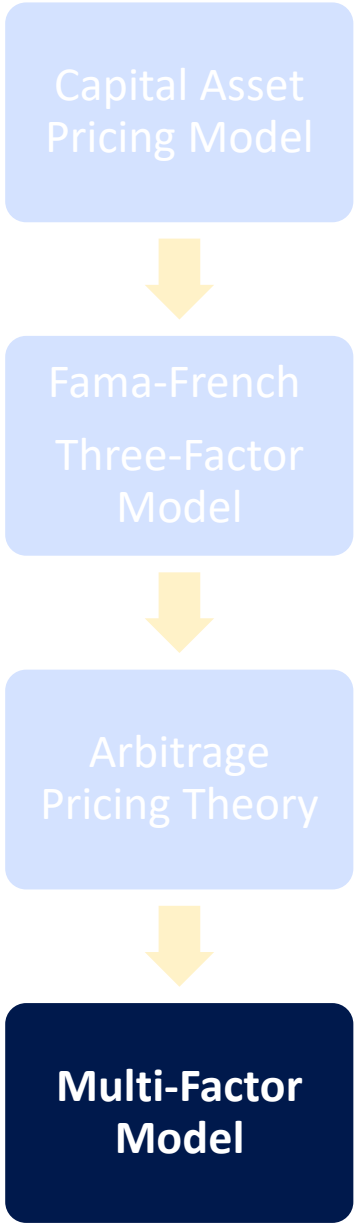
Factor

$$E(R_M - R_f),\ HML,\ SMB,\ P/E,\ P/S\ \cdots$$

Fitting

OLS，LASSO，Machine Learning ⋯

$$R_j = a_j + b_{j1}F_1 + b_{j2}F_2 + \cdots + b_{jn}F_n + \epsilon_j$$



Section Two

Data

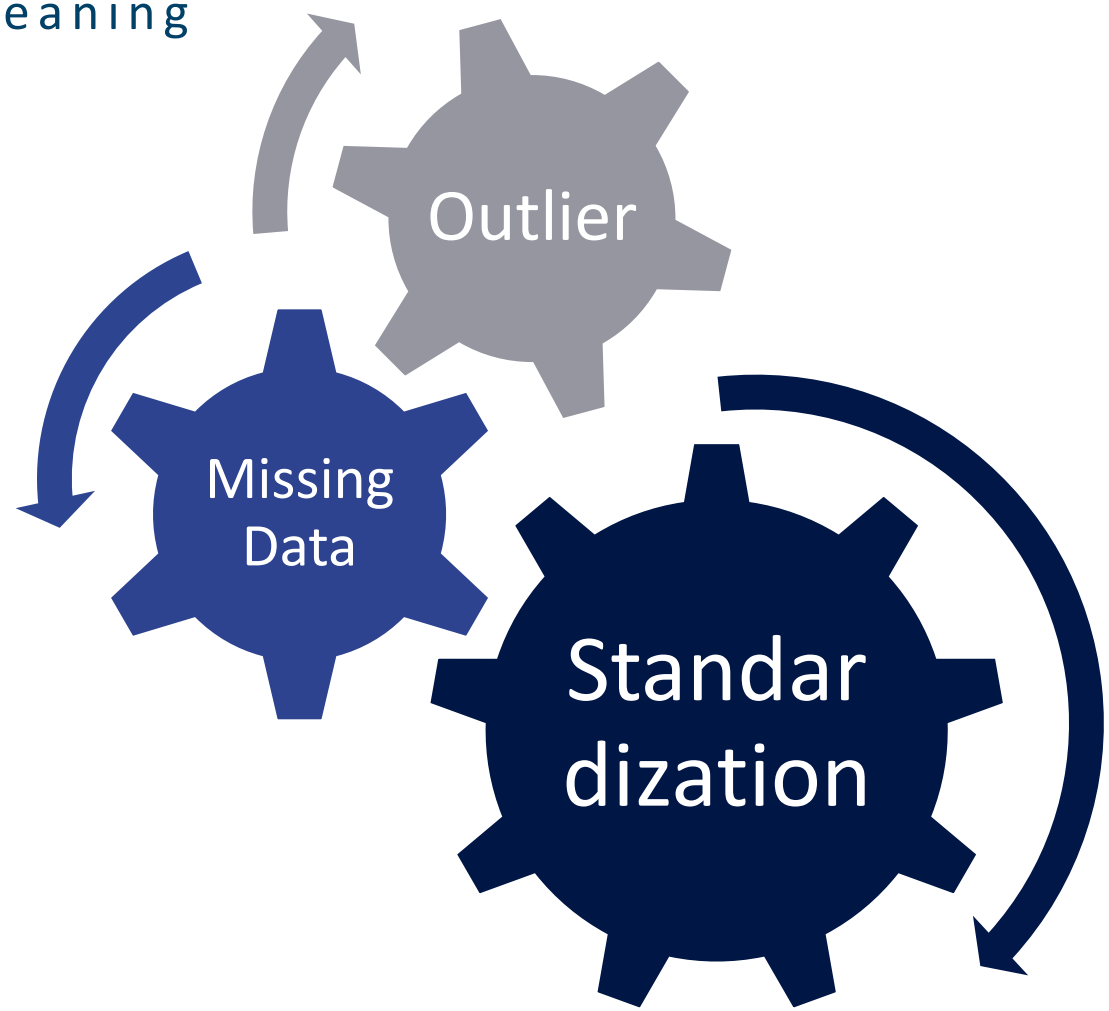
Traditional Multi-Factor Model

Sample Selection

- Stock Pool:
  - A-share Market
- Period:
  - 2006-01-01 — 2019-03-01
- Rules:
  - Drop **ST/PT** stocks
  - Drop stocks that have been listed for **less than 3 years**
  - Drop stocks that **cannot be bought or sold** due to suspension of trading, etc.

Traditional Multi-Factor Model

Data Cleaning



Traditional Multi-Factor Model

Factor Calculation

Num	Factor Equation
F_1	Net Profit for the past 12 months/ Gross Operating Income for the past 12 months
F_2	Current Assets - Current Liabilities/Total Assets
F_3	Free Cash Flow of Enterprises/Total capital stock
F_4	year-on-year growth rate of BPS
F_5	90% mark of the past month's return.
F_6	standard deviation of return over the past month
F_7	return over the past six months
F_8	maximum/minimum of price over the past three months
F_9	standard deviation of volume over the past year
…	…
F_{94}	average turnover over the past month

Section Three

Factor Test

Traditional Multi-Factor Model

Factor Test

$$\begin{bmatrix} r_{ti} \\ \vdots \\ r_{tn} \end{bmatrix} = \begin{bmatrix} \beta_{t11} & I_{t1u} & \cdots & I_{t1v} & m_{t1m} \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ \beta_{tn1} & I_{tnu} & \cdots & I_{tnv} & m_{tnm} \end{bmatrix} \cdot \begin{bmatrix} f_{ti} \\ \vdots \\ f_{tn} \end{bmatrix} + \begin{bmatrix} \mu_{ti} \\ \vdots \\ \mu_{tn} \end{bmatrix}$$

Traditional Multi-Factor Model

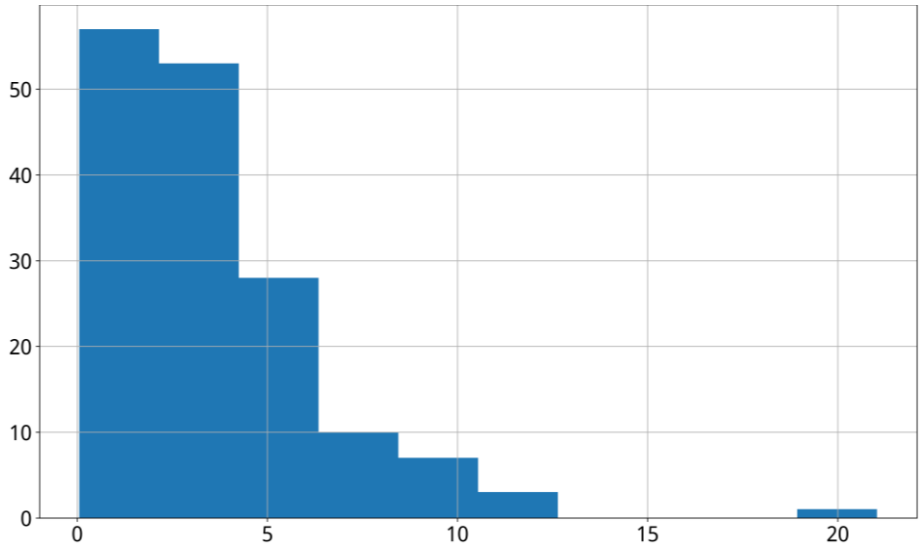
Factor Test

Value	F38	F129
$\mu_{\|T\|}$	3.54	3.56
$\|T\| > 2\ Ratio$	68.60%	64.80%
$T > 0\ Ratio$	61.60%	25.20%
μ_{IC}	5.29%	-7.46%
$\mu_{\|IC\|}$	12.00%	11.10%
σ_{IC}	14.10%	11.90%
$IC > 0\ Ratio$	66.00%	33.30%
$\|IC\| > 0.02\ Ratio$	88.70%	87.40%
IR	37.21%	-62.70%

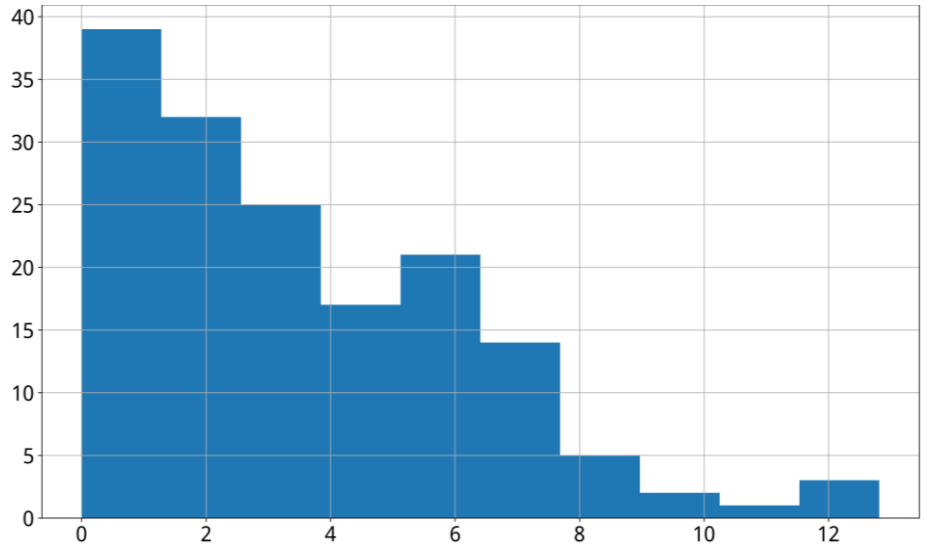
Traditional Multi-Factor Model

Factor Test

F38's $|T|$ Frequency Distribution



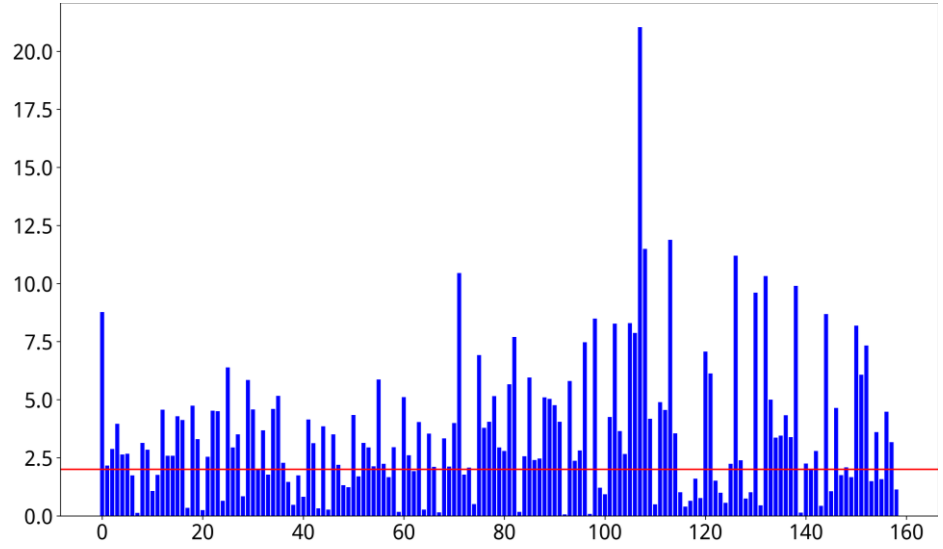
F129's $|T|$ Frequency Distribution



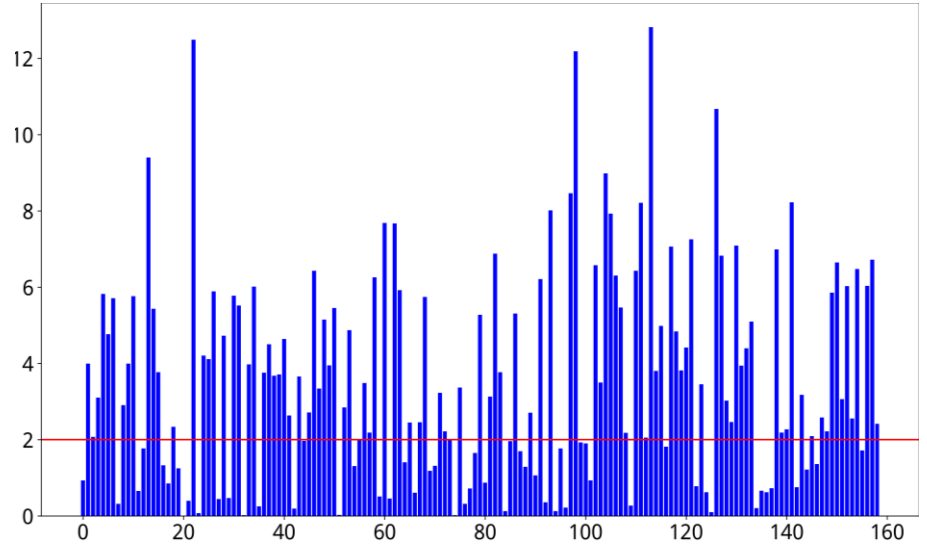
Traditional Multi-Factor Model

Factor Test

F38's $|T|$ Time Series



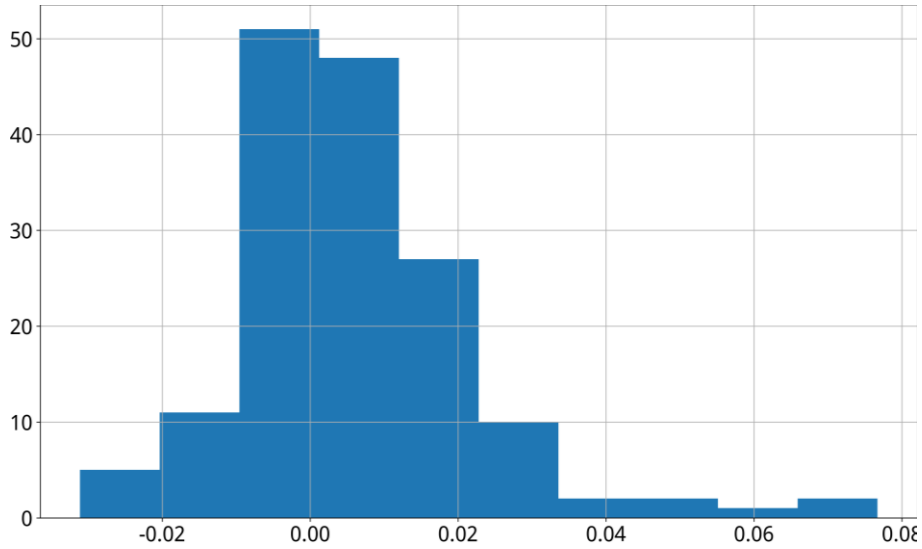
F129's $|T|$ Time Series



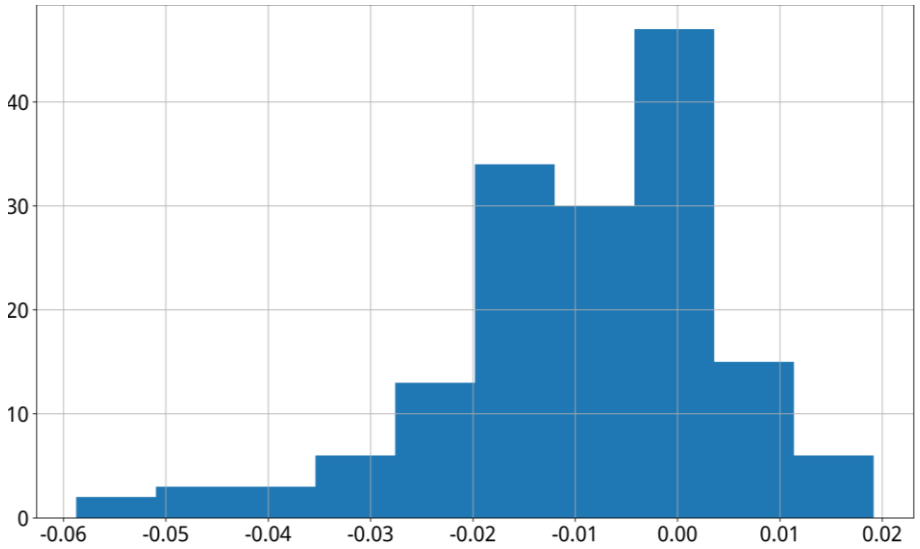
Traditional Multi-Factor Model

Factor Test

F38's f_i Frequency Distribution



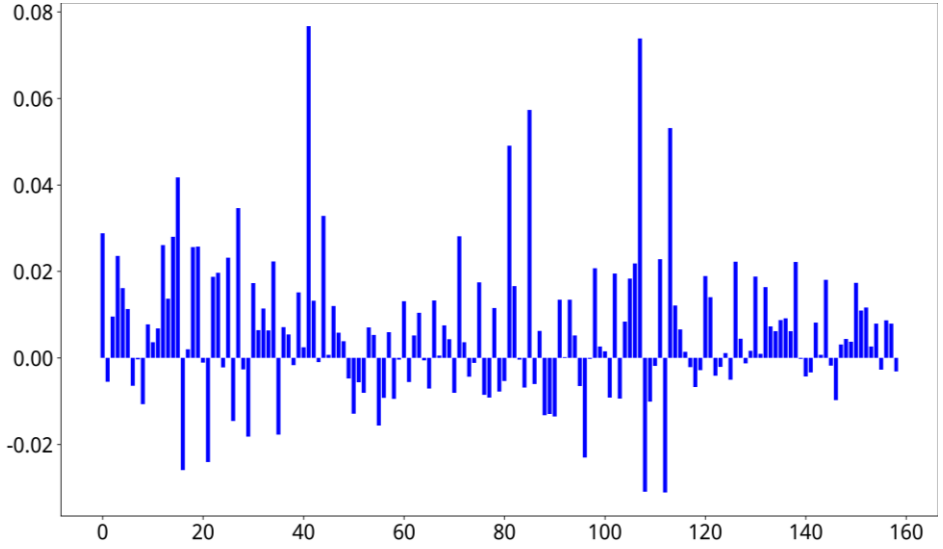
F129's f_i Frequency Distribution



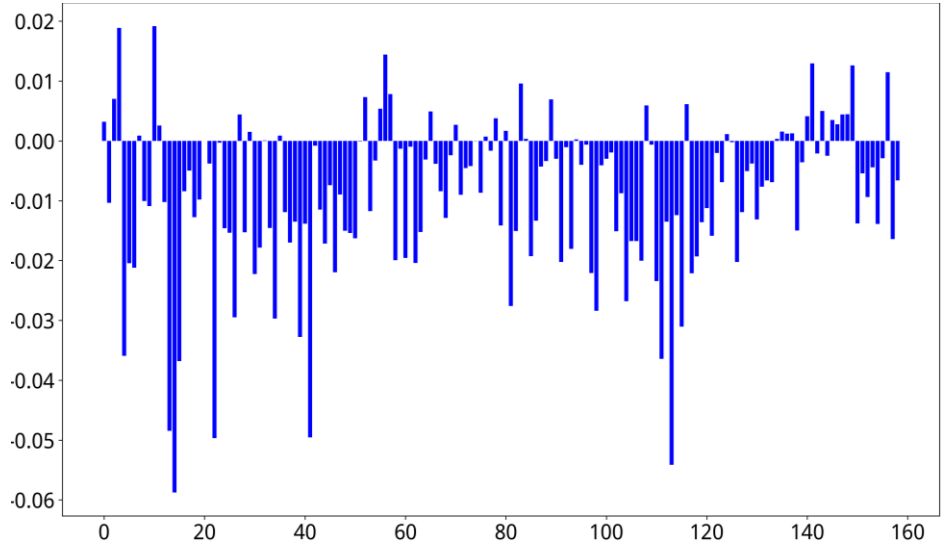
Traditional Multi-Factor Model

Factor Test

F38's f_i Time Series



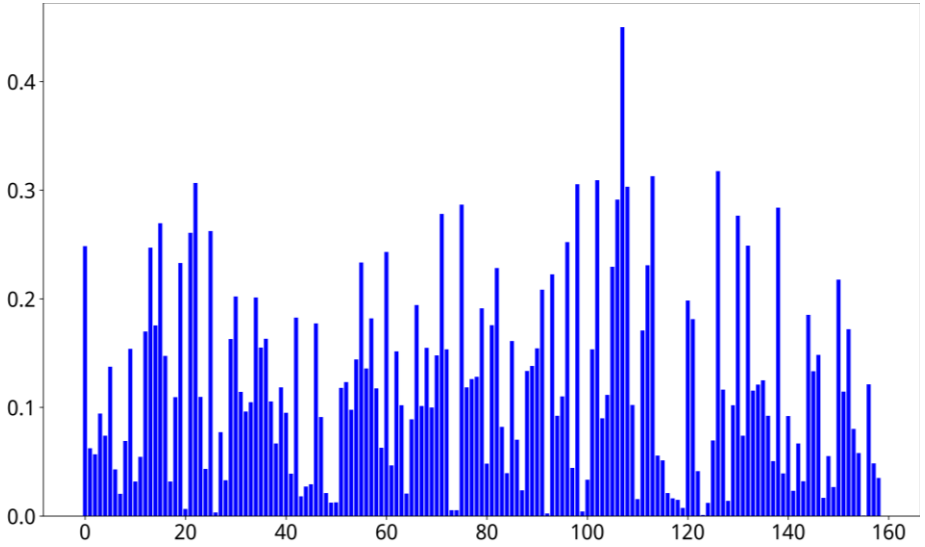
F129's f_i Time Series



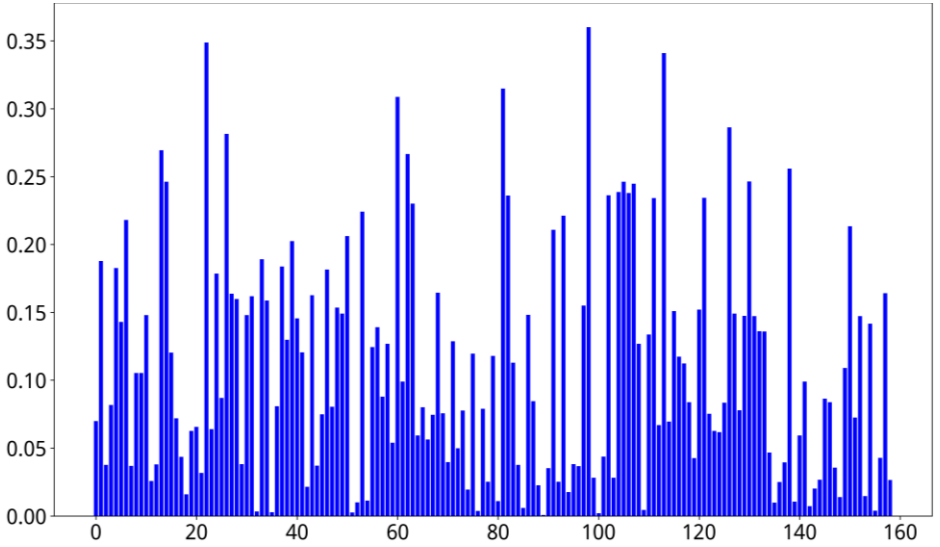
Traditional Multi-Factor Model

Factor Test

F38's $|IC|$ Time Series



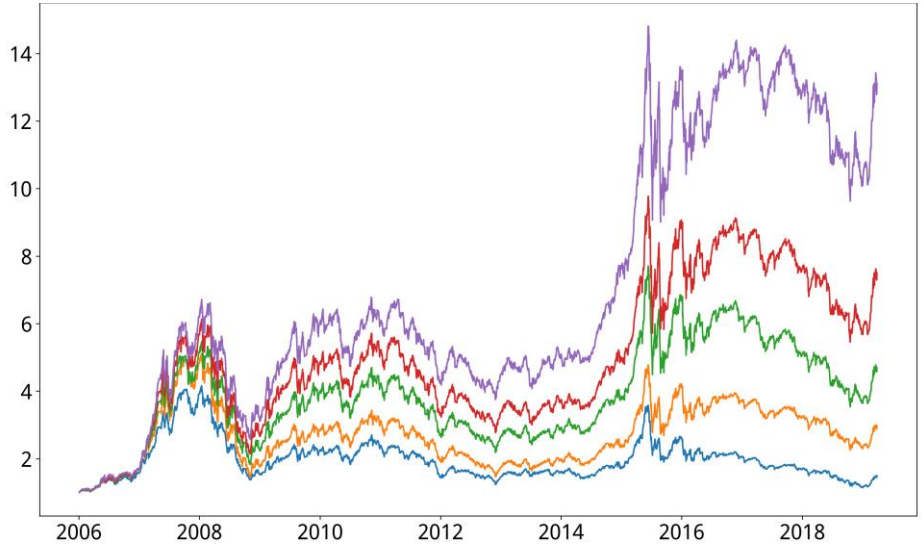
F129's $|IC|$ Time Series

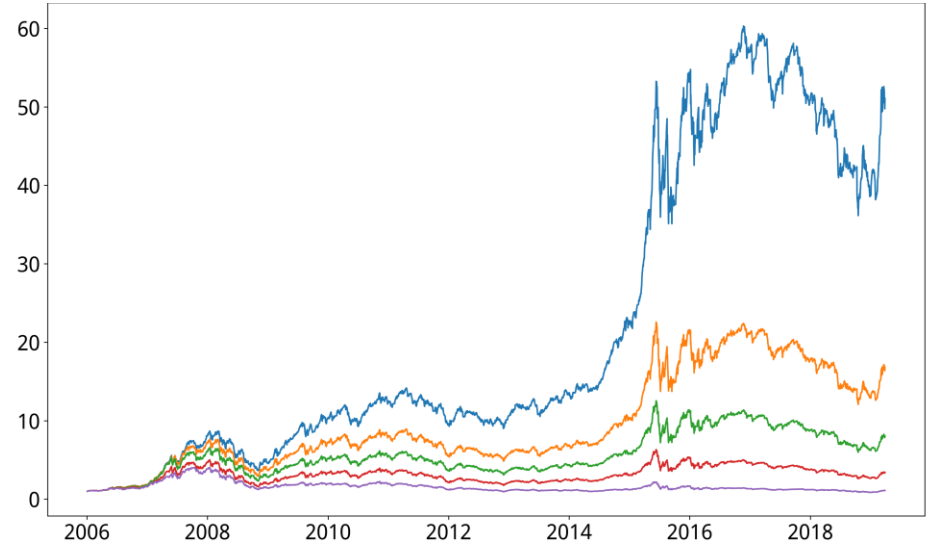


Traditional Multi-Factor Model

Factor Test

F38 & F129's Stratified Backtracking Accumulated Returns





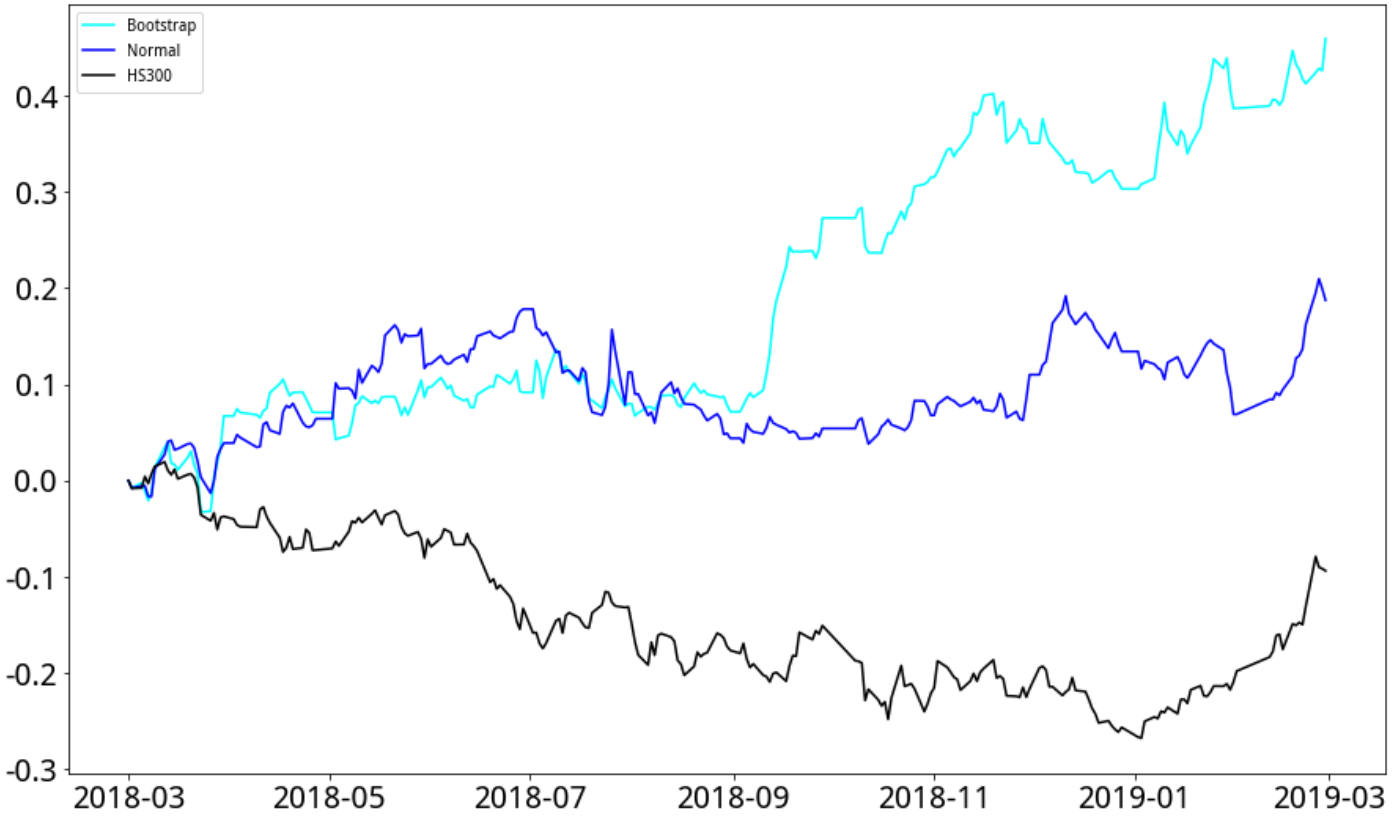
Section Four

Traditional Multi-Factor Model

Traditional Multi-Factor Model

Fitting using Ordinary Least Squares

Portfolio

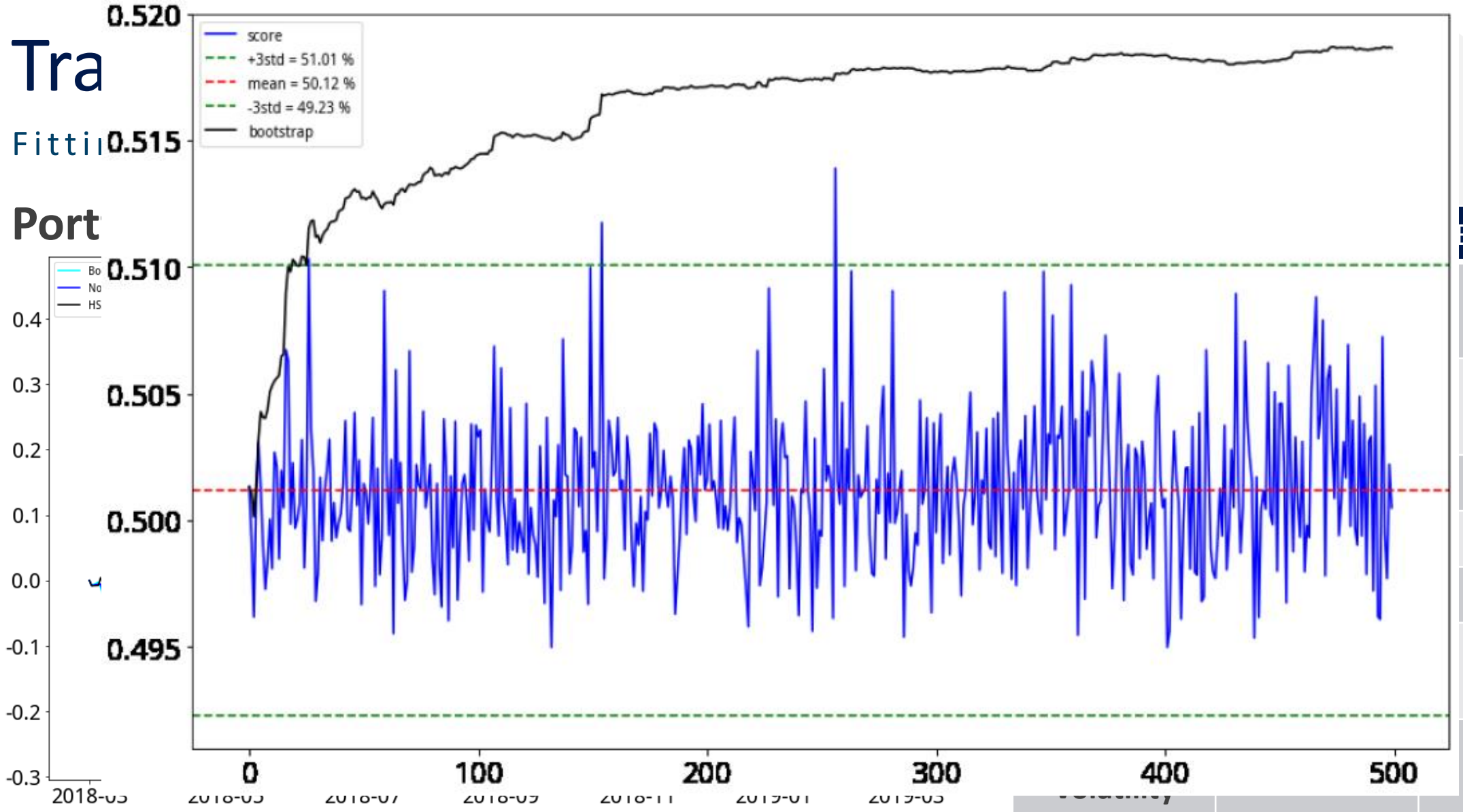


Portfolio	Normal	Bootstrap
Accumulated Return	18.7%	45.9%
Abnormal Return	28.1%	55.3%
Alpha	0.179	0.465
Beta	0.101	0.223
Sharp Ratio	1.066	2.278
Maximum Drawdown	8.23%	7.40%
Average Volatility	1.156%	1.134%

Tra

Fittii

Port

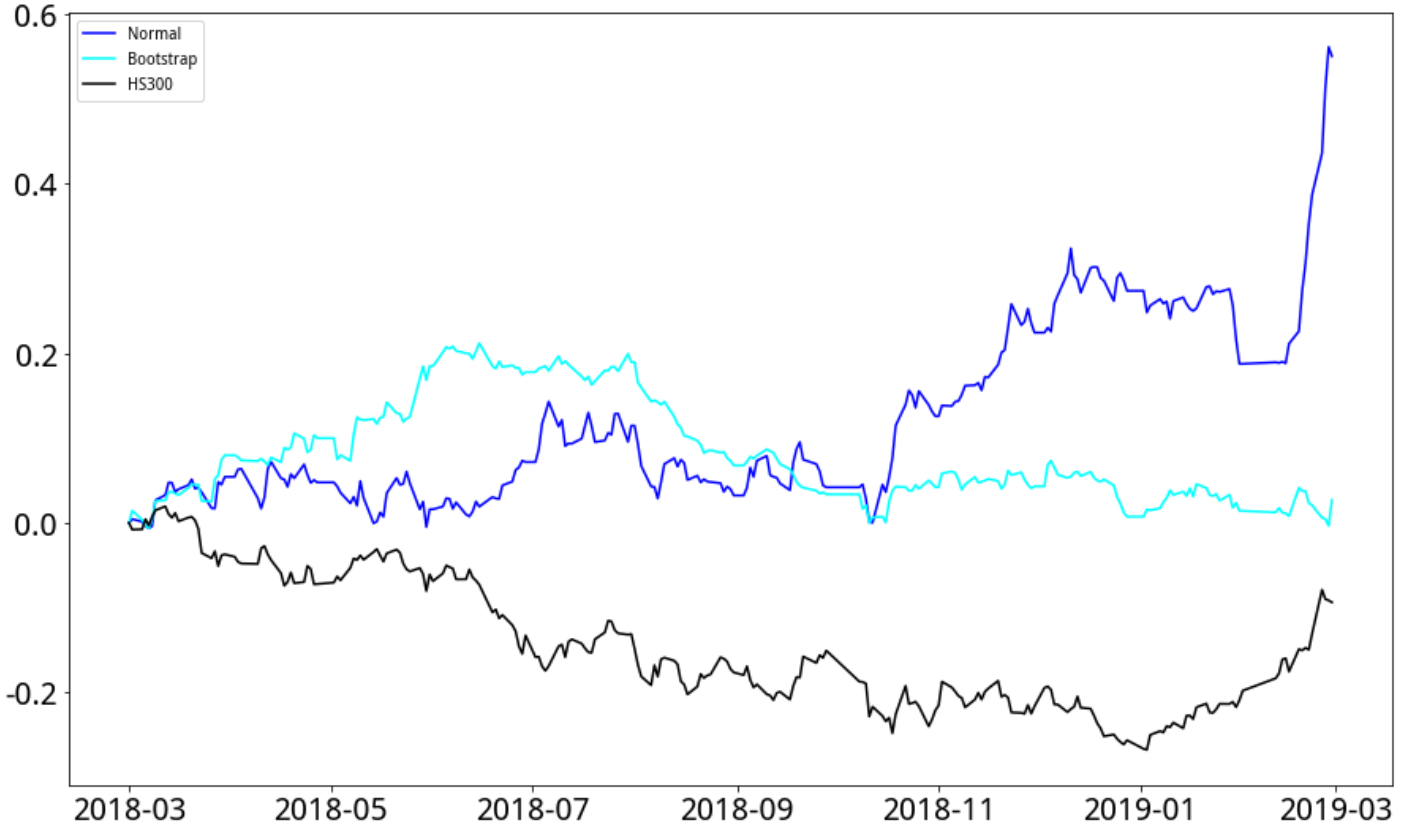


Bootstrap
45.9%
55.3%
0.465
0.223
2.278
7.40%
1.134%

Traditional Multi-Factor Model

Fitting using Least Absolute Shrinkage and Selection Operator

Portfolio



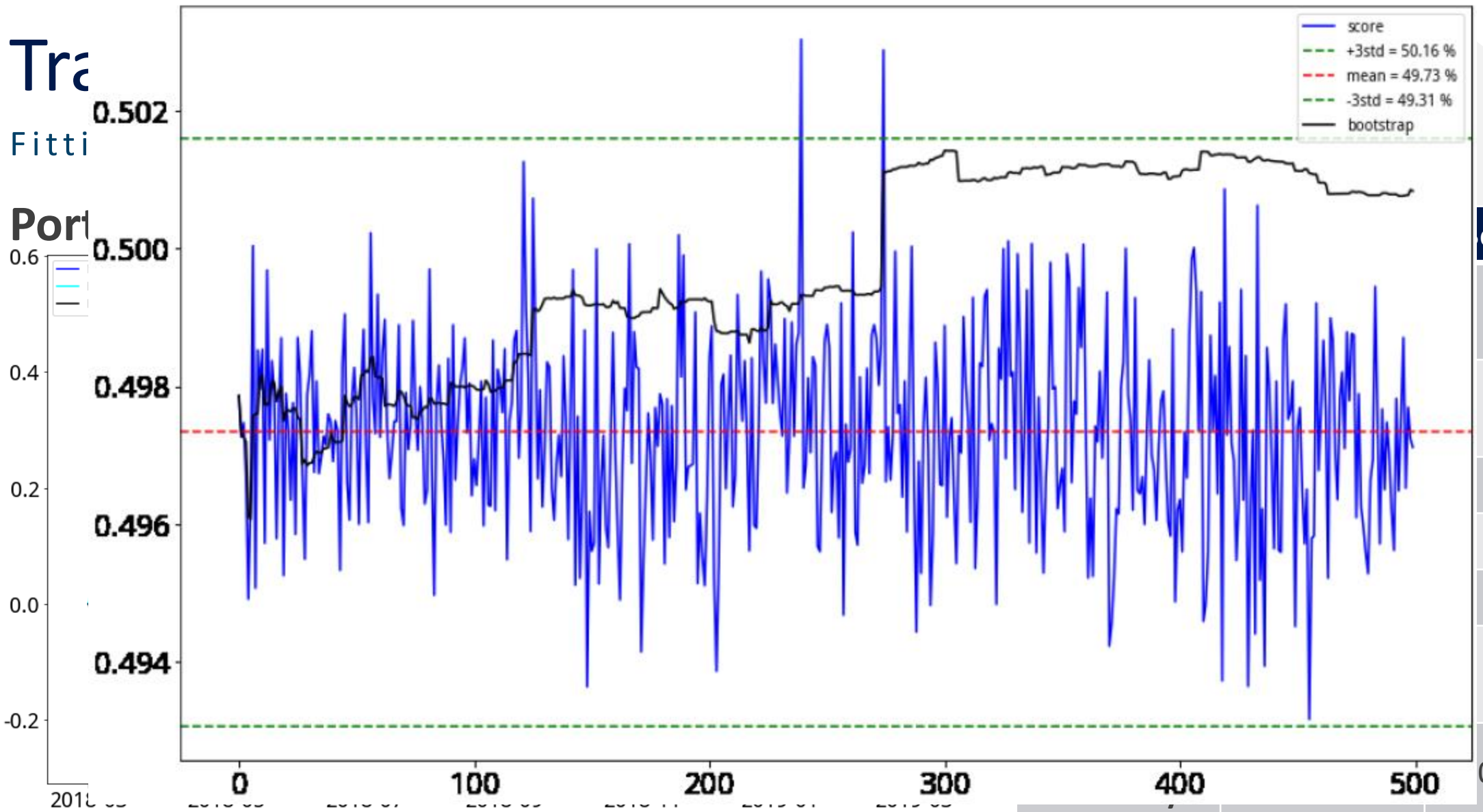
Portfolio	Normal	Bootstrap
Accumulated Return	55.0%	2.70%
Abnormal Return	64.4%	12.1%
Alpha	0.541	0.019
Beta	0.095	0.108
Sharp Ratio	2.077	0.265
Maximum Drawdown	8.15%	6.00%
Average Volatility	1.468%	0.905%

Py

Tra

Fitti

Port



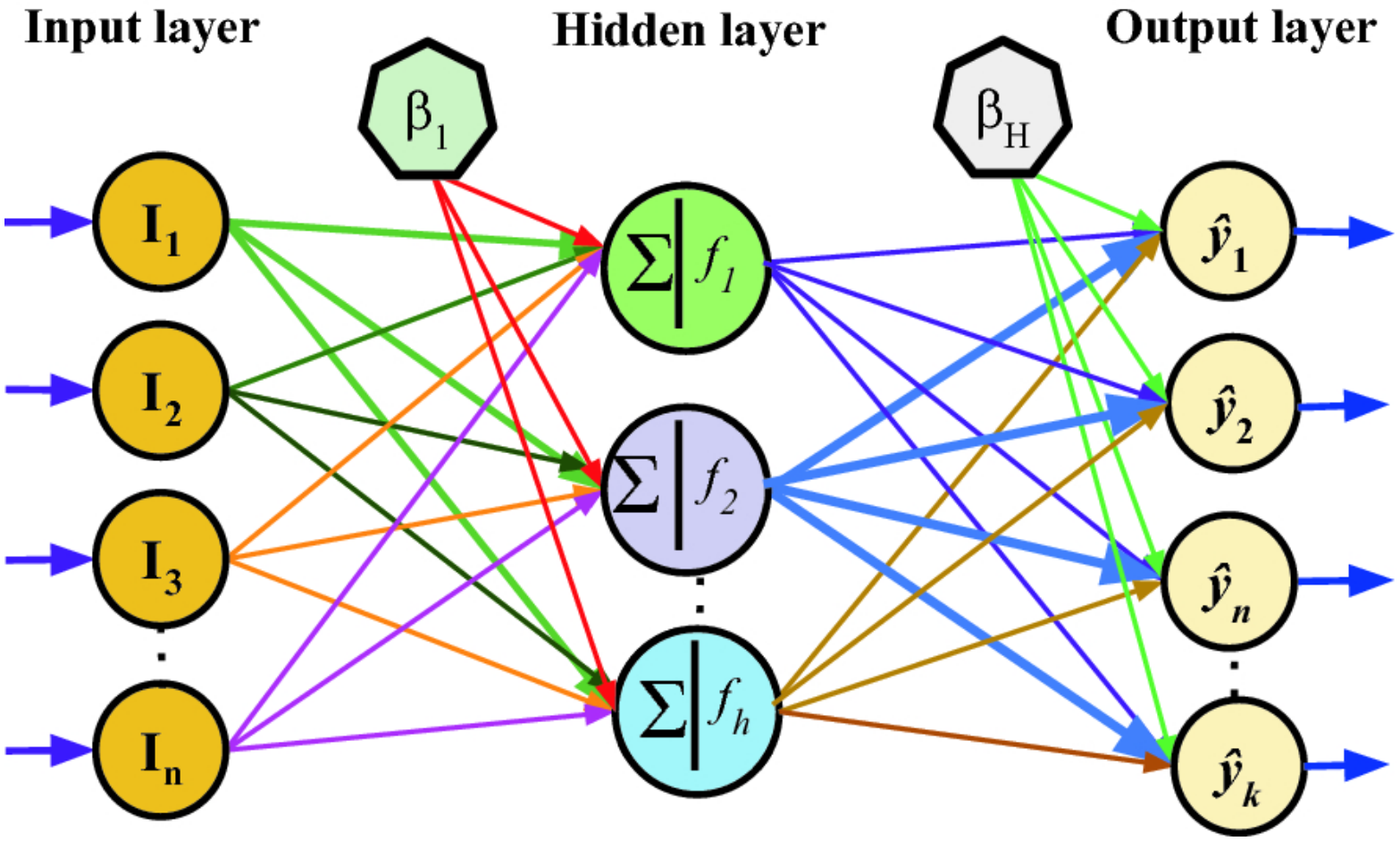
ootstrap
2.70%
12.1%
0.019
0.108
0.265
6.00%
0.905%

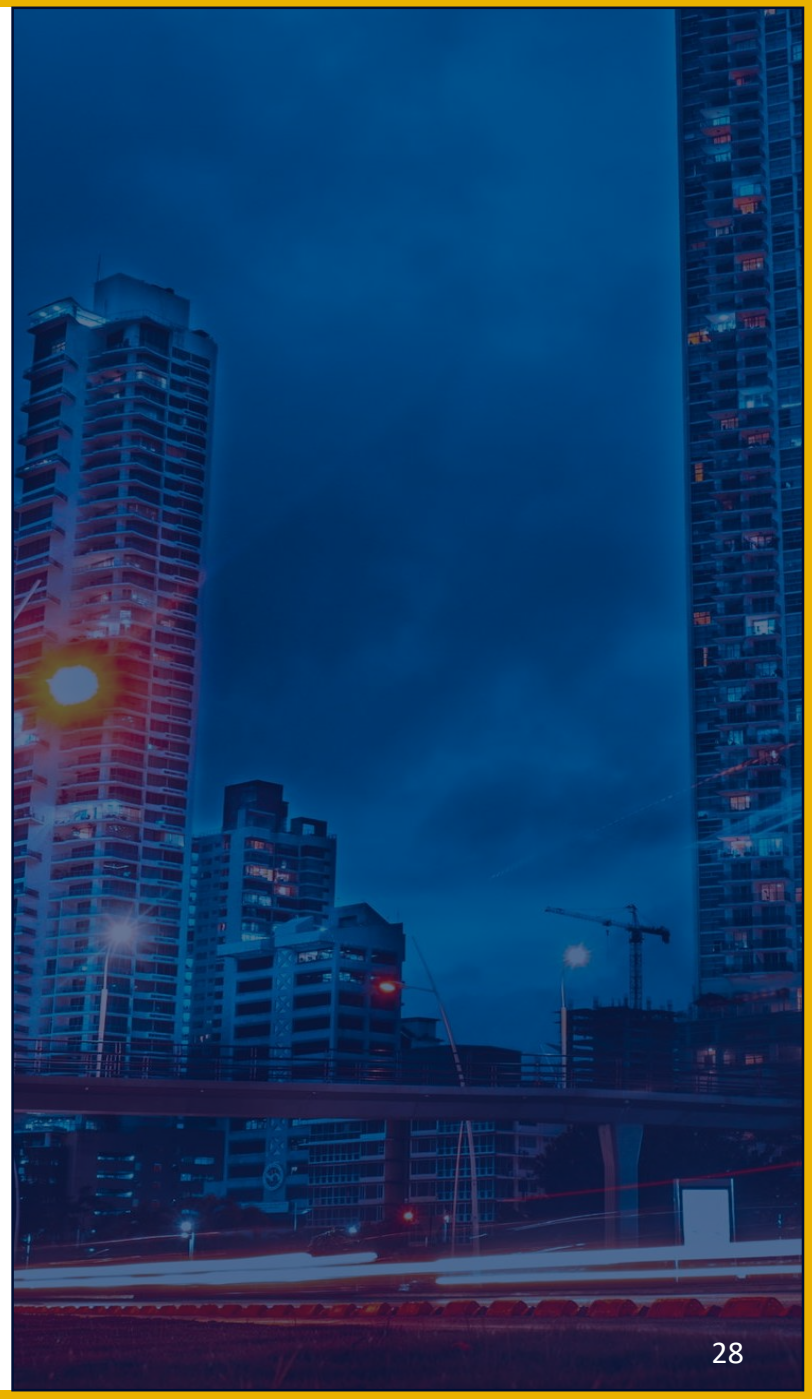
Section Five

Multi-Factor Model based on Machine Learning

Multi-Factor Model based on Machine Learning

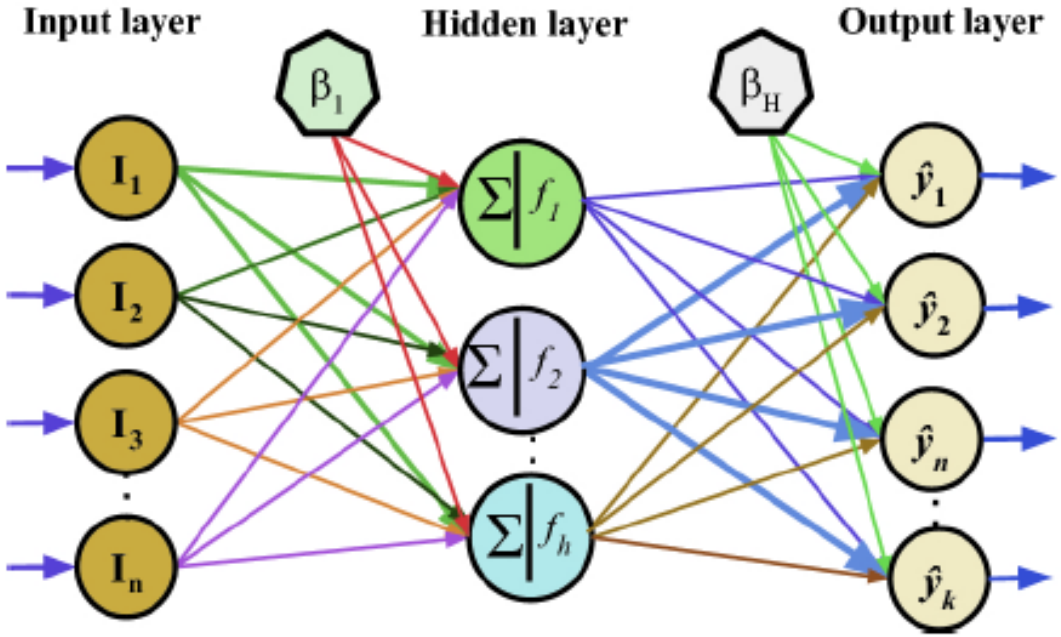
Fitting using Multi-Layer Perception





Multi-Factor Model based on Machine Learning

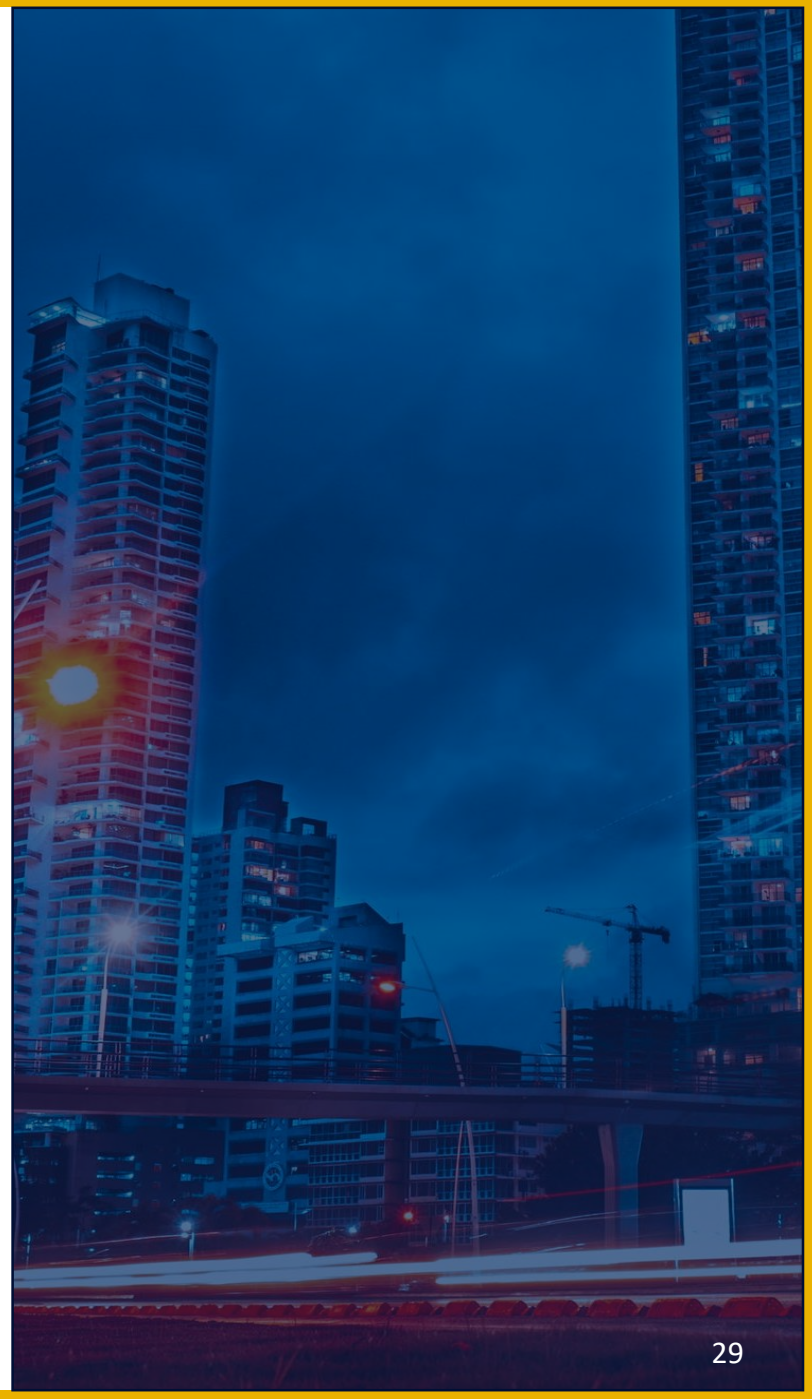
Fitting using Multi-Layer Perception



ReLU

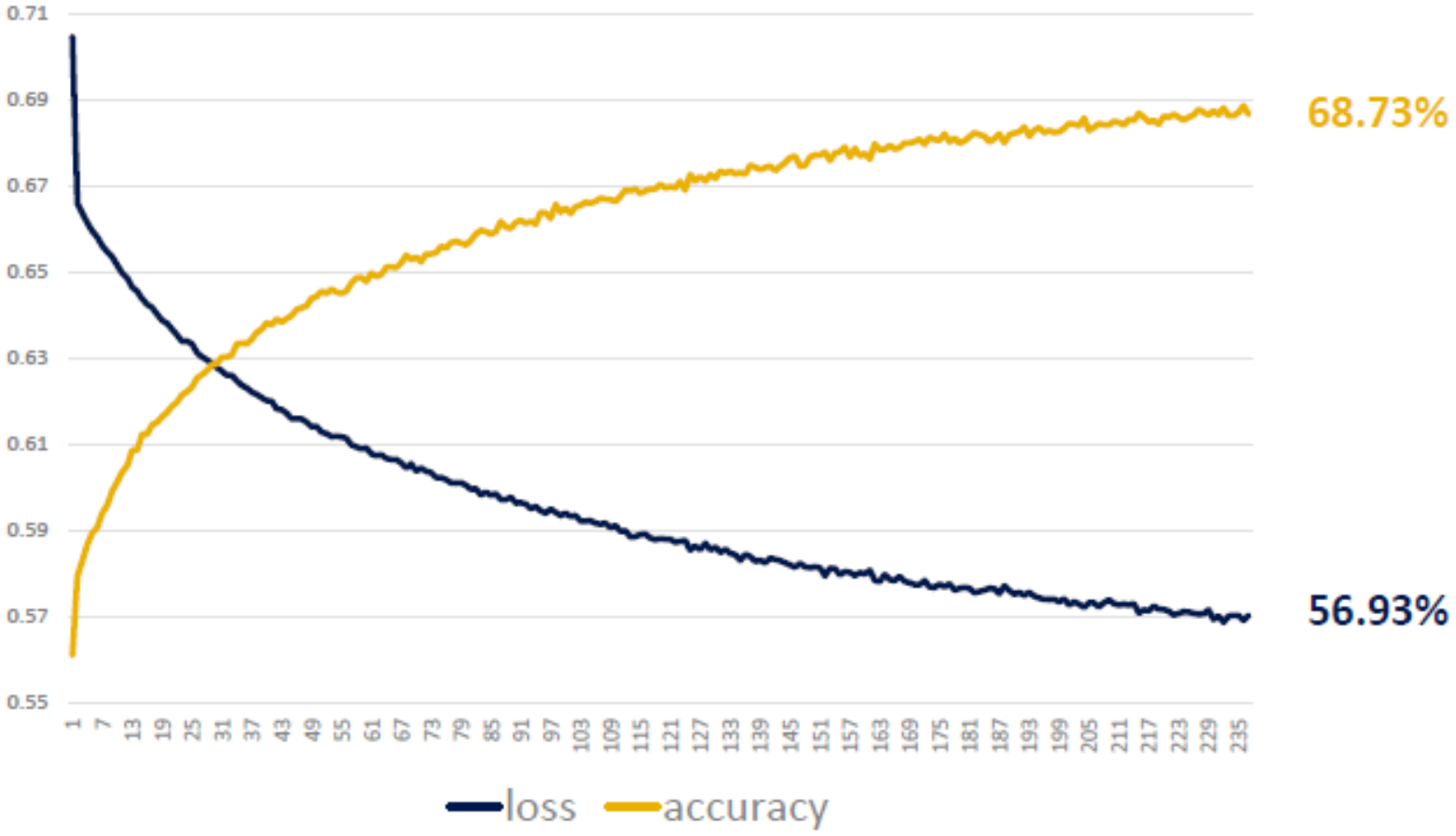
Softmax

Dropout



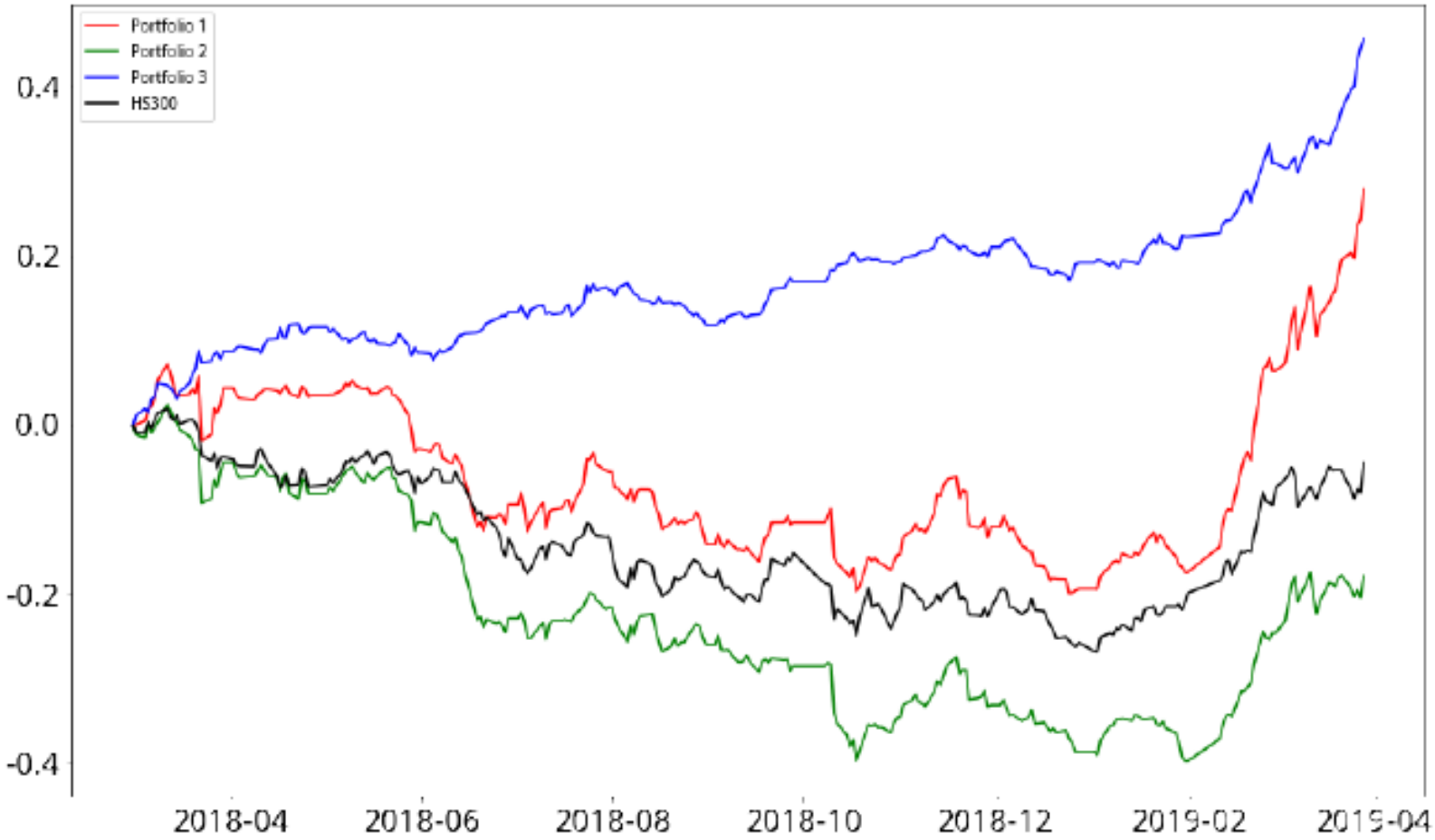
Multi-Factor Model based on Machine Learning

Fitting using Multi-Layer Perception



Multi-Factor Model based on Machine Learning

Fitting using Multi-Layer Perception



Portfolio	
Accumulated Return	42.8%
Abnormal Return	52.2%
Alpha	0.412
Beta	0.063
Sharp Ratio	3.262
Maximum Drawdown	4.48%
Average Volatility	0.670%

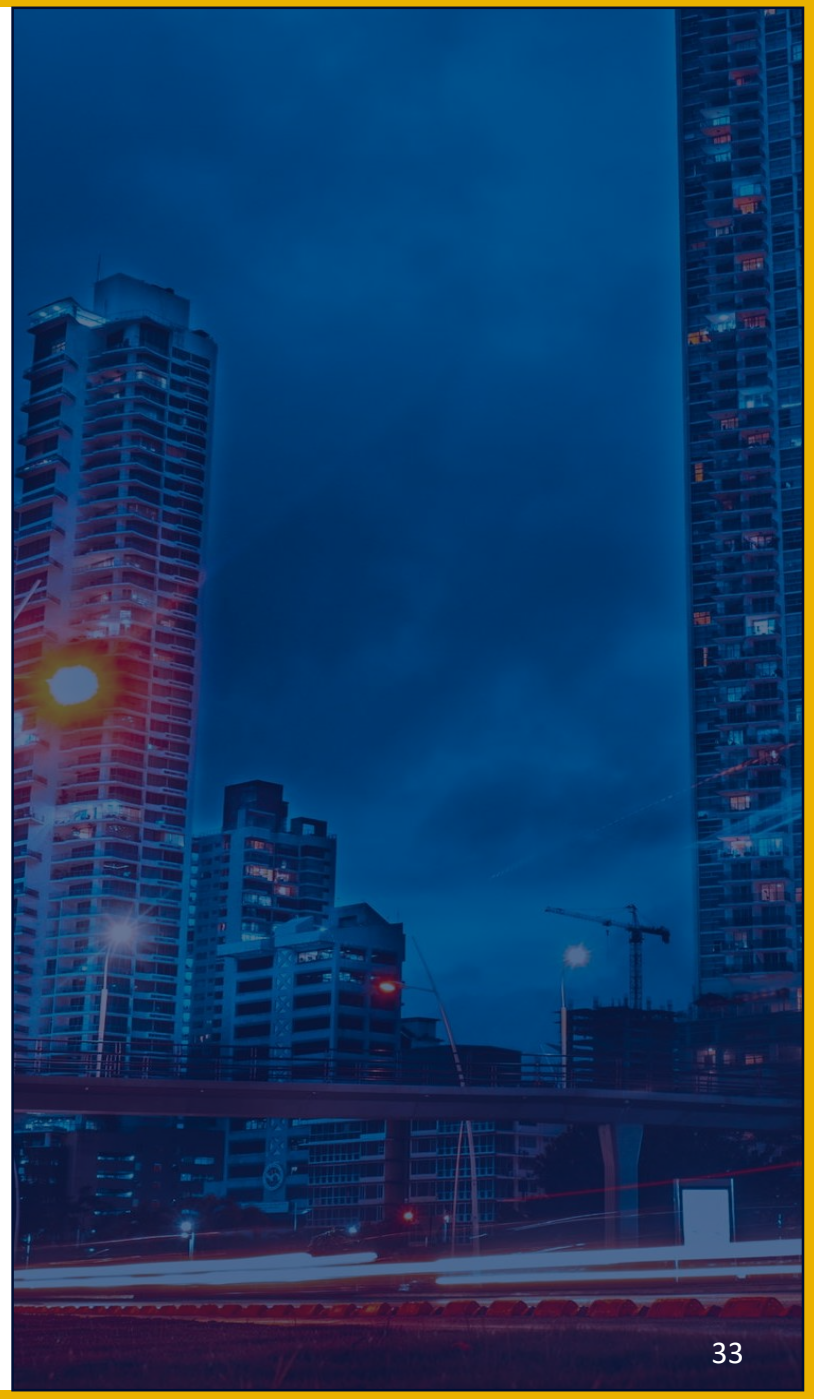
Section Six

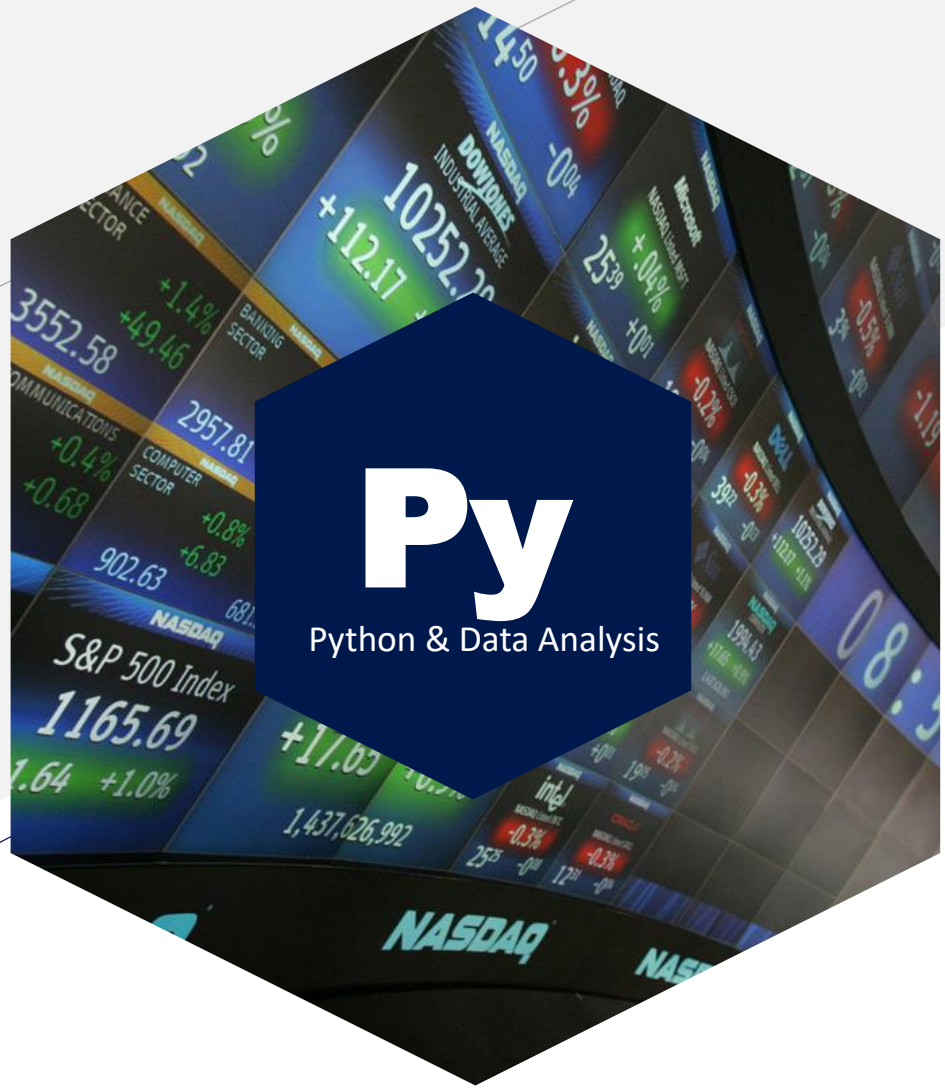
Model Comparation

Multi-Factor Model based on Machine Learning

Fitting using Random Forest

Portfolio	OLS	LASSO	MLP
Accumulated Return	45.9%	**55.0%**	42.8%
Abnormal Return	55.3%	64.4%	52.2%
Alpha	0.465	0.541	0.412
Beta	0.223	0.095	0.063
Sharp Ratio	2.278	2.077	**3.262**
Maximum Drawdown	7.40%	8.15%	**4.48%**
Average Volatility	1.134%	1.468%	**0.670%**





Thank You.

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