

CAPITAL COMPASS



Developing quantitative tools to assist
trading decisions in US equity market.

Currently live at <http://3.104.120.14/>

<https://www.canva.com/design/DAG2xPOZbuw/ZNmGXpJEDM78LFxVgC8hAg/edit>

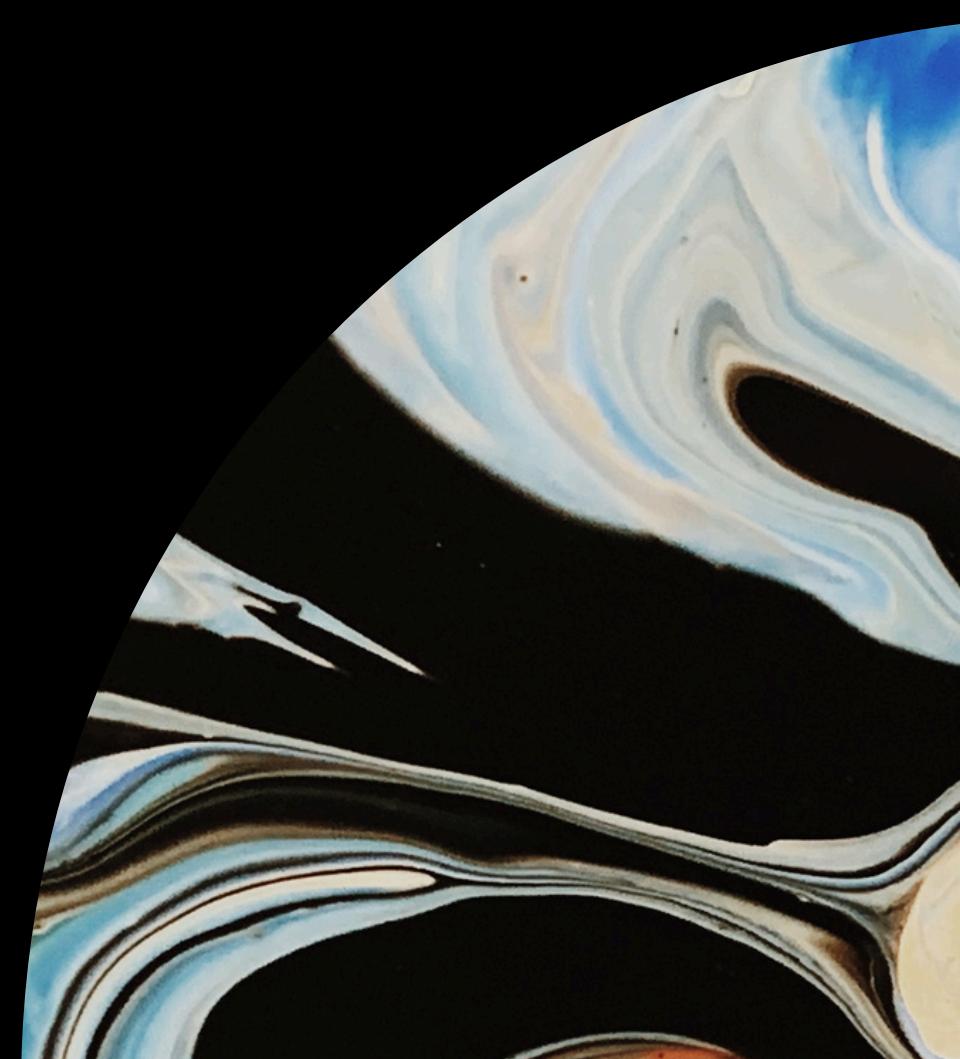


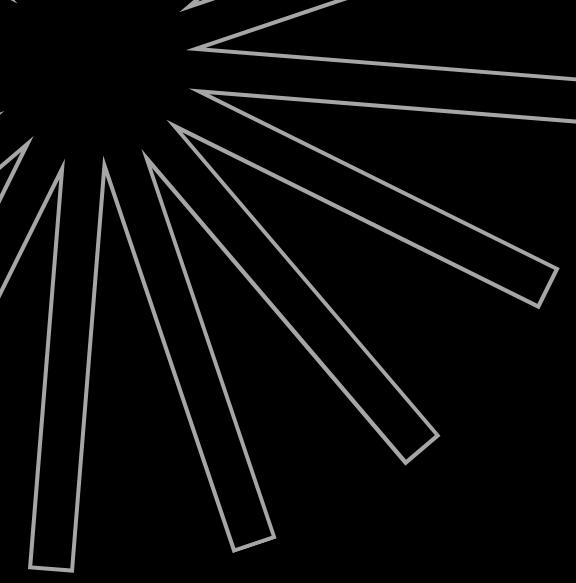
Team 11 - Bobbers

Charles, Hoang, Shawna, Phawat, Henri, Trey
(left to right, top to bottom)

Presentation Outline

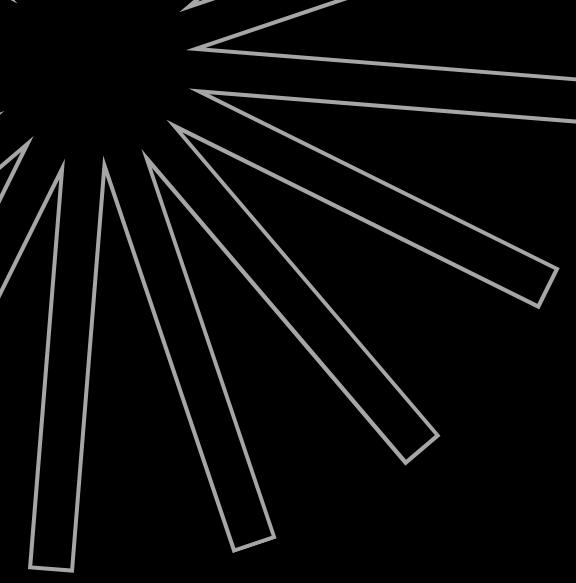
1. Introduction & Motivation
2. Demo
3. Solution Overview
4. Implementation Details
5. Challenges, Lessons Learned & Future Work
6. Project Goal Evaluation
7. Conclusion & Thanks





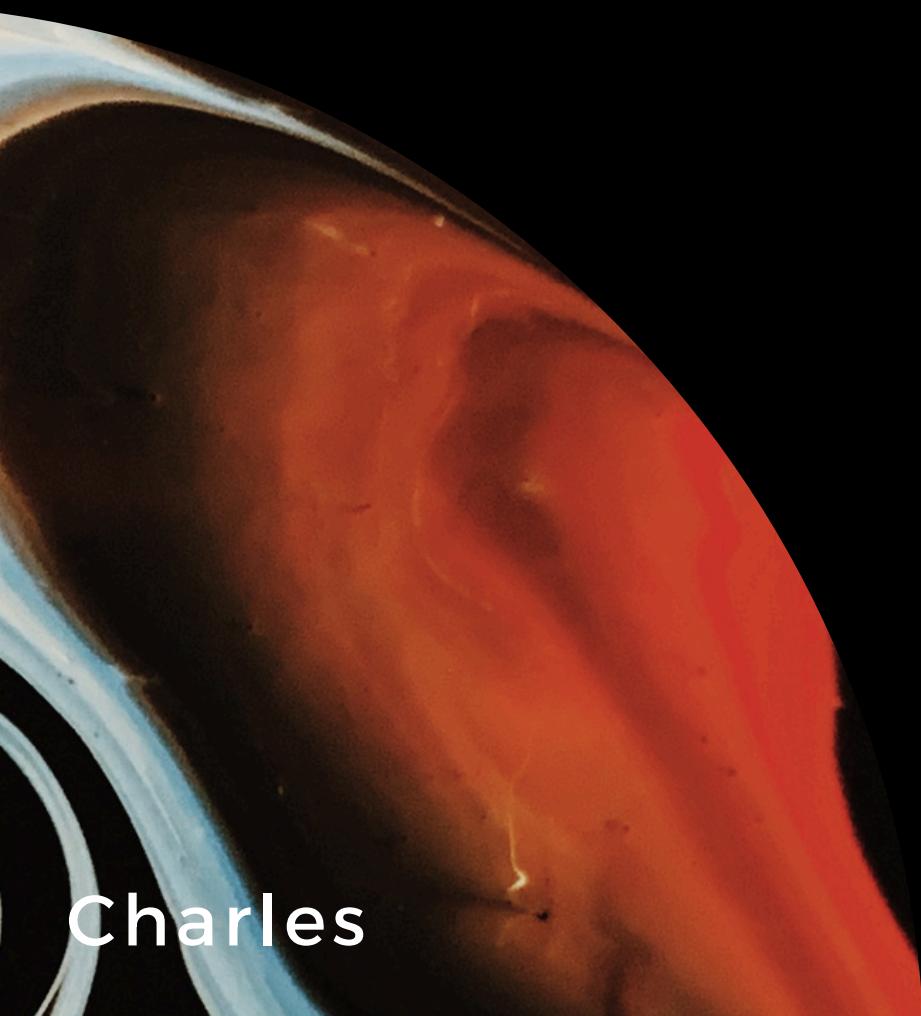
INTRODUCTION

Even though fund managers focus on investing in the long term, it is still important to optimise the short-term timing of their buy/sell decisions.



INTRODUCTION

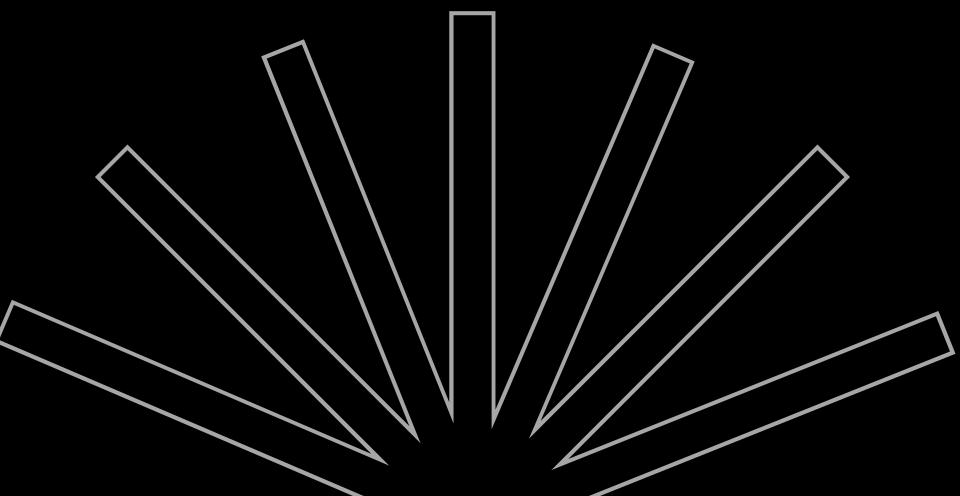
Even though fund managers focus on investing in the long term, it is still important to optimise the short-term timing of their buy/sell decisions.



Our work analyses the short-term trending/mean reverting behaviour of stocks, to help guide investors in fine-tuning the timing of their buy/sell decisions instead of doing so arbitrarily and risking value loss.

Novelty of our product

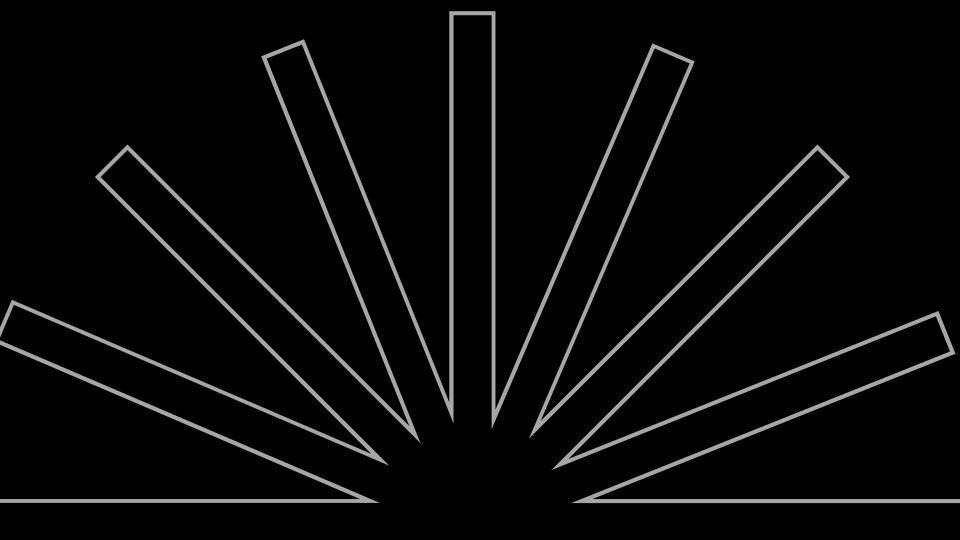
Pooled market-wide learning



Novelty of our product

Pooled market-wide learning

Convenient and streamlined web-app

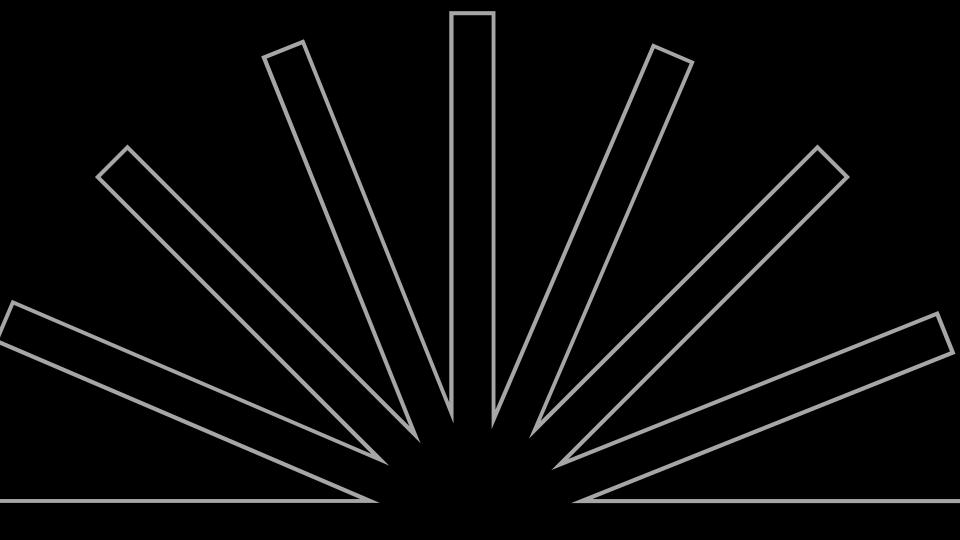


Novelty of our product

Pooled market-wide learning

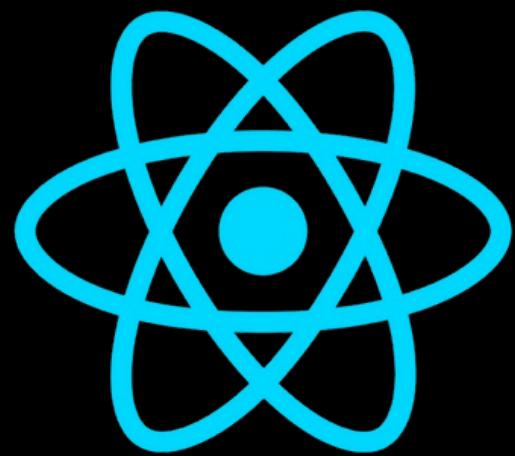
Convenient and streamlined web-app

Robust & flexible to incomplete data etc



LIVE DEMO

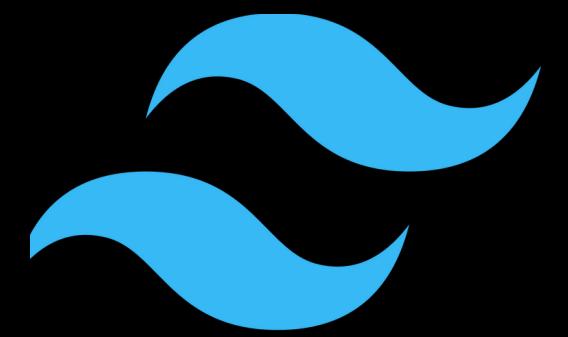
FRONTEND TECHNOLOGIES



React

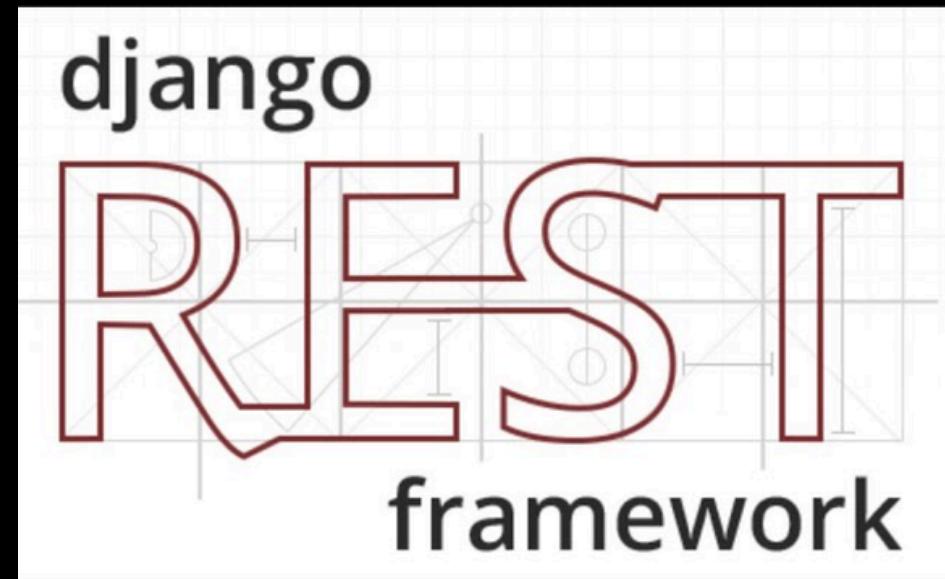


Next.js

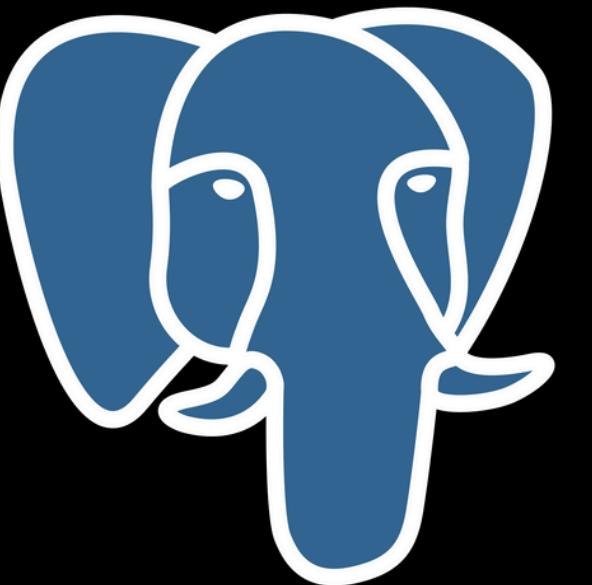


Tailwind CSS

BACKEND TECHNOLOGIES



Django REST

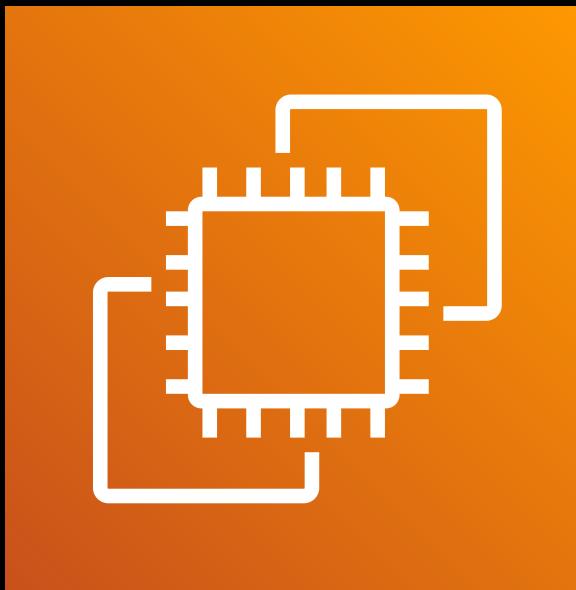


PostgreSQL Database
Engine



Python 3.12+

DEPLOYMENT TECHNOLOGIES



AWS EC2

t3.xlarge VM

tmux utility

4 CPU Cores

16GB RAM

Ubuntu Linux

USD\$ 0.21 p/h

Implementation Details: Uploading

Take a pre-formatted
Excel spreadsheet

Trey



Implementation Details: Uploading

Upload Your Data

Upload your Excel file containing stock price data for analysis

File Upload
Drag and drop your file or click to browse

Drop your file here
or click to browse

Upload Data

File Requirements
Ensure your data meets these requirements for optimal analysis

- File Format**
Excel only (.xlsx) with UTF-8 encoding
- Required Headers**
Note: A header row of stock names
- Data Requirements**
No empty rows; dates parseable by backend (e.g., %d-%b-%Y like 30-Jul-2010).
- File Size**
Maximum 200MB per file

Sample (long format)

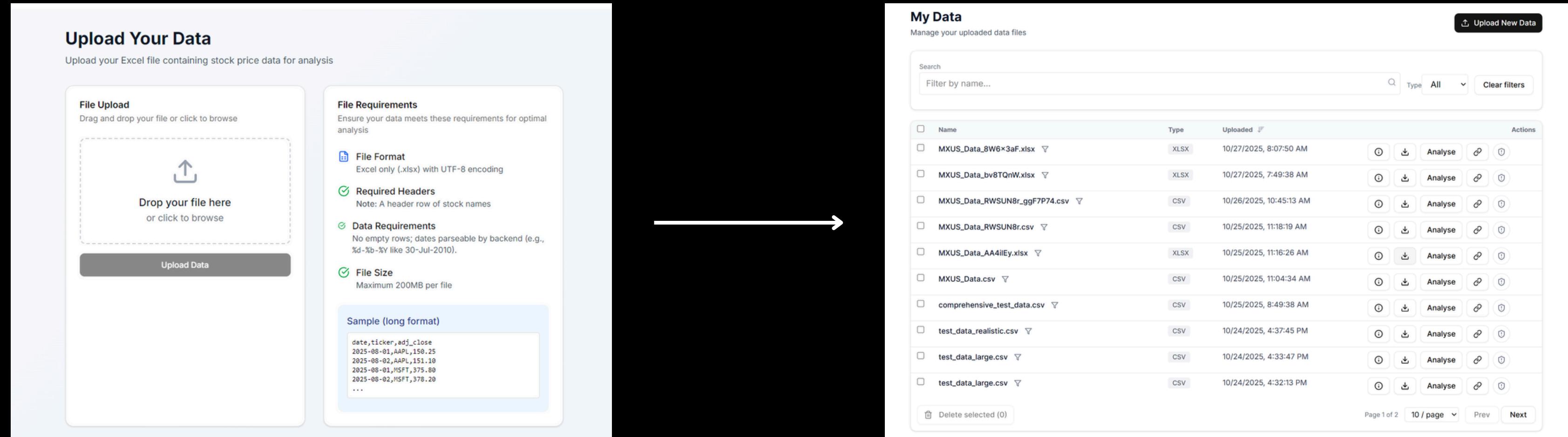
```
date,ticker,adj_close
2025-08-01,AAPL,150.25
2025-08-02,AAPL,151.10
2025-08-01,MSFT,375.80
2025-08-02,MSFT,378.20
...
```

Take a pre-formatted
Excel spreadsheet



Upload to the Capital
Compass Webapp

Implementation Details: Uploading

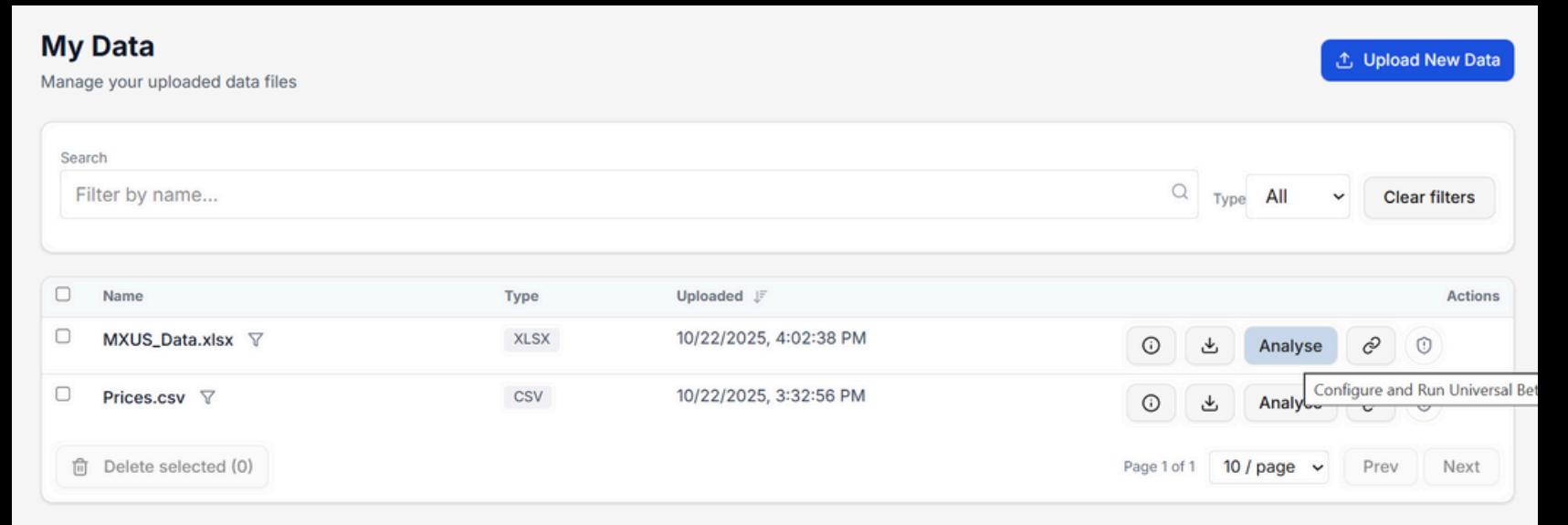


Take a pre-formatted
Excel spreadsheet

Upload to the Capital
Compass Webapp

View/Download your
uploaded file on the
'My Data' page

Implementation Details: Analysis



My Data

Manage your uploaded data files

Upload New Data

Search

Filter by name...

Type: All

Clear filters

Name	Type	Uploaded	Actions
MXUS_Data.xlsx	XLSX	10/22/2025, 4:02:38 PM	<input type="button" value="Analyse"/> <input type="button" value="Download"/> <input type="button" value="Edit"/> <input type="button" value="Delete"/>
Prices.csv	CSV	10/22/2025, 3:32:56 PM	<input type="button" value="Analyse"/> <input type="button" value="Download"/> <input type="button" value="Edit"/> <input type="button" value="Delete"/>

Page 1 of 1 10 / page Prev Next

Click 'Analyse' on
desired Upload

Implementation Details: Analysis

My Data
Manage your uploaded data files

Upload New Data

Search
Filter by name...

Name Type Uploaded Actions

- MXUS_Data.xlsx XLSX 10/22/2025, 4:02:38 PM
- Prices.csv CSV 10/22/2025, 3:32:56 PM

Page 1 of 1 10 / page Prev Next

Delete selected (0)

2 Configure Model
Select one or more prediction horizons for your beta forecasting model

Prediction Horizons
1d 5d 10d 20d
Selected: 5d Clear
Server-side sector filtering is only applied if the uploaded dataset includes a sector column and the backend is configured to use it.

Advanced Model Training Parameters
Training Period (Days) 1 Year (252 days) Testing Period (Days) 1 Year (252 days) (must be < training period)
Regularization Strength (Alpha) 0.01 (Standard)
L1 Ratio (ElasticNet mix) 0 (Ridge / L2) Current: 0.50 1 (Lasso / L1)
Multi-horizon mode: Single horizon
Enabled automatically when you choose more than one horizon.

DATA SOURCE
Uploaded file Awaiting upload...
A temporary processing session is used under the hood. You usually do not need the session tag, but it can help support debug issues.

Run Universal Beta Model

Click 'Analyse' on
desired Upload



Select Desired Model
Hyper-parameters

Implementation Details: Analysis



Capital Compass

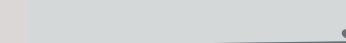
Showing 20 of 530 filtered stocks

Ticker	Created At	β Coefficient ↓	Trend	Volatility	Train β	Lag Train β	AR(1) Corr 10d	AR(1) Corr 20d	AR(1) Corr 60d	Sign Persist 20d	Sign Persist 60d	Return 1d	Return 5d	Return 20d	Vol 63d	V 1
CVNA UN	7/25/2024, 12:00:00 PM	0.021	↗	0.054	0.125	0.125	0.244	0.053	0.156	0.368	0.441	0.006	-0.039	-0.008	0.054	0
MSTR UW	7/25/2024, 12:00:00 PM	0.005	↗	0.060	-0.045	-0.047	0.108	0.109	-0.013	0.737	0.525	-0.040	0.044	0.130	0.060	0
COIN UW	7/25/2024, 12:00:00 PM	0.004	↗	0.046	-0.036	-0.043	0.132	0.086	-0.115	0.632	0.525	-0.055	0.001	0.097	0.046	0
SNAP UN	7/25/2024, 12:00:00 PM	0.001	↗	0.044	0.012	0.016	-0.205	-0.141	-0.023	0.368	0.373	-0.010	-0.078	-0.210	0.044	0
RIVN UW	7/25/2024, 12:00:00 PM	0.001	↗	0.050	0.081	0.080	-0.408	-0.025	0.020	0.579	0.458	-0.001	-0.036	0.114	0.050	0
RBLX UN	7/25/2024, 12:00:00 PM	-0.002	↘	0.035	-0.027	-0.026	0.146	-0.105	0.002	0.474	0.492	0.015	0.019	0.098	0.035	0
SMCI UW	7/25/2024, 12:00:00 PM	-0.002	↘	0.048	-0.035	-0.039	-0.088	-0.065	-0.024	0.526	0.492	-0.022	-0.137	-0.162	0.048	0

Click 'Analyse' on
desired Upload



Select Desired Model
Hyper-parameters



View Results on the
'Results' page

Model

The model predicts short-term stock momentum (“b”) across multiple time horizons by analysing predictive signals derived from historical return behavior.

Model

The model predicts short-term stock momentum (“b”) across multiple time horizons by analysing predictive signals derived from historical return behavior.

Possible time horizons:

- 1 day (daily)
- 5 days (weekly)
- 10 days (fortnightly)
- 20 days (monthly)

MEAN REVERSION VS TRENDING

Positive Momentum /
Mean Reversion

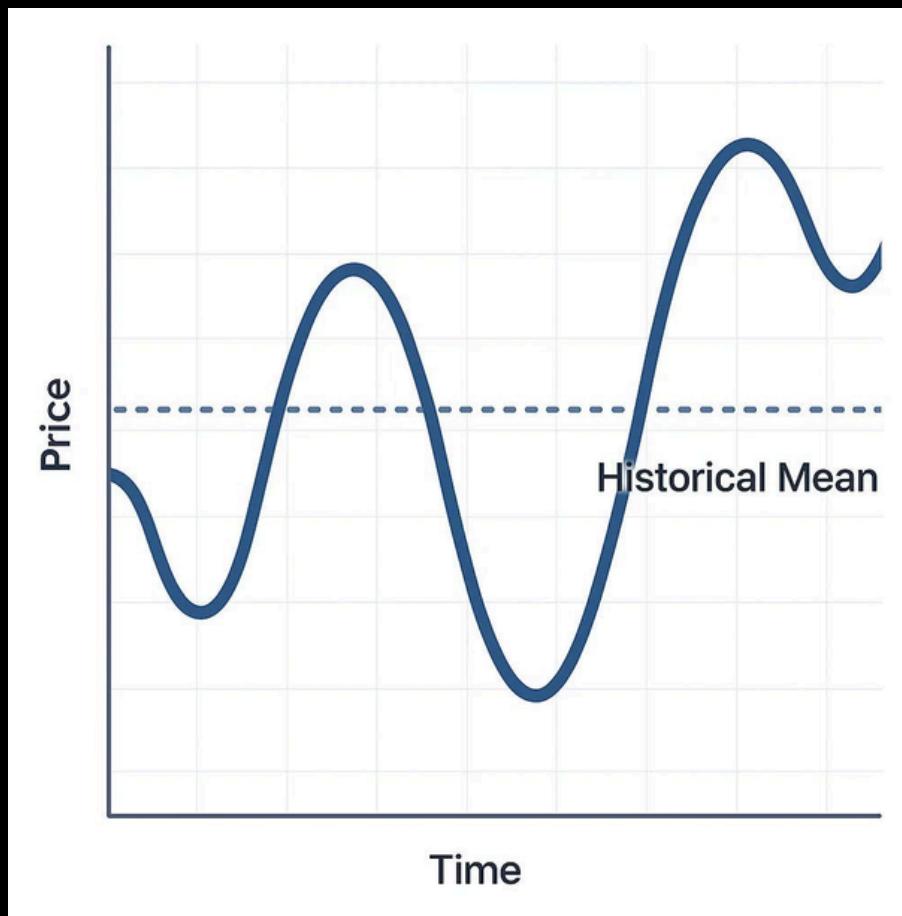


Image:
<https://medium.com/@jlabs/hurst-mean-reversion-of-time-series-data-08b608479656>

Negative Momentum /
Trending

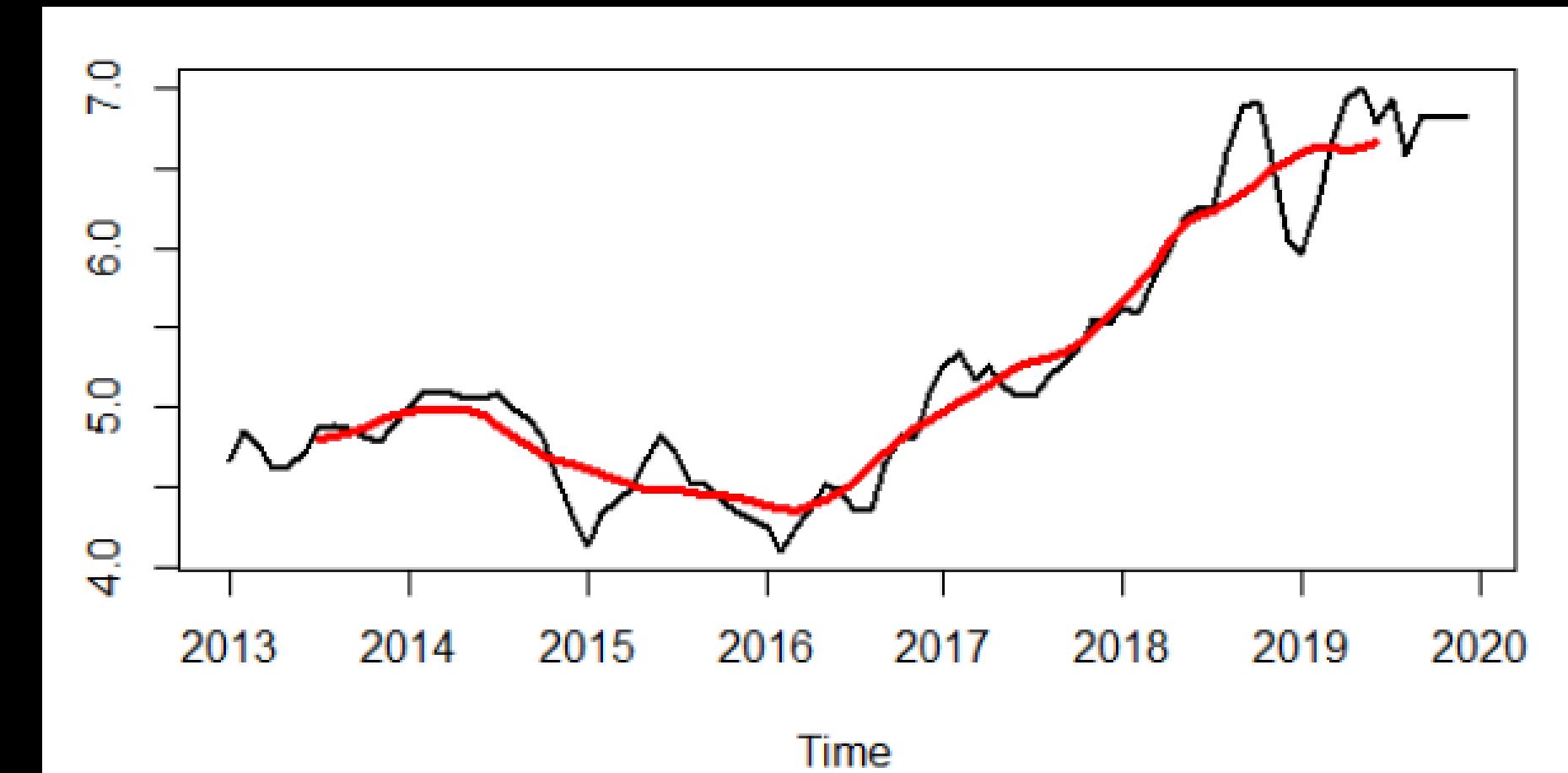
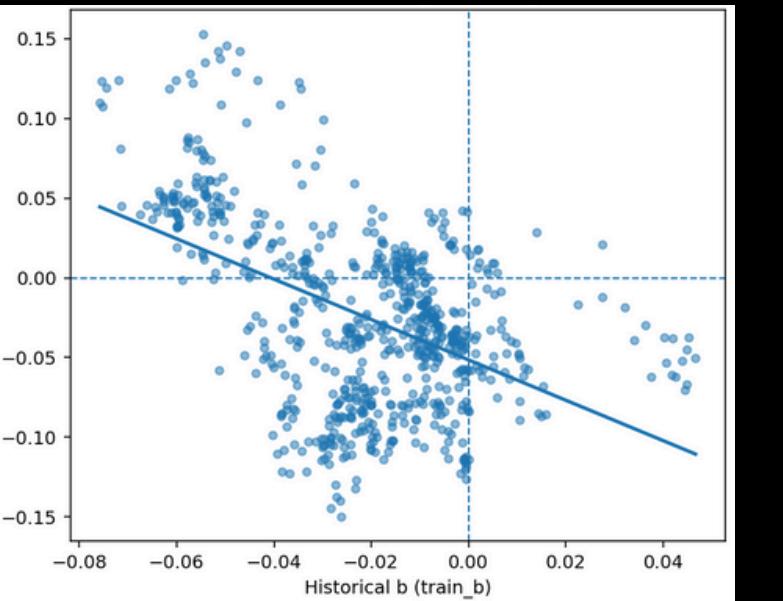
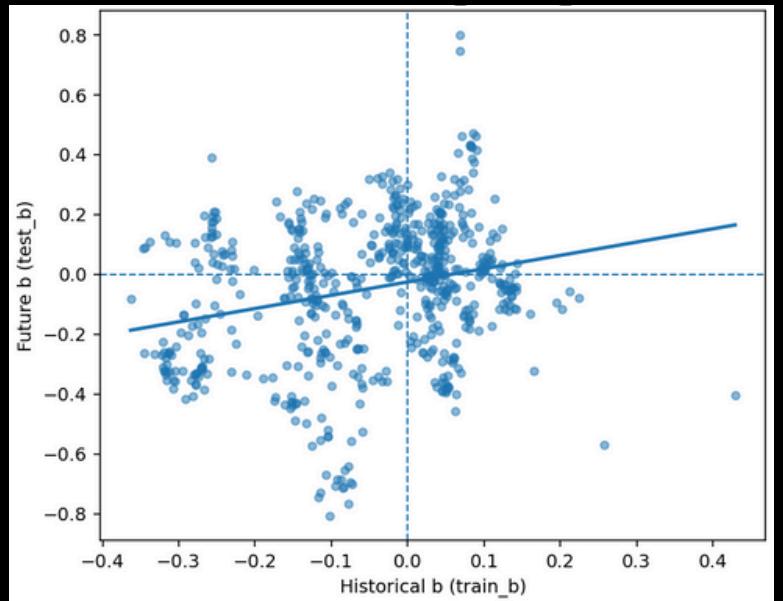


Image:
<https://www.r-bloggers.com/2020/03/trend-forecasting-models-and-seasonality-with-time-series/>

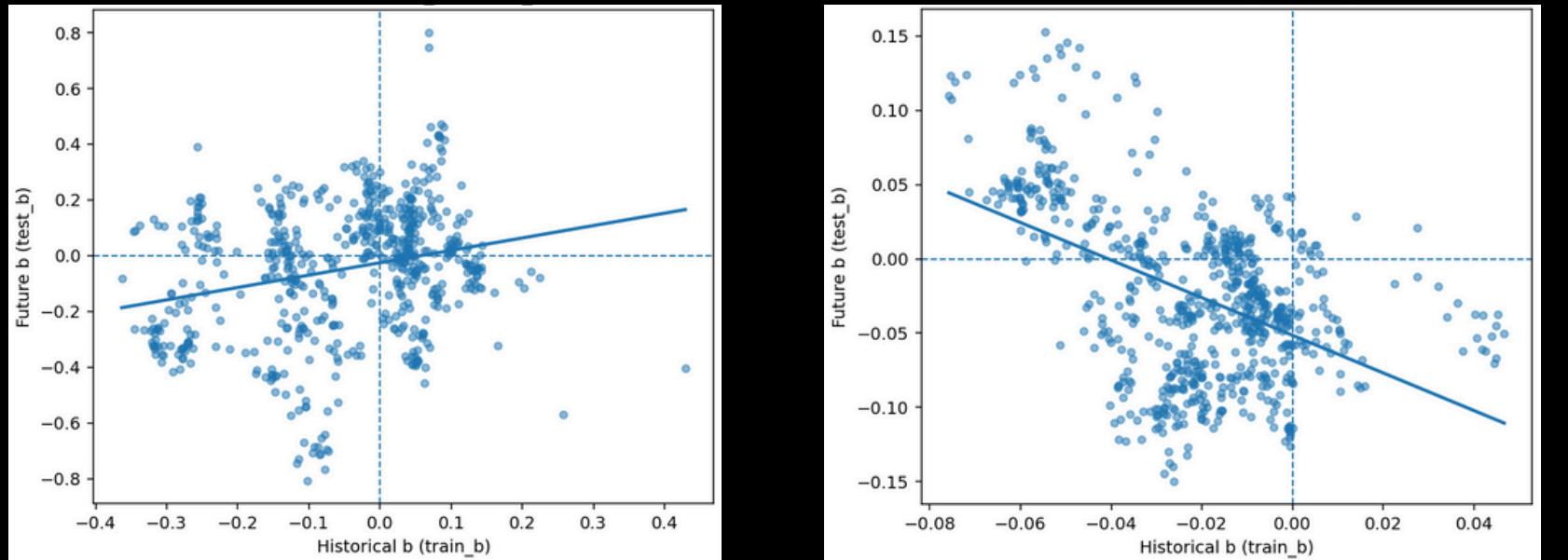
TWO PARTS OF THE MODEL

1. Find historical b



TWO PARTS OF THE MODEL

1. Find historical b



2. Predict future b value



Image:
<https://cdn-icons-png.freepik.com/256/12492/12492225.png?semt=ais white label>

We have used Python packages such as Numpy, Pandas, StatsModels, and our self-developed algorithms.

HISTORICAL B - MODEL

We use ARIMA(1, 0, 0)

$$R_{t+1} = C + b \cdot R_t$$

Where:

- R_{t+1} is the return of time $t + 1$
- C is a constant (representing the y intercept)
- b is the mean reversion coefficient
- R_t is the return of time t

HISTORICAL B - MODEL

We use ARIMA(1, 0, 0)

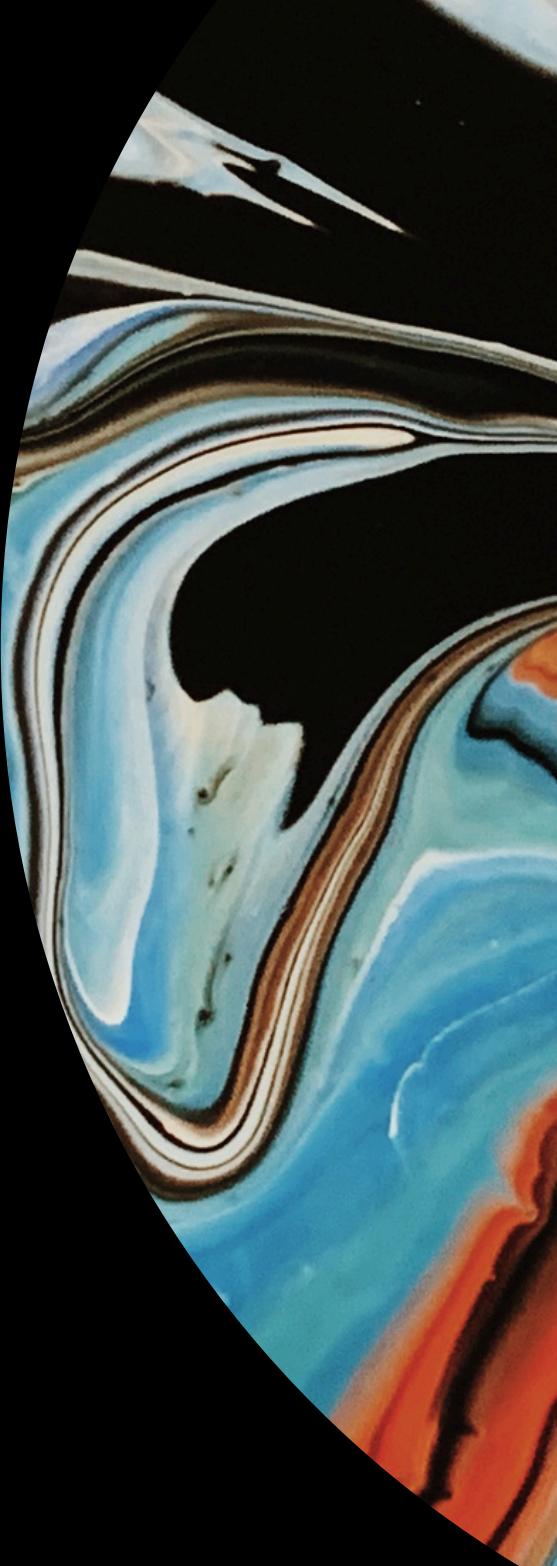
$$R_{t+1} = C + \underbrace{b \cdot R_t}_{\text{what we are trying to find}}$$

Where:

- R_{t+1} is the return of time $t + 1$
- C is a constant (representing the y intercept)
- b is the mean reversion coefficient
- R_t is the return of time t

PREDICTING FUTURE B - PREDICTORS

- AR(1)-layer inputs
 - train_b
 - lag_train_b
- Autocorrelation
 - ar1_corr_10d
 - ar1_corr_20d
 - ar1_corr_60d
- Sign persistence
 - sign_persist_20d
 - sign_persist_60d
- Recent returns
 - ret_1d
 - ret_5d
 - ret_20d
- Volatility
 - vol_63d
 - vol_126d
 - vol_252d
 - vol_756d
- Trend / Momentum level
 - Z_ma_20d
- Cross-Sectional Rank of Volatility
 - cs_rank_vol_63d
 - cs_rank_vol_126d
 - cs_rank_vol_252d
 - cs_rank_vol_756d
- Cross-sectional ranks
 - cs_rank_ret_1d
 - cs_rank_ret_5d
 - cs_rank_ret_20d
 - cs_rank_z_ma_20d
- Cross-sectional dispersion
 - xsec_disp_1d
 - xsec_disp_30d



ELASTIC NET

Combines two regularization methods and their strengths:

- L1 (Lasso) - Feature selection
- L2 (Ridge) - Stability

ELASTIC NET

Combines two regularization methods and their strengths:

- L1 (Lasso) - Feature selection
- L2 (Ridge) - Stability

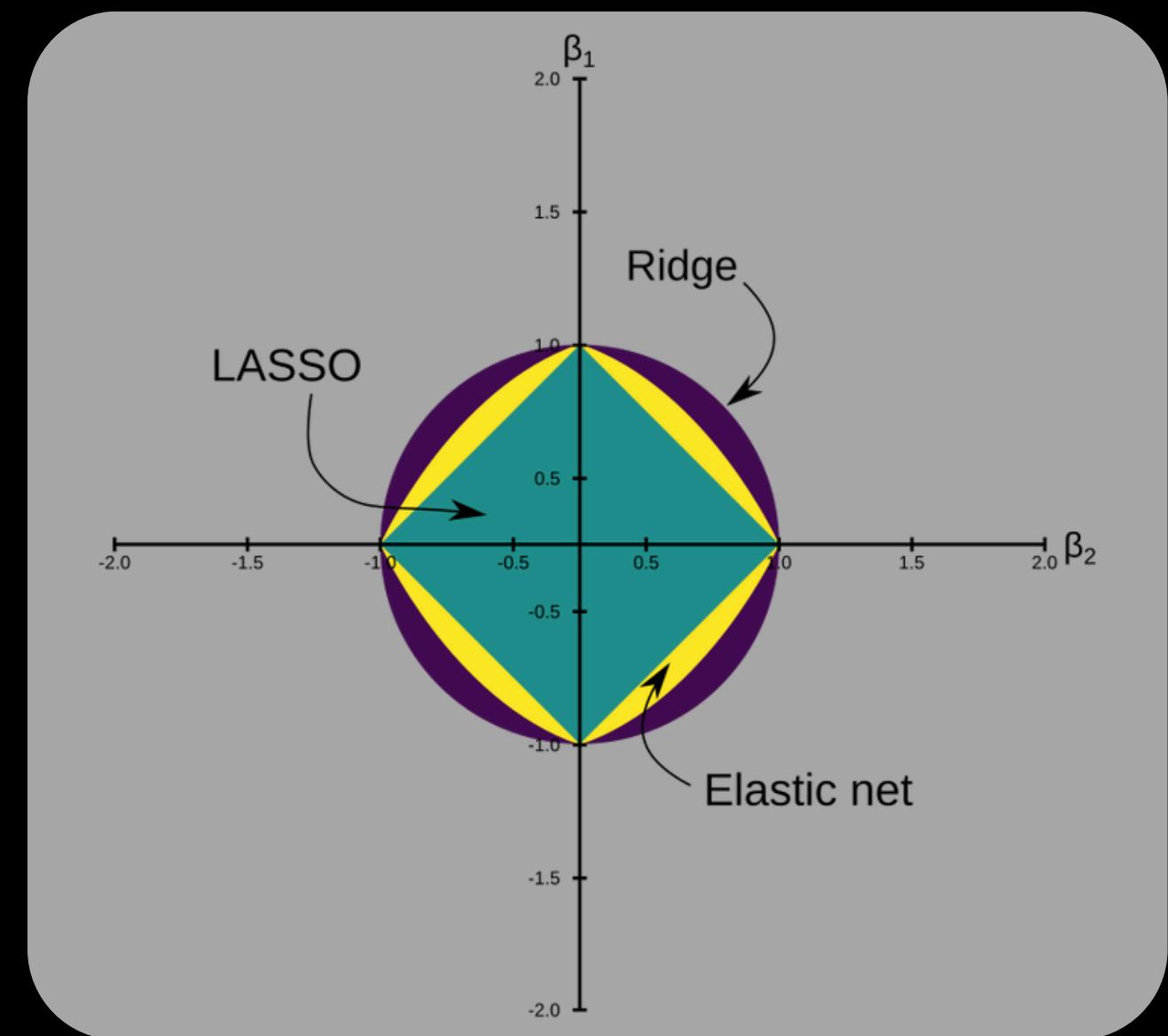


Image:
<https://analyticsindiamag.com/ai-trends/hands-on-tutorial-on-elasticnet-regression/>

ELASTIC NET

Combines two regularization methods and their strengths:

- L1 (Lasso) - Feature selection
- L2 (Ridge) - Stability

Creates an accurate, flexible, and robust model.

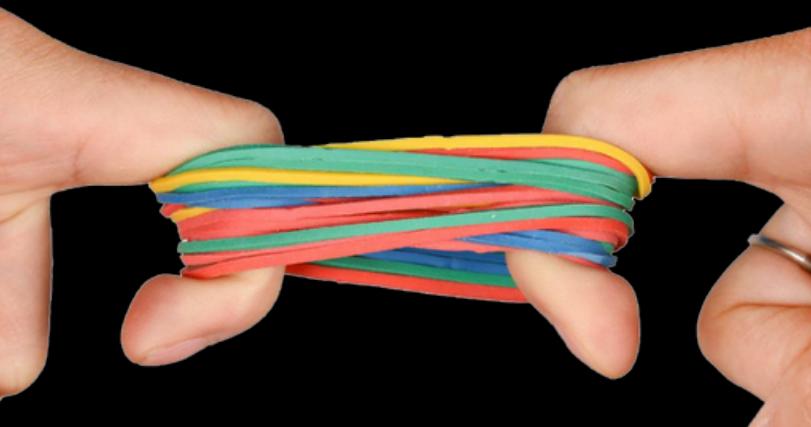


Image:
<https://www.pngegg.com/en/png-bamjq/download>

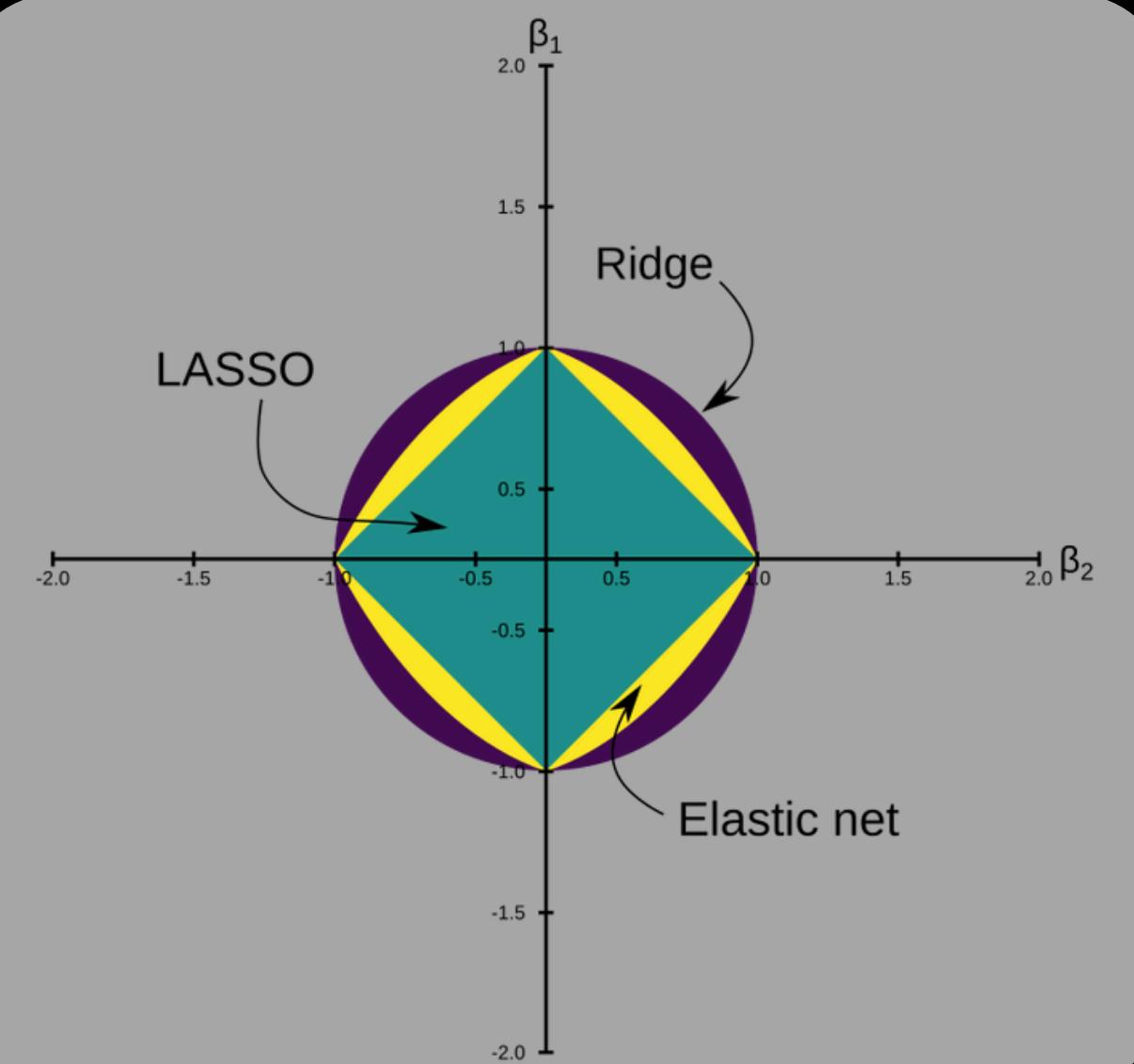


Image:
<https://analyticsindiamag.com/ai-trends/hands-on-tutorial-on-elasticnet-regression/>

MODEL EVALUATION

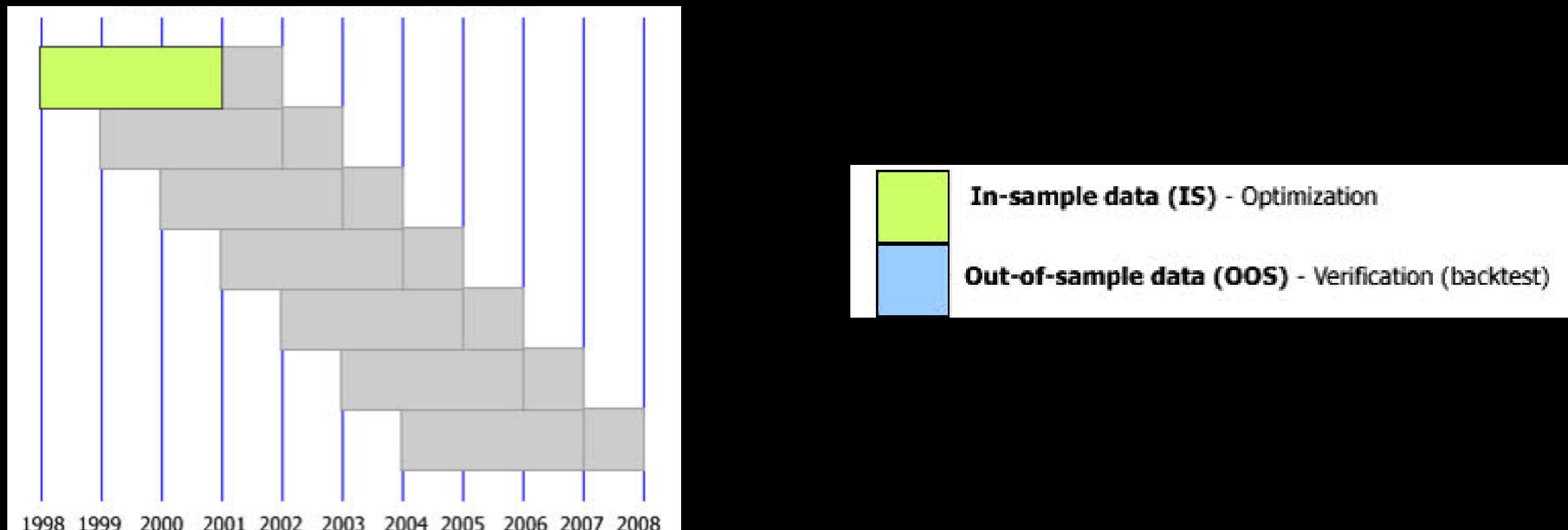
Metrics:

- MAE (0.06)
- RMSE (0.08)
- Directional accuracy (59.5%)
- Global R^2 (0.036)
- Mean R^2 per fold (-0.15)
- Weighted R^2 (-0.18)

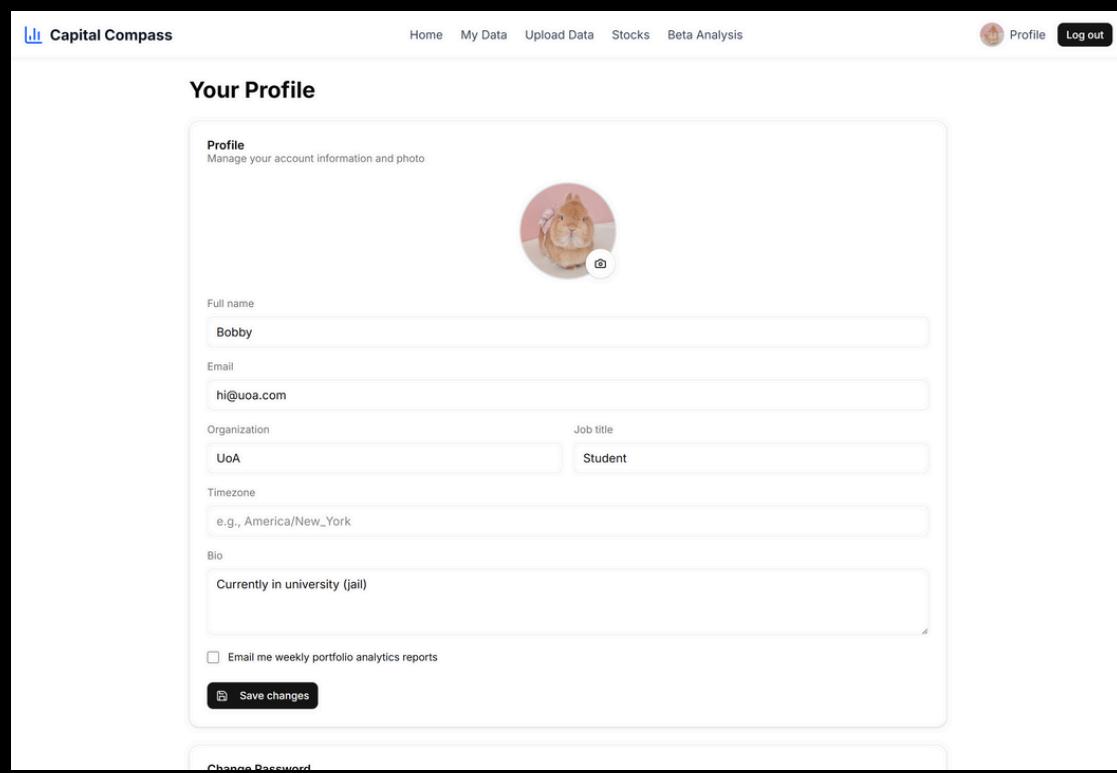
MODEL EVALUATION

Metrics:

- MAE (0.06)
- RMSE (0.08)
- Directional accuracy (59.5%)
- Global R^2 (0.036)
- Mean R^2 per fold (-0.15)
- Weighted R^2 (-0.18)

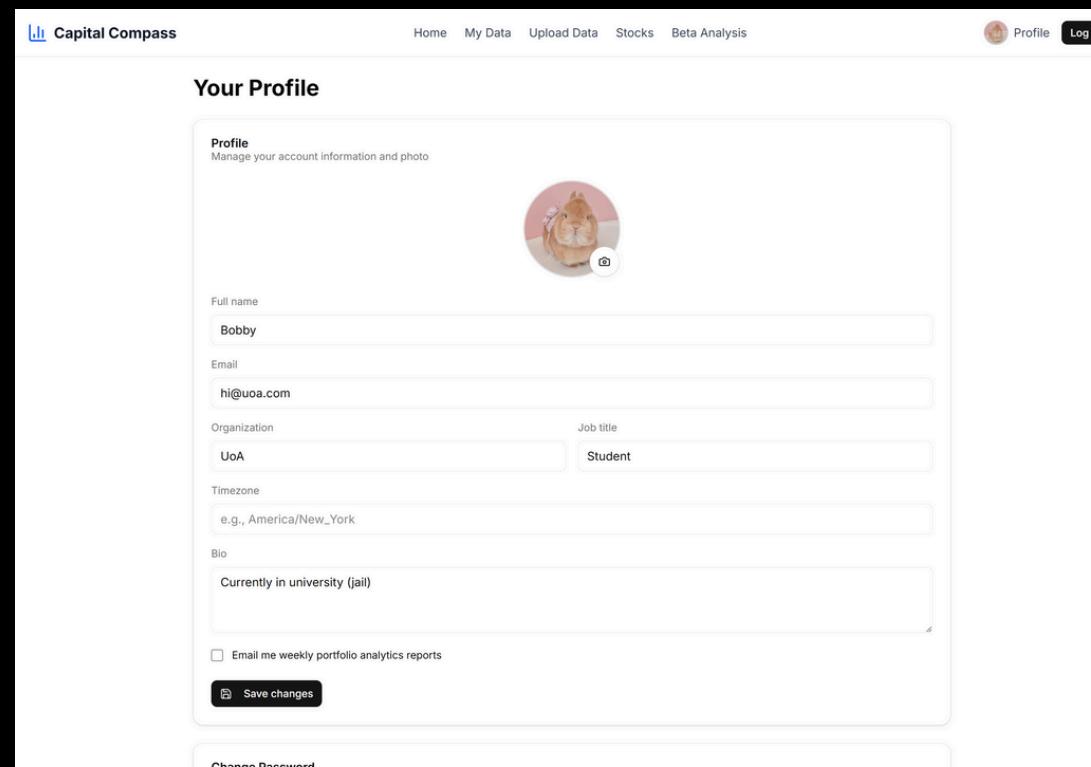


ADDITIONAL FEATURES



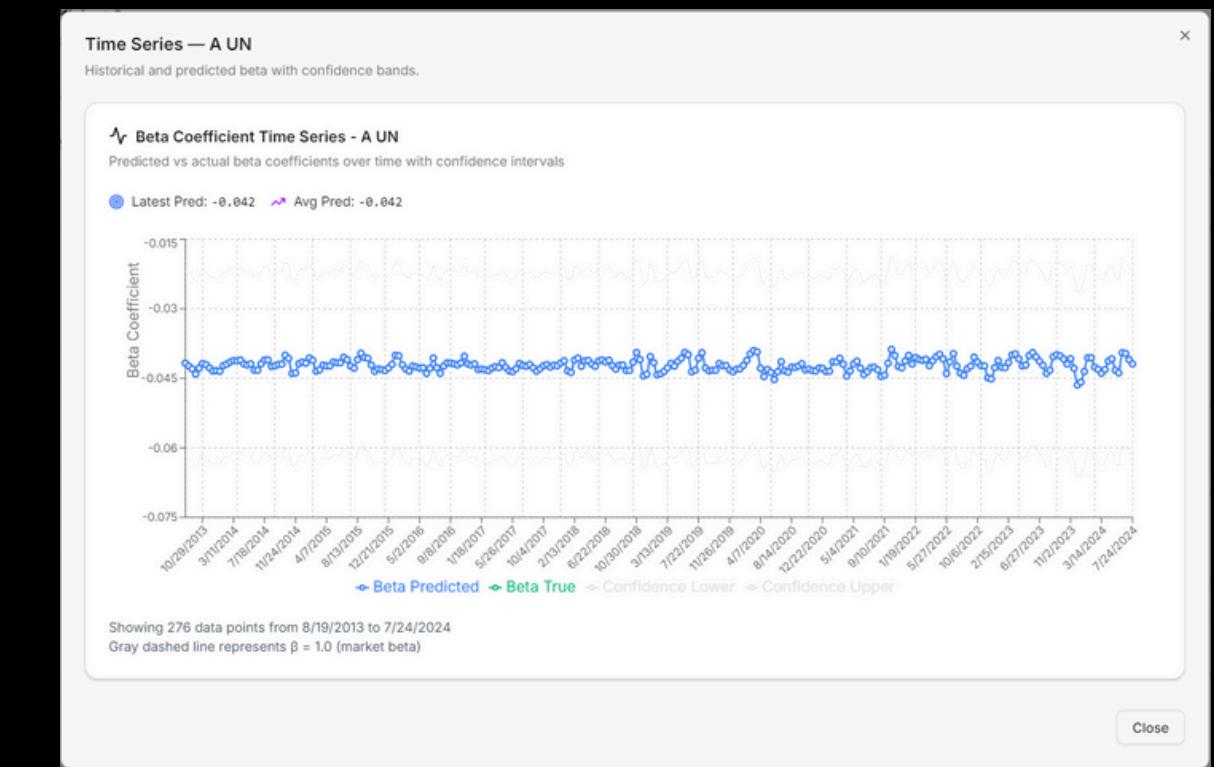
Profile Customization

ADDITIONAL FEATURES



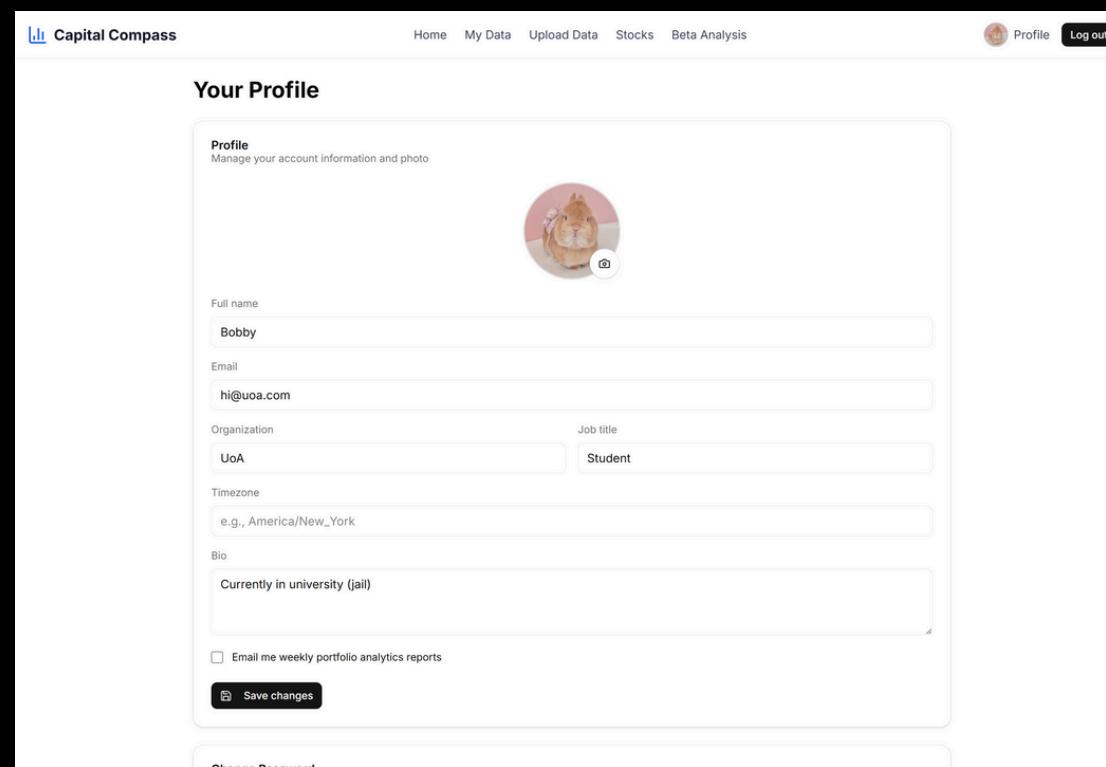
The screenshot shows the 'Your Profile' section of the Capital Compass application. At the top, there's a navigation bar with links for Home, My Data, Upload Data, Stocks, Beta Analysis, Profile (which is the active tab), and Log out. Below the navigation is a sub-header 'Your Profile' with a 'Profile' link. The main content area contains fields for 'Full name' (Bobby), 'Email' (hi@uoa.com), 'Organization' (UoA), 'Job title' (Student), 'Timezone' (e.g., America/New_York), and a 'Bio' section (Currently in university (jail)). There's also a checkbox for 'Email me weekly portfolio analytics reports' and a 'Save changes' button. At the bottom, there's a 'Change Password' link.

Profile Customization



Stock Beta Time Series

ADDITIONAL FEATURES



Capital Compass

Home My Data Upload Data Stocks Beta Analysis

Profile Log out

Your Profile

Profile
Manage your account information and photo

Full name: Bobby

Email: hi@uoa.com

Organization: UOA

Job title: Student

Timezone: e.g., America/New_York

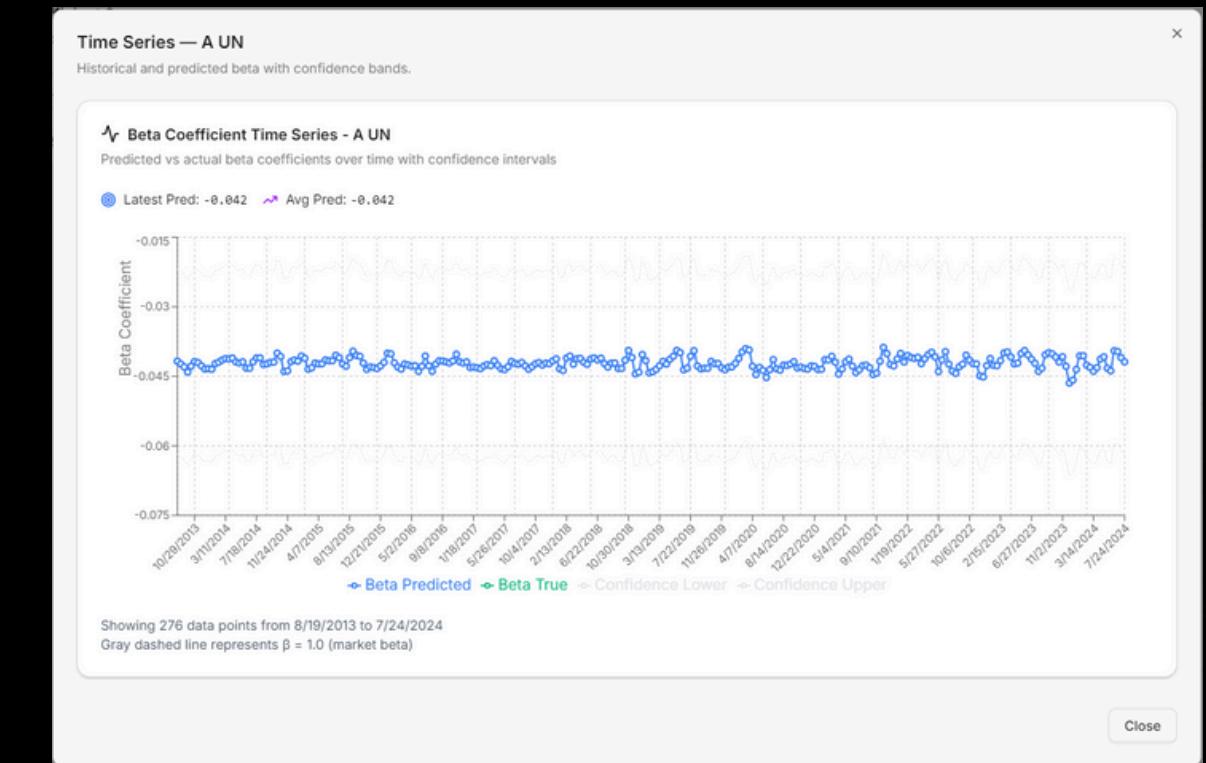
Bio: Currently in university (jail)

Email me weekly portfolio analytics reports

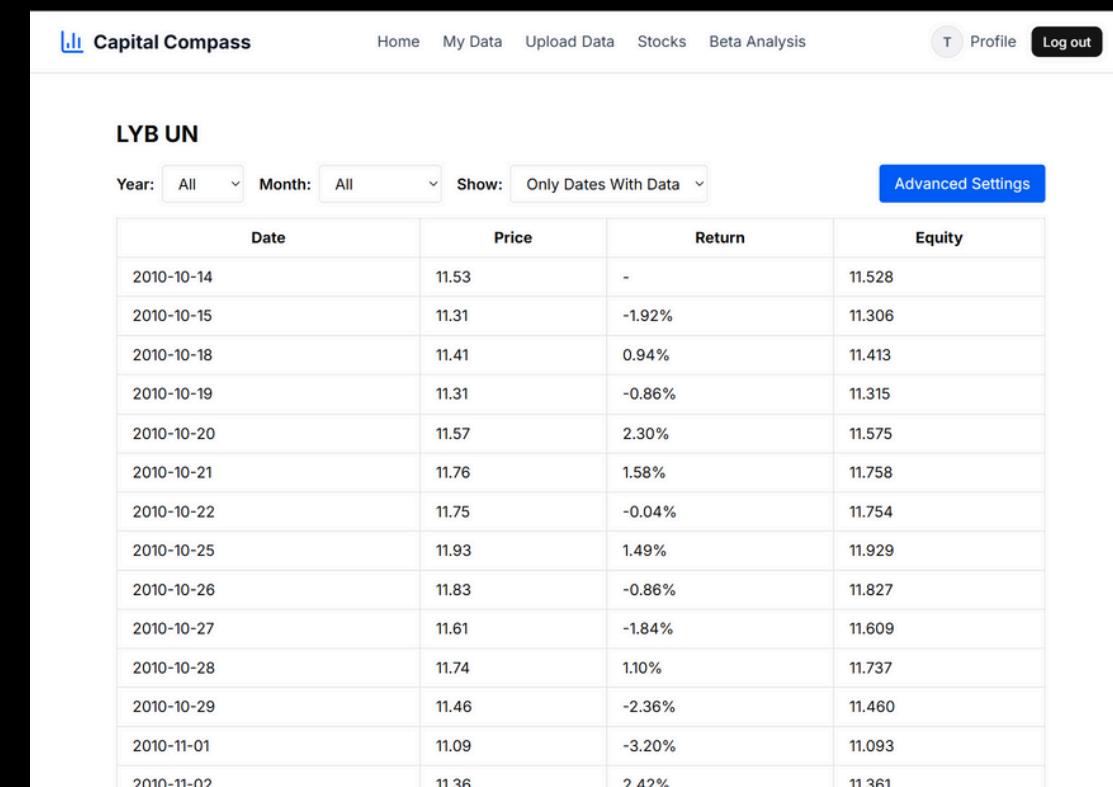
Save changes

Change Password

Profile Customization



Stock Beta Time Series

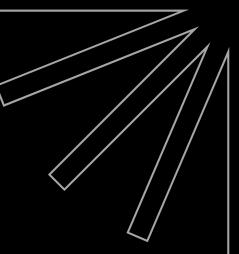


LYB UN

Year: All Month: All Show: Only Dates With Data Advanced Settings

Date	Price	Return	Equity
2010-10-14	11.53	-	11.528
2010-10-15	11.31	-1.92%	11.306
2010-10-18	11.41	0.94%	11.413
2010-10-19	11.31	-0.86%	11.315
2010-10-20	11.57	2.30%	11.575
2010-10-21	11.76	1.58%	11.758
2010-10-22	11.75	-0.04%	11.754
2010-10-25	11.93	1.49%	11.929
2010-10-26	11.83	-0.86%	11.827
2010-10-27	11.61	-1.84%	11.609
2010-10-28	11.74	1.10%	11.737
2010-10-29	11.46	-2.36%	11.460
2010-11-01	11.09	-3.20%	11.093
2010-11-02	11.36	2.42%	11.361

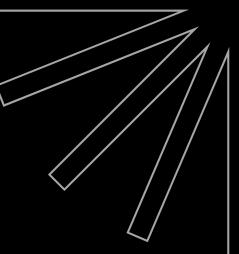
CHALLENGES & LESSONS LEARNED



What Worked

- Integrating Next.js ↔ Django REST ↔ Postgres
- AWS Integration with the webapp
- Handling NaN serialization and JSON errors
- Uploading of Properly formatted Excel files
- Calculation of β -coefficient, factors, etc.
- Intuitive and feature-rich frontend
- Robust & flexible model

CHALLENGES & LESSONS LEARNED



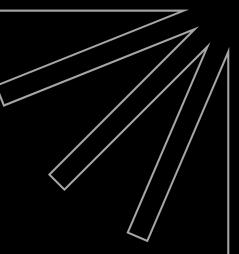
What Worked

- Integrating Next.js ↔ Django REST ↔ Postgres
- AWS Integration with the webapp
- Handling NaN serialization and JSON errors
- Uploading of Properly formatted Excel files
- Calculation of β -coefficient, factors, etc.
- Intuitive and feature-rich frontend
- Robust & flexible model

Challenges Faced

- Model Runtime
- Choosing what predictors to use
- Choosing what predictive model to use
- Prevent look-ahead bias for backtesting
- Clustering
- Clear Communication with client and team members

CHALLENGES & LESSONS LEARNED



What Worked

- Integrating Next.js ↔ Django REST ↔ Postgres
- AWS Integration with the webapp
- Handling NaN serialization and JSON errors
- Uploading of Properly formatted Excel files
- Calculation of β -coefficient, factors, etc.
- Intuitive and feature-rich frontend
- Robust & flexible model

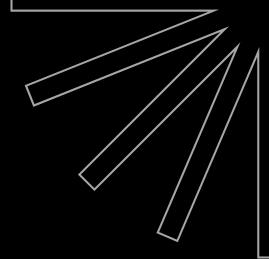
Lessons Learned

- Clear communications and outline from the start
- Clear documentation accelerates debugging
- Iteration > perfection for complex pipelines
- Time management

Challenges Faced

- Model Runtime
- Choosing what predictors to use
- Choosing what predictive model to use
- Prevent look-ahead bias for backtesting
- Clustering
- Clear Communication with client and team members

CHALLENGES & LESSONS LEARNED



What Worked

- Integrating Next.js ↔ Django REST ↔ Postgres
- AWS Integration with the webapp
- Handling NaN serialization and JSON errors
- Uploading of Properly formatted Excel files
- Calculation of β -coefficient, factors, etc.
- Intuitive and feature-rich frontend
- Robust & flexible model

Lessons Learned

- Clear communications and outline from the start
- Clear documentation accelerates debugging
- Iteration > perfection for complex pipelines
- Time management

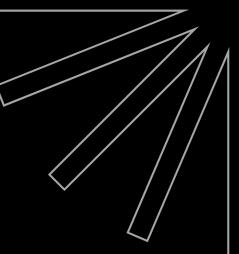
Challenges Faced

- Model Runtime
- Choosing what predictors to use
- Choosing what predictive model to use
- Prevent look-ahead bias for backtesting
- Clustering
- Clear Communication with client and team members

Future Work

- CSV file analysis
- Expanded analysis options
 - Machine learning
- User accounts with permission tiers

PROJECT GOAL EVALUATION



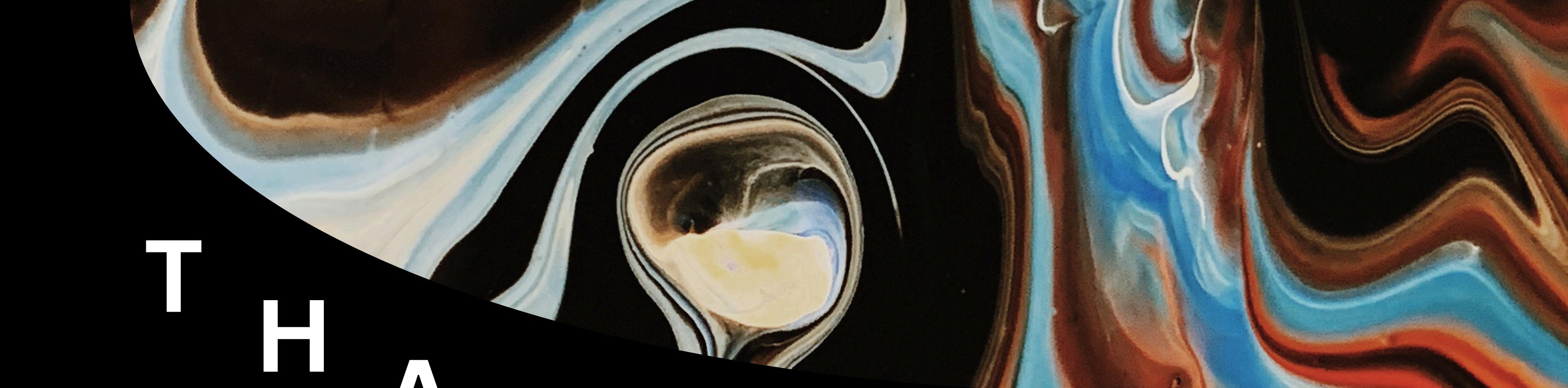
Our Goals:

- Develop a Robust Mean-Reversion Analysis Model
- Incorporate Peer and Market Context Through Clustering
- Create a Weighted Scoring System with MVP Backtesting
- Design a User-Friendly Web Platform for Analysis Delivery

=> We have achieved all of these goals except clustering. We tried to cluster stock based on given price data but could not find any significant result.



THANK YOU!



THANK YOU!

Special thanks to

Nicholas Bagnall
Anna Trofimova
Andrew Balemi
Matt Edwards