Stock Advisory MLOps Platform

Team Members: Baichuan DU, Binong HAN, Linhui SANG
GitHub Repository: https://github.com/larrysangfake/dsba-platform-template.git

Introduction

This toolset supports a realistic financial use case where individuals—such as employees, executives, and founders—hold some company stock. This project aims to provide a simple, actionable toolset to help them manage their stock holdings effectively. The platform showcases MLOps workflows focused on automation, deployment and reproducibility.

Solution Overview

We are building a toolset that includes a stock price prediction model, a risk assessment dashboard, and a sell/hold recommendation engine. The toolset will be deployed as a web app, making it easy for executives to access and use.

Workflows Implemented

Workflow	Description
Data Pipeline	Fetch stock data using yfinance in Python, preprocess using pandas, calculate log returns, 50-day and 200-day average prices, store data locally for model construction
Model Training	Use GARCH, Monte Carlo Simulation and Random Forest for stock price forecasting
Deployment	Deploy model as REST API with FastAPI; package using Docker
Monitoring	Log predictions; prepare for future drift detection & retraining integration

Functionality

The Diversification Advisor module provides personalized recommendations on whether the user should continue to hold, partially sell, or diversify their company stock holdings. It integrates insights from the stock price forecasting modules, performs portfolio concentration analysis, and simulates risk impact of diversification using Modern Portfolio Theory (MPT).

This module uses a rule-based logic engine that takes four main inputs:

1. Price Trend Forecast:
    - **Stock Price Prediction**: Train and deploy Monte Carlo Simulation, GARCH and Random Forest to predict stock price trends.
2. Recommendation Engine:
    - **Personalized Decision Support:** Compare Monte Carlo simulation results against user-defined thresholds.
    - **Generate actionable insights:**
        - Hold recommendation
        - Sell recommendation
        - Potential gain estimations
    - **Input Parameters:**
        - Stock ticker
        - Purchase cost/price
        - Total stock amount
        - Minimum desired gain.
3. Concentration Ratio:

    Computed as:

    $$Concentration\ Ratio\ = \frac{Stock\ Value}{Total\ Portfolio\ Value}$$

    If the ratio exceeds 60%, the user is flagged as having high concentration risk.
4. Portfolio Volatility Simulation

    If the user hypothetically sells 20% of the concentrated stock and reinvests into a benchmark ETF (e.g., SPY), the module compares the original vs. adjusted portfolio volatility using:

    $$\sigma_p = \sqrt{(w_1\sigma_1)^2 + (w_2\sigma_2)^2 + 2w_1w_2\sigma_1\sigma_2\rho}$$

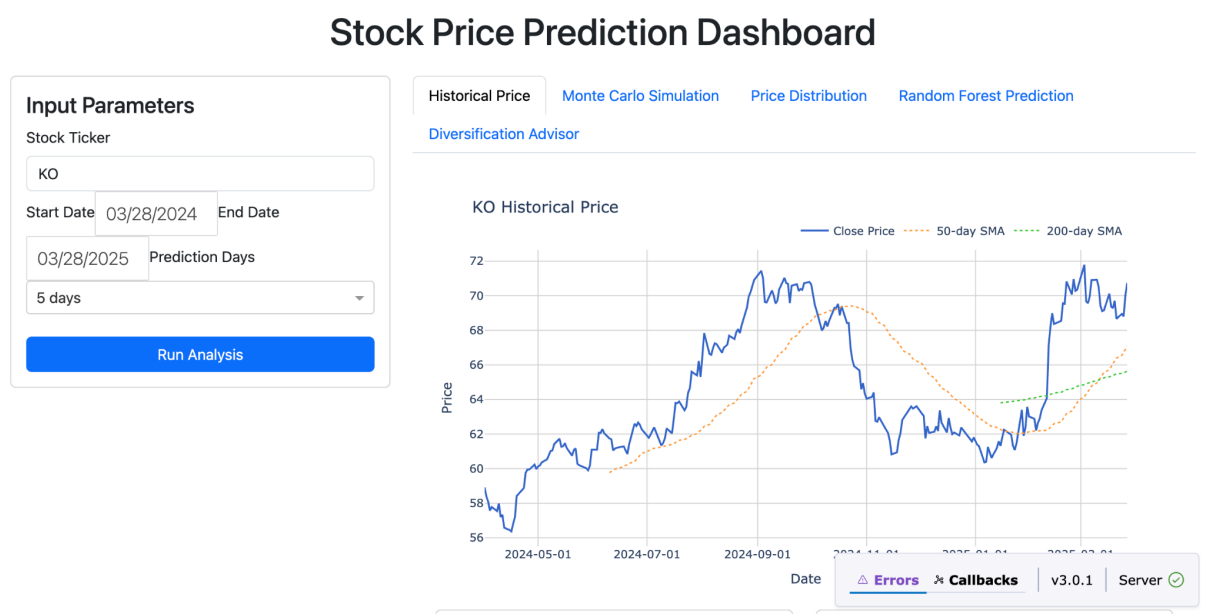
Tools and Technologies

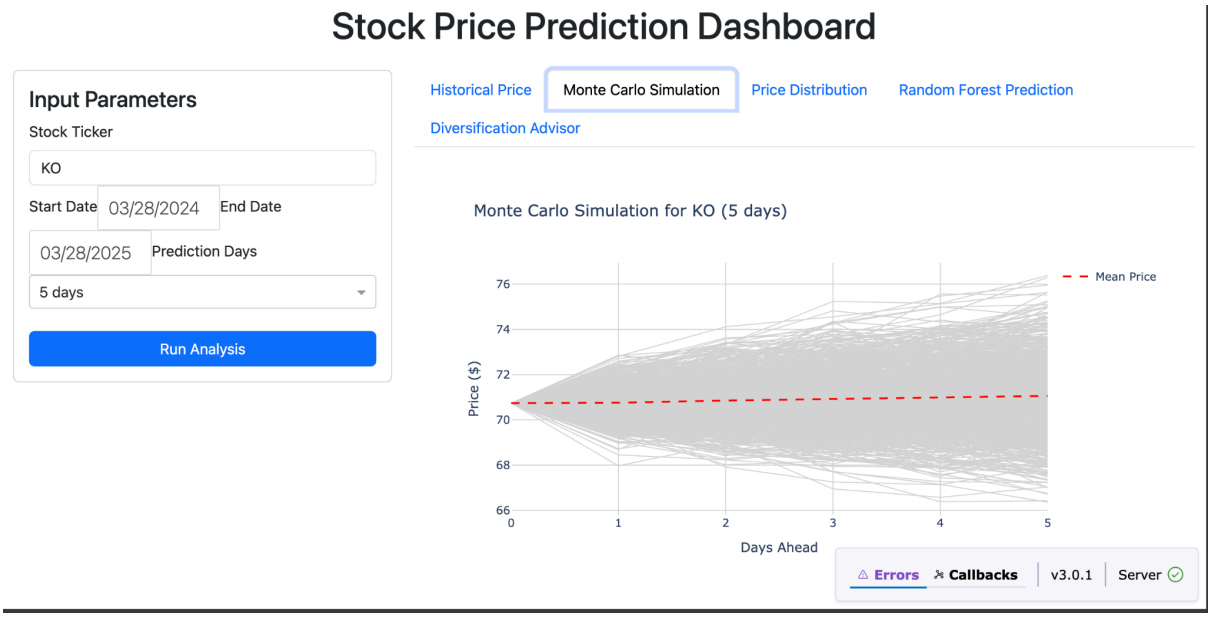
- **Data Collection**: yfinance, pandas,numpy
- **Modeling**: Random Forest, scikit-learn
- **Deployment**: FastAPI, Docker
- **Data Visualization**: dash, plotly

Expected Outcomes

The toolset will help executives make informed decisions about their stock holdings, reducing risk and improving financial outcomes. It will also demonstrate the core skills of MLOps, including model deployment, monitoring, and automation.

Appendices


Stock Price Prediction Dashboard
Input Parameters
Stock Ticker
KO
Start Date 03/28/2024 End Date
03/28/2025 Prediction Days
5 days
Run Analysis
Historical Price
Monte Carlo Simulation
Price Distribution
Random Forest Prediction
Diversification Advisor
KO Historical Price
Close Price
50-day SMA
200-day SMA
Price
72
70
68
66
64
62
60
58
56
2024-05-01
2024-07-01
2024-09-01
Date
Errors
Callbacks
v3.0.1
Server


Stock Price Prediction Dashboard
Input Parameters
Stock Ticker
KO
Start Date 03/28/2024 End Date
03/28/2025 Prediction Days
5 days
Run Analysis
Historical Price
Monte Carlo Simulation
Price Distribution
Random Forest Prediction
Diversification Advisor
Monte Carlo Simulation for KO (5 days)
Mean Price
Price ($)
76
74
72
70
68
66
0
1
2
3
4
5
Days Ahead
Errors
Callbacks
v3.0.1
Server

Stock Price Prediction Dashboard

Input Parameters

Stock Ticker

KO

Start Date 03/28/2024 End Date

03/28/2025 Prediction Days

5 days

Run Analysis

Historical Price | Monte Carlo Simulation | Price Distribution | Random Forest Prediction | Diversification Advisor

Distribution of KO Price in 5 Days

Errors | Callbacks | v3.0.1 | Server

Stock Price Prediction Dashboard

Input Parameters

Stock Ticker

KO

Start Date 03/28/2024 End Date

03/28/2025 Prediction Days

5 days

Run Analysis

Historical Price | Monte Carlo Simulation | Price Distribution | Random Forest Prediction | Diversification Advisor

Random Forest Prediction for KO (5 days)

Errors | Callbacks | v3.0.1 | Server

Stock Price Prediction Dashboard

Input Parameters

Stock Ticker

KO

Start Date 03/28/2024 End Date

03/28/2025 Prediction Days

5 days

Run Analysis

Historical Price | Monte Carlo Simulation | Price Distribution | Random Forest Prediction | Diversification Advisor

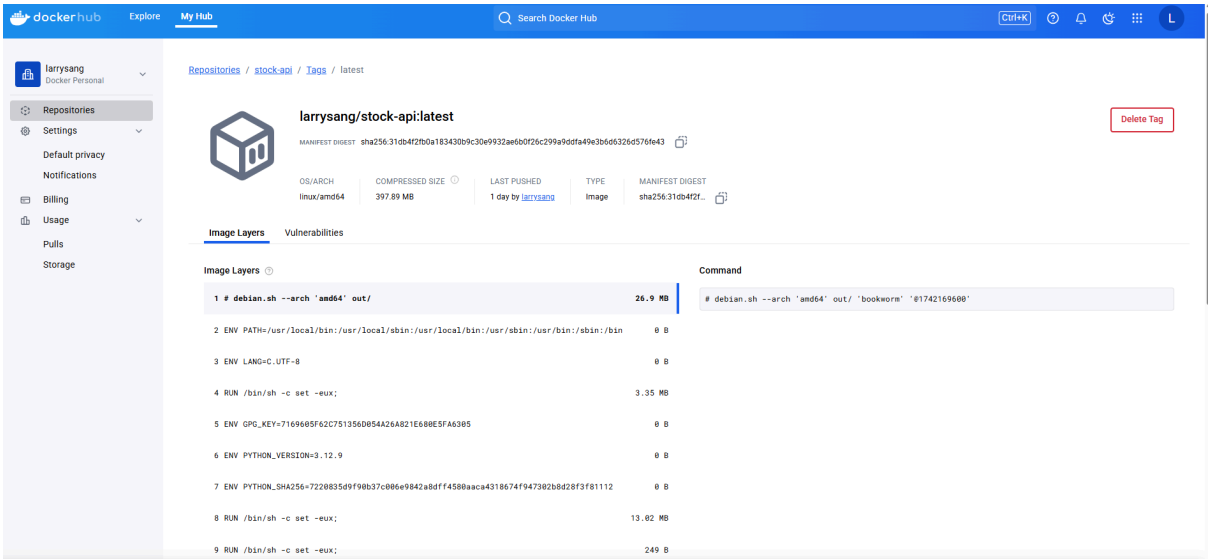
Monte Carlo-Based Advisor

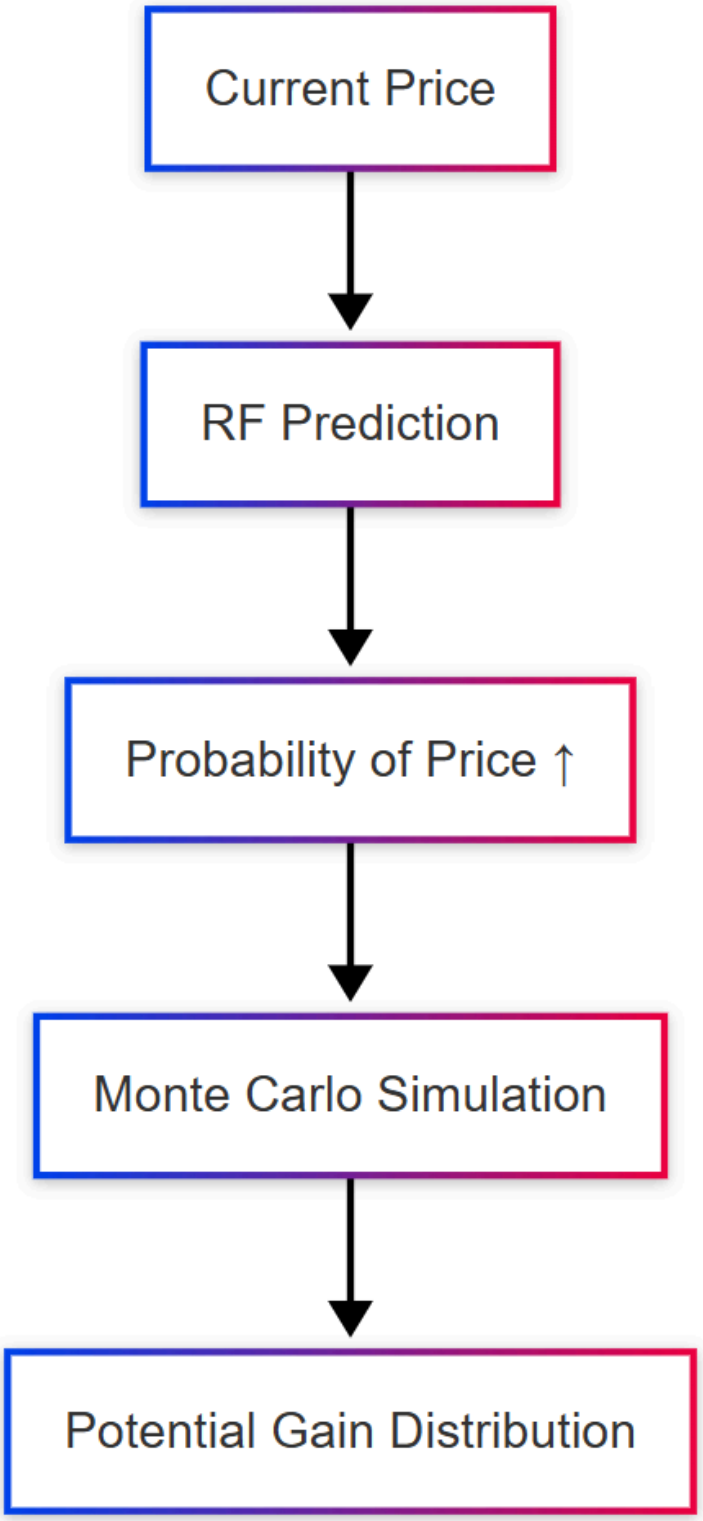
```
The model predicts a stable price trend.
High stock concentration detected. Consider diversifying.
Diversification reduces overall portfolio risk.
Recommendation: Sell 20% and reinvest in low-volatility assets like S&P 500 ETFs.
```

Random Forest-Based Advisor

```
The model predicts a short-term decline. Please be cautious.
High stock concentration detected. Consider diversifying.
Diversification reduces overall portfolio risk.
Recommendation: Sell 20% and reinvest in low-volatility assets like S&P 500 ETFs.
```

Errors | Callbacks | v3.0.1 | Server


docker hub
Explore
My Hub
Search Docker Hub
Ctrl+K
L
larrysang
Docker Personal
Repositories
Settings
Default privacy
Notifications
Billing
Usage
Pulls
Storage
Repositories / stock-api / Tags / latest
larrysang/stock-api:latest
MANIFEST DIGEST sha256:31db4f2fb0a183430b9c30e9932ae6b0f26c299a9ddfa49e3b6d6326d576fe43
Delete Tag
OS/ARCH
linux/amd64
COMPRESSED SIZE
397.89 MB
LAST PUSHED
1 day by larrysang
TYPE
Image
MANIFEST DIGEST
sha256:31db4f2f...
Image Layers
Vulnerabilities
Image Layers
1 # debian.sh --arch 'amd64' out/ 26.9 MB
2 ENV PATH=/usr/local/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin 0 B
3 ENV LANG=C.UTF-8 0 B
4 RUN /bin/sh -c set -eux; 3.35 MB
5 ENV GPG_KEY=7169605F62C751356D054A26A821E680E5FA6305 0 B
6 ENV PYTHON_VERSION=3.12.9 0 B
7 ENV PYTHON_SHA256=7220835d9f90b37c006e9842a8dff4580aaca4318674f947302b8d28f3f81112 0 B
8 RUN /bin/sh -c set -eux; 13.02 MB
9 RUN /bin/sh -c set -eux; 249 B
Command
debian.sh --arch 'amd64' out/ 'bookworm' '@1742169600'



Recommendation Logic