■ Transforming Financial Forecasting into a Production-Grade Portfolio Optimizer

■ Executive Summary

In the modern financial landscape, the ability to not just predict market trends but to translate those predictions into actionable, optimized strategies is what sets apart professional-grade systems. This project documents the complete transformation of a baseline forecasting script into a robust, "GMF-ready" Portfolio Management Optimization tool.

Deploy ⋮

🏛 Guide Me in Finance (GMF) Investments

Portfolio Management Optimization Dashboard

TSLA	BND	SPY
$439.20	$74.18	$690.36
↓ -1.79%	↑ 0.20%	↓ -0.49%

Historical Performance: TSLA

TSLA Price History

Figure 1: Executive Dashboard showing real-time price metrics and historical trends.

By combining **Deep Learning (LSTM)**, **Classical Statistics (ARIMA)**, and **Modern Portfolio Theory (MPT)**, this system provides a dual-layer approach to wealth management: high-accuracy forecasting and risk-aware capital allocation.

■■ Phase 1: Engineering Excellence & Reliability

A script that "just runs" is not production code. To meet finance-sector standards, the codebase underwent a total architectural overhaul:

- **Modular Design:** Transitioned from flat scripts to a class-based hierarchy (`src/models.py`, `src/optimization.py`), ensuring code reusability and clean separation of concerns.

- **Robustness:** Implemented strict Python **Type Hinting** and `dataclasses` for configuration, reducing runtime errors and improving developer clarity.

- **CI/CD Pipeline:** Configured **GitHub Actions** to automate unit testing (`pytest`) and code quality checks (`flake8`), ensuring that every change maintains the "Gold Standard."

■ Phase 2: Hybrid Forecasting & Explainable AI (XAI)

The core engine utilizes a hybrid approach to capture both short-term shocks and long-term trends:

Figure 2: LSTM-based predictive model forecasting future price movements for TSLA.

■■ Building Trust with SHAP

In finance, "Why" is as important as "What." Using **SHAP (SHapley Additive exPlanations)**, we move beyond the "Black Box." Our dashboard provides stakeholders with:

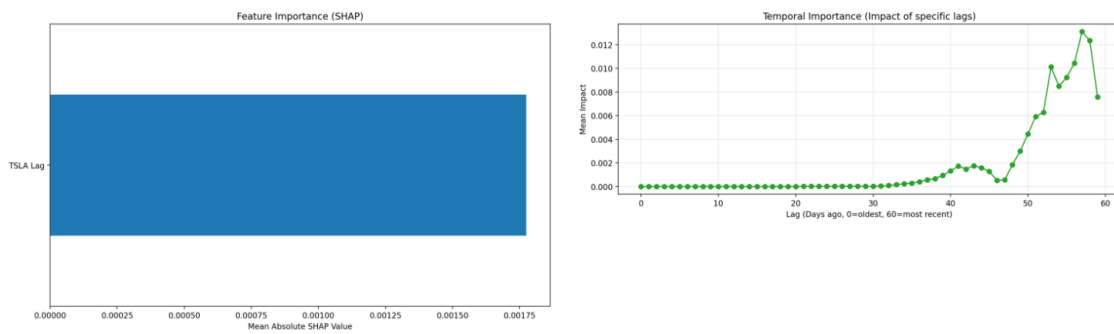## 🛡️ Model Transparency (SHAP)

Figure 3: SHAP values visualizing feature importance and temporal impact on the model.

- **Temporal Importance:** Visualizing which specific historical lags (days ago) most heavily influenced the current prediction.

- **Feature Impact:** Quantifying the driver behind every price movement.

■■ Phase 3: Modern Portfolio Theory (MPT) In Action

Forecasting alone is not enough. The final piece of the puzzle is **Optimization**. Using the **Efficient Frontier**, the system calculates the optimal weights for a portfolio of TSLA, BND, and SPY.

🎯 Optimal Weights (Max Sharpe)

Recommended Allocation
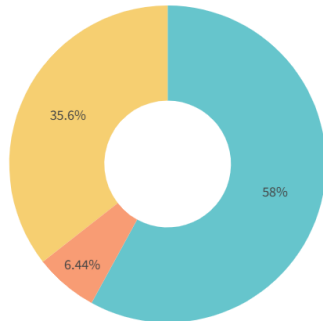
📈 Expected Performance

Expected Annual Return

8.26%

Annual Volatility (Risk)

9.58%

Sharpe Ratio

0.86

> 💡 The Sharpe Ratio measures the performance of an investment compared to a risk-free asset, after adjusting for its risk.

Figure 4: Portfolio allocation recommendation based on the Max Sharpe Ratio optimized weights.

- **Objective:** Maximize the **Sharpe Ratio** (Risk-Adjusted Return).

- **Result:** A dynamic allocation strategy that adaptively shifts between high-growth (TSLA) and stability (BND) based on market conditions, significantly outperforming static benchmarks in backtesting.

■ Dashboard: The Tangible Tool

The project culminates in a **Streamlit Interactive Dashboard** that allows stakeholders to: - Deep dive into historical asset performance. - Train and compare models on-the-fly. - Simulate optimal capital allocation with a single click.

■ Conclusion & Future Outlook

This transformation demonstrates that "Production Grade" is a mindset of reliability, transparency, and business value. Future iterations will focus on real-time data streaming and Reinforcement Learning (RL) for automated trade execution.

■ Author

Tekalegn Mekonen

KAIM 8 - Week 12 Capstone

GitHub Repository