

# MarketPulse: Daily Volatility & Returns Dashboard

## 1. Context & Background

MarketPulse is an automated analytics pipeline designed to provide portfolio managers, traders, and risk teams with a unified, up-to-date view of stock volatility behavior and predictive insights. By extracting, staging and preparing one year of daily price and volume data for selected tech stocks, MarketPulse enables rapid answering of critical questions around returns, volatility patterns, and short-term forecasts—without manual spreadsheet work.

## 2. Business Problem

- **Data Fragmentation:** Price history lives in multiple places (APIs, CSV exports, spreadsheets). Analysts spend hours gathering and cleaning raw data before any analysis can begin.
- **Manual Workflows:** The process of downloading, transforming and loading data into a database is error-prone and must be repeated for each new ticker or time period.
- **Lack of Predictive Insights:** Traders and risk managers need fast answers to questions such as "What will volatility look like next week?" or "How does current risk compare across our portfolio?" Current ad-hoc analyses cannot provide forward-looking insights or be easily refreshed.
- **Limited Risk Assessment:** Without standardized volatility metrics and forecasting capabilities, portfolio risk management relies on backward-looking analysis rather than predictive modeling.

## 3. Project Objective

- **Automate** the extraction of one year of daily OHLCV data for 3–5 stock tickers via the Yahoo Finance API.
- **Stage** cleaned data in a PostgreSQL schema (`marketpulse.stg\_stocks`) for reliability and performance.
- **Engineer** financial features including daily log returns and 14-day rolling volatility with proper annualization
- **Implement** advanced statistical modeling:
  - GARCH(1,1) volatility forecasting to project the next 14 trading days
  - Model validation and performance comparison across tickers
  - Persistence analysis for volatility clustering detection
- **Deliver** a comprehensive Power BI dashboard that answers key business questions and provides actionable insights for risk management and trading decisions.

## 4. Key Business Questions

- **Volatility Trends:** How does rolling volatility (14-day window, annualized) change through time for each stock?
- **Risk-Return Analysis:** How do risk and return metrics compare across different stocks in our portfolio?
- **Volatility Forecasting:** What is the projected volatility over the next 14 trading days based on advanced statistical models?
- **Model Performance:** Which stocks exhibit the most predictable volatility patterns and which models perform best?
- **Cross-Ticker Comparison:** How do current volatility levels and forecasts vary across our tech stock portfolio?
- **Risk Assessment:** What are the maximum daily loss/gain exposures and how many high-volatility days should we expect?

## 5. Glossary of Terms

- **Ticker Symbol**  
A short code representing a publicly traded security (e.g., AAPL, MSFT).
- **OHLCV**  
Daily market snapshot: Open, High, Low, Close prices plus traded Volume.
- **Daily Return**  
Percent change from the prior close:  $(\text{Close}_t - \text{Close}_{t-1}) / \text{Close}_{t-1} \times 100$ .
- **Rolling Volatility**  
The standard deviation of daily returns over a 14-day window, annualized by  $\sqrt{252}$ .
- **Anomaly Detection**  
Unsupervised learning (e.g., Isolation Forest) is used to flag extreme return days.
- **Time-Series Forecast**  
Projection of future volatility using models such as Prophet or ARIMA.
- **Forecast Horizon**  
The number of days into the future for which volatility is predicted (14 days).
- **Pipeline**  
The end-to-end sequence: Extract → Load → Transform → ML → Visualize.

## 6. Technical Implementation Highlights

- **Production ETL Pipeline:** Modular Python architecture with comprehensive logging and error handling
- **Advanced Statistical Modeling:** GARCH(1,1) implementation with AIC-based model comparison and persistence analysis
- **Financial Engineering:** Proper calculation of log returns, annualized volatility, and risk metrics

- **Database Integration:** PostgreSQL staging with data validation and quality checks
- **Executive Dashboards:** Multi-page Power BI analytics with interactive filtering and KPI tracking