

Automated Macro-Financial Risk Intelligence Pipeline

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Course: Diploma in Business Automation with Python - UCD Professional Academy

Introduction

The objective of this project was to design and implement an end-to-end automated macro-financial analytics pipeline using Python. The system retrieves real economic data from external APIs, processes and standardizes multiple macroeconomic indicators, applies a rule-based risk scoring model, and generates automated executive-level reports in Excel and PDF format. The primary goal was to simulate a financial planning and analysis (FP&A) macroeconomic monitoring system capable of supporting strategic decision-making through data-driven insights and automated reporting.

Methodology

The project was structured into modular components covering data acquisition, transformation, analysis, storage, and reporting automation. Data was retrieved programmatically using the Federal Reserve Economic Data (FRED) API. Four macroeconomic indicators were selected: Consumer Price Index (CPI), Unemployment Rate, Federal Funds Rate, and the 10-Year Treasury Yield.

Raw API responses were converted into structured Pandas DataFrames. Data cleaning included date normalization, numeric conversion, handling missing values, sorting, and alignment by time index. To enable meaningful comparison, all indicators were standardized to a monthly frequency.

Feature engineering included Month-over-Month (MoM) and Year-over-Year (YoY) percentage changes, as well as rolling averages (3 and 6 months). The datasets were merged into a consolidated macro table containing a long historical series suitable for trend analysis and reporting.

Analysis and Insight Generation

A rule-based macro risk engine was developed to simulate monitoring logic commonly used in FP&A environments. Risk signals are generated based on threshold logic such as elevated inflation, rising unemployment momentum, high policy interest rates, and bond yield stress.

Each condition contributes to a cumulative macro risk score classified as LOW, MEDIUM, or HIGH. To provide a more interpretable macro regime view, a composite Macro Financial Stress Index (MFSI) was implemented using standardized Z-scores across key variables.

The composite index is mapped into regimes (VERY LOW to CRITICAL) and linked to regime-based strategy interpretations suitable for scenario planning. The system also produces historical context tables (e.g., top high-stress periods) to help stakeholders compare the current environment against prior regimes.

SQL Integration

To simulate an enterprise data workflow, the processed dataset is stored in a local SQLite database. SQL queries generate an executive snapshot (latest period) and a last-12-month trend table.

These outputs are automatically exported and included as tabs in the Excel report, demonstrating integration between Python processing and SQL-based business intelligence workflows.

Reporting and Automation

The workflow is automated through a centralized pipeline script that executes:

- Data ingestion via API
- Transformation and feature engineering
- Risk scoring and regime classification
- SQL storage and query extraction
- Report generation

Outputs include a styled Excel workbook and an executive PDF briefing. Logging is implemented to track pipeline execution and support troubleshooting. The automated reports are designed to be repeatable and updated with minimal manual intervention.

Targeted Impact

The system simulates an automated macroeconomic monitoring tool that can support:

- Budgeting and scenario planning
- Inflation monitoring
- Interest rate exposure analysis
- Capital allocation timing

- Risk-based financial decision support

By automating data collection, transformation, and reporting, the solution reduces manual workload while improving analytical consistency and timeliness.

Conclusion

This project demonstrates an end-to-end automation solution that integrates API-based data acquisition, financial feature engineering, rule-based risk modeling, SQL storage, and automated reporting.

Beyond satisfying academic requirements, the solution reflects practical applications in financial analysis, business intelligence, and automation-driven decision support systems.