Advanced Programming Group Project

Project Description

<u>General:</u>

Team Member: Philipp Lizat, Eva Dubbins

Subject: „Euro foreign exchange reference rates"

Project Description: „The goal of this python project is to convert, analyze and forecast Euro foreign exchange rates using data from the European Central Bank. It will provide a simple currency converter supporting EUR to USD, CNY, AUD and CHF, a historical exchange rate analysis, and a forecast for the EUR/CAD exchange rate using SARIMAX.

Programming Language: Python

Upload Format: .py in GitHub

Data source: European Central Bank → <u>Link</u>

Currencies considered for conversion: Euro as reference, additionally Swiss franc (CHF), US dollar (USD), Chinese yuan renminbi (CNY), Australian dollar (AUD)

Currencies considered for forecast: Euro as reference, Canadian Dollar (CAD)

<u>Project 1: Interactive Currency Converter Based on Historical ECB Reference Rates</u>

In this project, we developed an interactive currency converter based on the official historical reference exchange rates published by the European Central Bank (ECB). The objective was to create a Python-based application that not only allows users to convert amounts between currencies using specific historical or current rates, but also enables the visualization of long-term exchange rate trends. The result is a tool that functions as both a financial calculator and a simplified analytical interface, offering practical utility as well as educational value.

We worked with a dataset that includes daily ECB reference rates from January 1, 1999, to May 6, 2025, covering more than 30 international currencies. To keep the scope focused and manageable, we selected four major currencies for the application: the US Dollar (USD), Swiss Franc (CHF), Chinese Yuan (CNY), and Australian Dollar (AUD). These currencies were chosen to reflect a diverse range of economic regions — including North America, Europe, Asia, and the Pacific — and to represent both stable reserve currencies and those influenced by commodity markets or emerging economies. All values in the dataset represent the exchange rate of 1 Euro in terms of the respective foreign currency.

We implemented the application in Python using core libraries such as pandas for data handling and preprocessing, and matplotlib for data visualization. After importing

and cleaning the dataset, which included managing missing values due to weekends or holidays and ensuring proper date formats, we created a user interface that accepts an amount in Euros, a target currency, and a specific date. The program retrieves the relevant exchange rate from the historical data and calculates the equivalent value in the selected currency. In addition to the conversion feature, we integrated a line plot that displays the historical exchange rate trend for a chosen currency, allowing users to explore long-term fluctuations and gain economic insights.

By transforming raw ECB data into a functional and visually intuitive tool, this project demonstrates how open financial data can be leveraged to build accessible and insightful applications. It underscores the value of transparent public data, time-series analysis, and thoughtful interface design in creating tools that serve both learning and real-world use.

Project 2: Forecasting EUR/CAD Exchange Rates Using SARIMAX Modeling

In the second project, we developed a time series forecasting model to predict future EUR/CAD exchange rates using statistical modeling techniques. The project aimed to simulate (and afterwards compare) a realistic scenario where financial analysts or businesses might seek to anticipate currency fluctuations in order to make informed investment or hedging decisions. We focused on modeling the EUR/CAD exchange rate because of its relevance for trade between the Eurozone and Canada, and because it offers interesting dynamics influenced by both European and North American economic conditions.

We again used daily foreign exchange reference rates provided by the European Central Bank (ECB), focusing specifically on the EUR/CAD pair. The data consisted of business day rates, with adjustments made to account for missing values caused by holidays or non-trading days.

The time series analysis was implemented in Python, and we used the SARIMAX (Seasonal AutoRegressive Integrated Moving Average with eXogenous regressors) model from the statsmodels library. After visualizing and examining the data for seasonality and trends, we selected a combination of non-seasonal and seasonal parameters to reflect both short-term fluctuations and longer-term patterns. The model was trained on data from 2018 through 2024, and then used to forecast the EUR/CAD exchange rate for the first four months of 2025 — a total of 65 business days.

To assess the performance of the model, we compared the forecasted values against the actual ECB rates for January to April 2025. This comparison included both absolute and relative deviation calculations, enabling us to quantify how accurate our predictions were. We also created a bar chart to visualize the daily forecast error, making it easy to identify periods of higher or lower predictive precision.