Project Write Up – STAT 418

Foreign Exchange Dashboard

Nils Berzins

Data Collection and Exploratory Data Analysis:

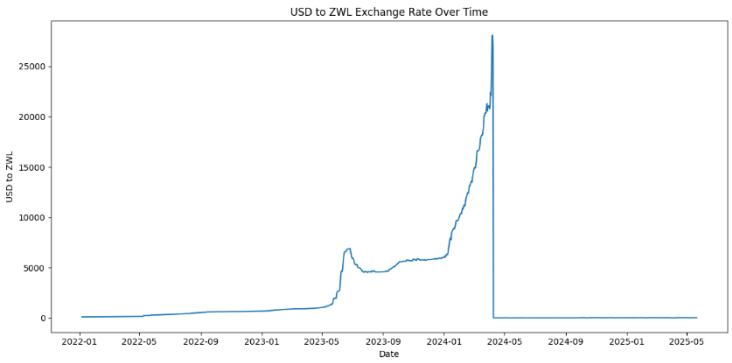
Per the project requirements, I sought out a data source or API that would provide me with JSON data. Stumbling upon the ExchangeRate-API, I decided I would do my project on forex rates. After getting my API key, one request from the API produced one day's worth of foreign exchange rate data, requiring a loop starting from January 1st, 2021 (beginning of non-legacy data in the API) to May 20th, 2025 (last day of my premium free trial with the API). I decided to keep all exchange rates pinned to the USD for ease of later conversion:

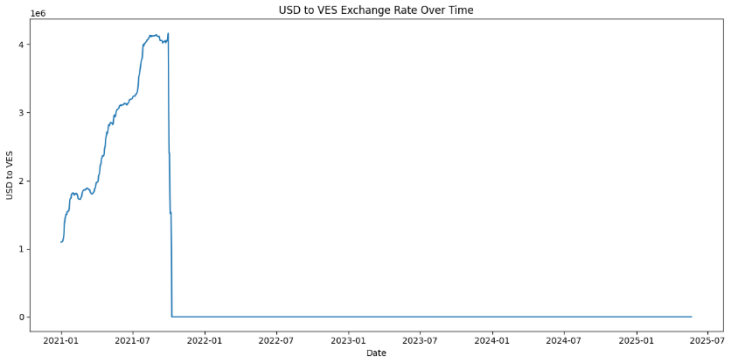
$$\frac{\frac{\text{Curr A}}{\text{USD}}}{\frac{\text{Curr B}}{\text{USD}}} = \frac{\text{Curr A}}{\text{Curr B}}$$

ExchangeRate-API's data is generally very well managed and easy to work with. In order to make a friendly interface for users who didn't know some of the more obscure currencies of the world (e.g. XCG or FKP being the Caribbean Guilder and Falkland Islands Pound, respectively), I prompted ChatGPT to provide me with the full currency names of all currencies available on ExchangeRate-API. Some gaps needed to be filled with some of the more obscure currencies (mentioned above), and one currency needed to be removed from the dataset for being a 1:1 match with another currency code: Both SLL and SLE referred to the Sierre Leonean Leone (removed SLE).

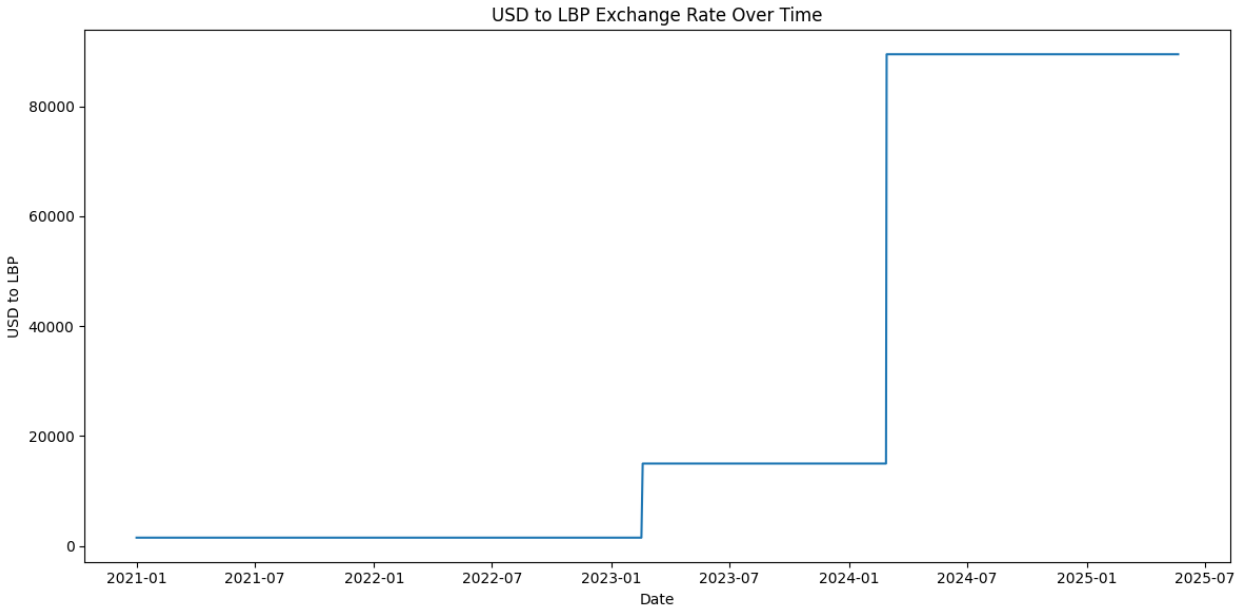
Now with a fully human-readable dataset, I did some light EDA to find any other abnormalities or trends within a largely clean and well-organized dataset. The main examples of confusing or abnormal data came from countries that suffer from hyperinflation (in floating foreign exchange regimes) or extreme devaluation pressures (in fixed exchange rate regimes).

In the case of the Zimbabwean Dollar and the Venezuelan Sovereign Bolivar, hyperinflationary pressures drove these currencies out of circulation. The adoption of a new currency can be seen graphically by the near-instant drop to 0 in their respective redenomination dates.





However, in the case of the Lebanese Pound (LBP), the Lebanese Central Bank “pegs” their currency to the United States Dollar (as many countries do or with a basket combination of many stable currencies). The central bank decided they needed to devalue their currency by 90% to respond to deep internal economic crises while also combating rampant speculation on the currency’s value. Graphically this can be seen by the instantaneous rise from 1,500 Pound per USD to 15,000. Yet another devaluation order was issued in 2024 to align closely with the parallel market rate, indicating over a 98% loss in value since 2019.



In both cases, whether it be hyperinflation or fixed rate devaluation, these currencies still reflect (at least at one point) tradable stores of value whose trends could still be captured in the ARIMA modelling.

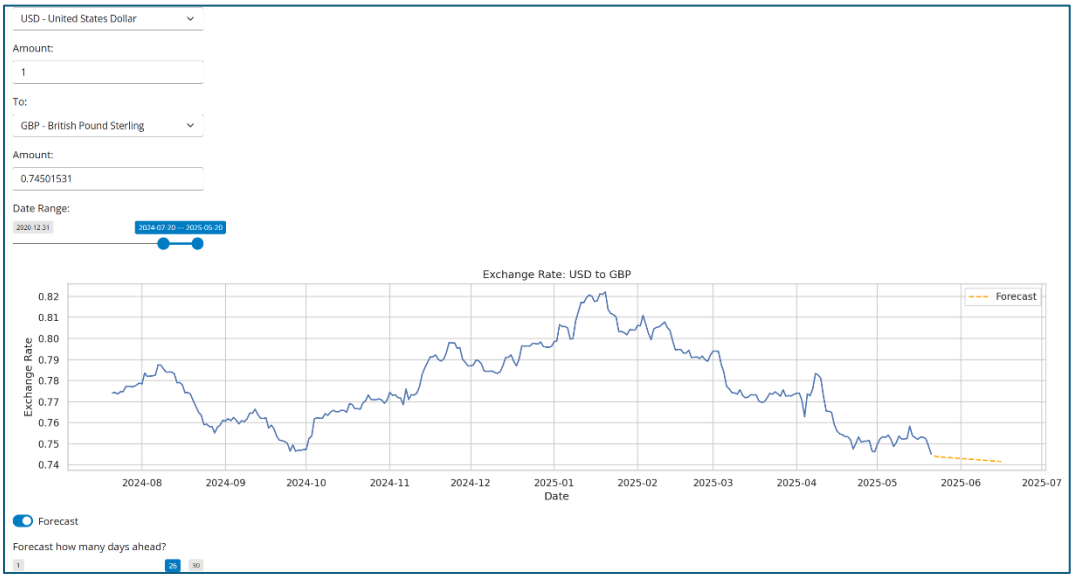
Methodology:

Given the time series nature of the data, ARIMA modelling was the intuitive choice for forecasting short-term currency fluctuations. Although there was an initial appeal to allow the user to select their own forecasting function and combination of p/d/q, defaulting to pmdarima's auto_arima() function allowed me time to ensure the user experience was fully reactive while also ensuring users were always given the most likely short-term forecast. To ensure that the model wouldn't extrapolate to unreasonable lengths (given the volatility of the forex market) I would decide to limit the forecasting length to 30 days, which still can effectively capture short term trend.

The decision to use shiny over other dashboarding software was partly due to a desire to refresh myself on shiny after having already worked with it on various R-based projects while also providing users with a more interactive experience. The dashboard was built using the shinydashboard framework to create an accessible, interactive interface. Users can select any currency supported by the API, specify a time window, and view both historical exchange rate trends and ARIMA-based forecasts.

Results:

The product (as of June 3rd, 2025) is a clean but interactive plotting and forecasting application that gives the user full access to exchange rate information and plotting functionality. Users can select any combination of currencies, time frames, and forecasting windows with a relatively quick response time (per Shiny's capabilities).



Future iterations of the application will see changes to the design of the user interface to make it more visually appealing, including a reorganization of the country code drop downs, amount calculation bars, and forecasting switch. Furthermore, adding up to date data by making a request to ExchangeRate-API once daily to expand the current dataset. And finally, adding full customizability to the kind of forecasting model you are using (MA, ARIMA, GARCH, etc.).