**A Data-Driven Study of Kenya’s Exchange Rate Dynamics**

**Understanding the Forces Shaping Kenya’s Currency Valuations**

**Introduction**

In a rapidly globalizing world, exchange rates play a critical role in shaping the economic terrain of nations. Kenya, as a hub for East African trade and investment, serves as an exemplary case for observing the dynamics of foreign exchange markets. This study adopts a data-driven approach to identify the factors influencing Kenya’s exchange rate movements, offering insights into how macroeconomic indicators, global trends, and market sentiment interact to affect the value of the Kenyan shilling (KES).

**Overview of Kenya’s Exchange Rate System**

Kenya operates under a **floating exchange rate regime**, where the value of the KES is primarily determined by market forces of demand and supply. Although the Central Bank of Kenya (CBK) occasionally intervenes to prevent extreme volatility, the exchange rate largely reflects the country's macroeconomic fundamentals and performance relative to its trading partners.

**Data Collection and Methodology**

This study employs a combination of historical exchange rate data and macroeconomic indicators sourced from:

* **World Bank Group**
* **Central Bank of Kenya (CBK)**
* **Kenya National Bureau of Statistics (KNBS)**
* **Macrotrends.net**

**Key Variables**

* **Exchange Rate (USD/KES):**  
  Monthly and daily data from 2003 to 2024 for both buying and selling rates (CBK).
* **Inflation Rates:**  
  Monthly data from 2005 to 2025 (KNBS).
* **Public Debt:**  
  Monthly data on domestic and external debt from 2000 to 2021 (CBK).
* **Unemployment Rate:**  
  Annual data from 1991 to 2023 (Macrotrends.net).
* **Other Macroeconomic Indicators:**
  + GDP deflator (annual %)
  + IBRD loans and IDA credits (current US$)
  + Inflation (consumer prices, annual %)
  + Total remittances
  + Foreign direct investment, net (BoP, current US$)
  + Exports and imports of goods and services (current US$)
  + GDP per capita (current US$)
  + Banking and central bank interest rates

**Objectives**

1. To conduct exploratory data analysis (EDA) on the USD/KES exchange rate from 2003 to 2023, identifying major trends, seasonal patterns, and conducting time series decomposition.
2. To develop and compare time series forecasting models to predict exchange rate movements in 2024 and validate forecasts against actual 2024 data.
3. To apply supervised learning techniques to detect distinct volatility or trend regimes in USD/KES exchange rate data.
4. To determine the macroeconomic indicators with the greatest influence on exchange rate behavior.

**Data Understanding**

The dataset comprises macroeconomic and financial indicators from multiple reputable sources. The **exchange rate (USD/KES)** is the primary target variable, with the following as explanatory features:

* **Interest Rates:** Deposit, lending, overdraft, and savings rates
* **Central Bank Rates:** Treasury bills (T-bills), cash reserve ratio, and inter-bank lending rates
* **Imports/Exports**
* **Unemployment**
* **Inflation**
* **Foreign Direct Investment**
* **Debt and Loans**

**Data Frequency and Processing**

Due to varying data frequencies (daily, monthly, and yearly), averages were computed to harmonize the datasets. Four datasets were constructed:

* **Monthly Dataset** – includes repeated values due to averaging and will be used for initial analysis.
* **Yearly Average Dataset** – contains unique values and will be used for long-term modeling.

Initial exploration will focus on the **monthly dataset** for short-term pattern identification, followed by modeling using the **yearly dataset** to enhance forecasting robustness.

**Modeling Approach**

We will implement and compare several models for forecasting the USD/KES exchange rate:

* **ARIMA** – Traditional statistical model for time series forecasting.
* **PROPHET** – An additive regression model with a piecewise linear or logistic growth curve trend.
* **XGBoost** – A tree-based ensemble machine learning model adapted for time series.
* **LSTM Neural Network** – Deep learning model suitable for capturing long-term dependencies in sequential data
* **Moving average / Exponential Smoothing** - Methods for producing time series models

**Evaluation Strategy**

Model performance will be evaluated using a range of statistical and visual metrics:

* **RMSE (Root Mean Squared Error)**
* **MAE (Mean Absolute Error)**
* **MAPE (Mean Absolute Percentage Error)**
* **R² Score (for regression models)**
* **Comparison of predicted vs. actual exchange rates (2024)**
* **Residual analysis** to assess model assumptions and detect overfitting or bias

**Deployment and Practical Application**

Deployment could be implemented using platforms such as **Streamlit**, **Power BI**, or integrated into a **Python Flask API** for web-based accessibility.