High-Frequency forex Simulation and Volatility Analysis

1. Project Overview

This report presents a comprehensive analysis of high-frequency simulated Forex data with a focus on volatility measurement and detection using the 'mid' price. The analysis covers both 1-minute and 5-minute data for GBP/USD and other G10 currency pairs.

2. Simulated Data Generation

Mid-price data was simulated using a Geometric Brownian Motion (GBM) process to mimic high-frequency Forex tick behavior. The simulation was carried out for major G10 currency pairs at 1-minute and 5-minute intervals.

3. Volatility Measures

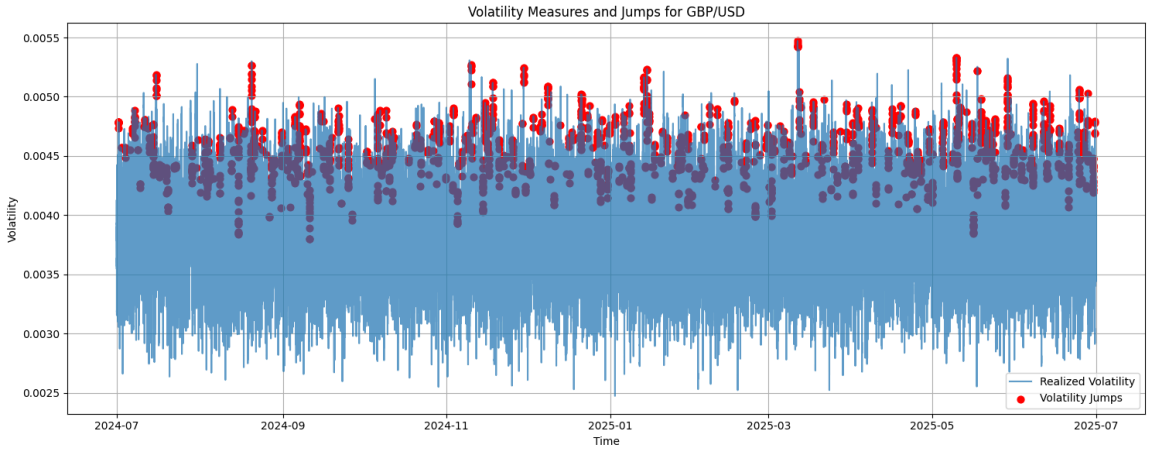
- Historical Volatility: Rolling 60-minute standard deviation of log returns.

- EWMA Volatility: Exponentially weighted volatility with decay factor $\lambda = 0.94$.

- Realized-Volatility: Square root of the rolling sum of squared log returns (60-minute window).

4. Volatility Jump Detection

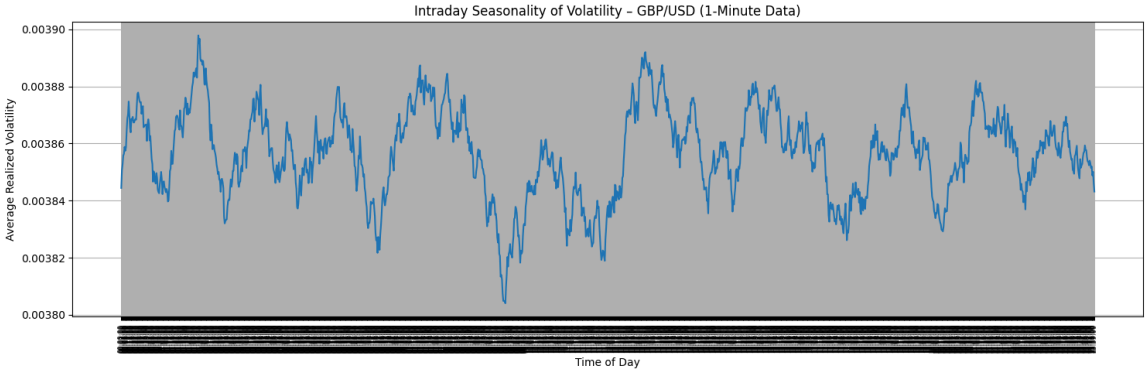
Volatility jumps were detected by comparing realized volatility with a 240-minute rolling mean and standard deviation. A jump was flagged if realized volatility exceeded the mean by more than 3 standard deviations.



The aforementioned plot shows the volatility jumps (in red dots) observed throughout the analyzed period.

5. Intraday Seasonality Analysis

Volatility was analyzed across different times of the trading day using squared returns grouped by HH:MM time buckets as shown below.



The above mentioned plot's analysis revealed systematic variations in volatility throughout the trading day.