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Performance of seasonal and double seasonal autoregressive integrated moving average models with ARCH/GARCH in forecasting exchange rates in Sri Lanka

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The exchange rate is one of the most essential economic indices and forecasting its chaotic and uncertain behaviour is challenging for business practitioners and academic researchers. This study mainly evaluated the performance of Seasonal Autoregressive Integrated Moving Average (SARIMA) and Double SARIMA (DSARIMA) with Autoregressive Conditional Heteroskedasticity (ARCH)/ Generalized ARCH (GARCH) models in forecasting daily exchange rates in Sri Lanka. This is the first study that used DSARIMA models with ARCH/GARCH of different specifications of error distributions, as previous studies focused on either on annual or weekly seasonality separately in forecasting exchange rates. The study considered USD, EURO, JPY, GBP, AUD, CAD, SGD and CHF against LKR, daily exchange rates from 1st January 2008 to 28th February 2022. Data were split non-randomly for training from 1st January 2008 to 07th January 2022 and the remainder for testing. The stationary of the exchange rates was checked, and the weekly and annual seasonality patterns were examined from the tests of Webel-Ollech (WO), Friedman rank (FR), and Kruskal-Wallis (KW). Model diagnostics checking was carried out with the tests of Ljung-Box, Jarque–Bera, and ARCH to check the presence of autocorrelation, normality, and heteroskedasticity in the residuals, respectively. The ARCH/GARCH specifications of normal, skew-normal, student-t, and skew-t were applied, as the correct innovation of the appropriate error distribution increases the accuracy of the fitted volatile model. Moreover, DSARIMA models were compared with the Seasonal Autoregressive Integrated Moving Average (SARIMA) models considering several performance criteria which were calculated from the original test values and forecasted values. Transformations of log and differencing were applied respectively to convert all the non-stationary exchange rates to stationary. Overall, weekly and annual seasonality patterns were observed for all the exchange rates from the results of WO, FR, and KW tests, except for FR test results, indicated that there is no annual seasonality in every exchange rate. Hence, SARIMA and DSARIMA models were fitted incorporating weekly and annual seasonality separately and together, respectively. Here, the seasonality feature was included using Fourier terms as external regressors to the ARIMA process. In conclusion, the compared results between fitted models favoured SARIMA for CHF against LKR, SARIMA with ARCH/GARCH for USD, EURO, JPY, GBP, and AUD against LKR, and DSARIMA with ARCH/GARCH models for CAD and SGD against LKR with the lower values. Overall, predicted values captured the behaviour of the exchange rates. However, a considerable number of volatile movements of the currency exchange rates were not very well captured, and they were observed by the graphs of actual vs fitted. Hence, as future work, this study proposes to build a time-series extension model incorporating the real distribution of the exchange rates. Nevertheless, the knowledge from the results of this study is important in managerial and financial decision makings and many others. Further, this study will add more value to the existing literature.

Keywords: ARCH, Double Seasonal Autoregressive Integrated Moving Average (DSARIMA), Exchange rates, Forecasting, GARCH.

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