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***Do you think the euro will go down or up? – Let’s find out!***

***Introduction***

As an economics and mathematics major, I picked up a topic that can combine my two majors: forecasting euro/USD exchange rate. The reason why I chose euro/USD is very special because of my experience of studying abroad in Rome, Italy in 2022. Plus, when I was in Italy, I learned that euro/USD currency pair is so special itself because dollar is the safest asset in the world and euro is the currency of more than 20 countries. I aimed to build two models to forecast the exchange rate: Multivariate time series regression and Box Jenkins Time Series Modeling.

***Result***

*Data*: At first, I collected the monthly data from 2000 to 2022 on both the USA and the Eura Area, but after examining the data of economic variables such as interest rates, it was clear that post-pandemic data is not the same as pre-pandemic data. For example, the United States lowered its interest rate to almost 0 to deal with the Covid-19. Therefore, we decided to use the post pandemic data - meaning January of 2020-December of 2022.

*Box Jenkins*: The beauty of Box Jenkins modeling is that it lets the data speak for itself – it only uses the data of response variable – in our case the historical euro/USD exchange rate. Because the time series plot of the exchange rate was not stationary, we took a first difference () to produce stationarity for **Box-Jenkins modelling** purposes. Secondly, we looked at the autocorrelation function which demonstrated that that the first difference is a white noise series, hence we model and forecast exchange rate as the **random walk** time series given by the formula,



where  = the exchange rate at time t and  is white noise with mean 0 and variance .

Finally, we used the MINITAB command to produce the forecasts for 1/1/2023 to 5/1/2023(shown below).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | 95% Limits | |  |
| Time Period | Forecast | SE Forecast | Lower | Upper | Actual |
| Jan 2023 | 1.06908 | 0.0244040 | 1.02124 | 1.11692 | 1.0862 |
| Feb 2023 | 1.06797 | 0.0345125 | 1.00031 | 1.13562 | 1.0576 |
| March 2023 | 1.06685 | 0.0422690 | 0.98398 | 1.14971 | 1.0836 |
| April 2023 | 1.06573 | 0.0488081 | 0.97005 | 1.16141 | 1.102 |
| May 2023 | 1.06461 | 0.0545691 | 0.95764 | 1.17159 | 1.0688 |

*Regression*: We chose our predictive variables as interest rate, inflation, consumer sentiment, and geopolitical risk index and our response variable is exchange rate. MINITAB has a Best Subsets command allowing the analyst to choose the “best” set of explanatory variables for building a regression model for the exchange rate response variable. We chose to model the exchange rate as a function of Euro Area inflation Rate and Euro Area consumer confidence due to the high **R-sq.** value and low **S** value. This is called **model** **parsimony.** Therefore, our regression equation:

|  |  |  |
| --- | --- | --- |
| exchange rate | = | 1.2187 - 0.01031 EA inflation rate + 0.003696 EA consumer confidence |

Explanation of variable choice: I found out that there is high correlation between euro money supply and European inflation rate, so it may imply that European money supply and market expectations/market confidence are the most important factors determining the exchange rate according to my regression. The coefficient of euro inflation rate is negative, meaning that when euro inflation rate increases (maybe due to increased euro supply), the euro will depreciate against the dollar. The coefficient of consumer sentiment is positive, meaning when the market has confidence in the European economic perspective, the euro appreciates against the dollar.

Since the residuals from the regression model are not independently distributed, we fit a Box-Jenkins AR (1) model to this time series which is represented as follows:

, where  is white noise.

So now we can do the forecasting and our final regression equation follows:

|  |  |  |
| --- | --- | --- |
| exchange rate | = | 1.21654 - 0.01127 EA inflation rate + 0.003131 EA consumer confidence + 0.679 RESI\_Lag1 |

Lastly, I did the prediction for the January 2023 – May 2023:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Time period | Fit | SE Fit | 95% CI | 95% PI | Actual |
| Jan 2023 | 1.06192 | 0.0065236 | (1.04862, 1.07523) | (1.01340, 1.11044) | 1.0862 |
| Feb 2023 | 1.06493 | 0.0063754 | (1.05193, 1.07794) | (1.01650, 1.11337) | 1.0576 |
| March 2023 | 1.08091 | 0.0051103 | (1.07048, 1.09133) | (1.03310, 1.12871) | 1.0836 |
| April 2023 | 1.08350 | 0.0051762 | (1.07294, 1.09405) | (1.03566, 1.13133) | 1.102 |
| May 2023 | 1.09299 | 0.0045645 | (1.08368, 1.10230) | (1.04541, 1.14057) | 1.0688 |

In conclusion, the predictions resulted from my two models were both good. The actual data was within the confidence level of the predictions I made. I learned a lot about time series analysis, especially Box Jenkins because I also used it in my regression to produce even better results.

We thank Albion College Donors for making this research possible. I will be presenting my research at Elkin Isaac next year and will do my thesis further on this topic.