

Inflation Rate Forecasting Using Time Series Analysis

DATA 690: Financial Data Science

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Objective

Inflation is a general increase in the prices of goods and services in an economy. Increase in inflation leads to economic growth but can also reduce investment returns. Inflation affects the balance of assets and liabilities of an individual and an overall economy.

In this project, we will predict and forecast inflation rates based on recorded inflation rates and chosen variables that affect inflation.

Data

Dependent Variables

Customer Price Index(CPI)

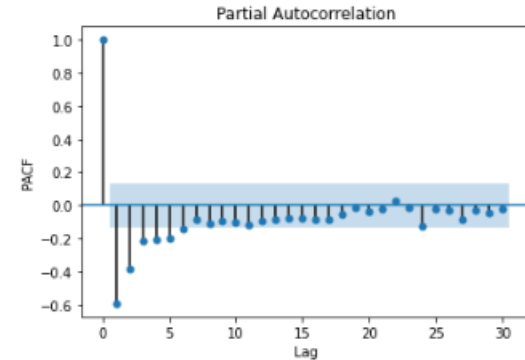
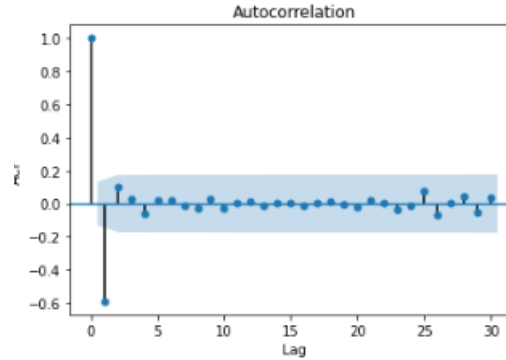
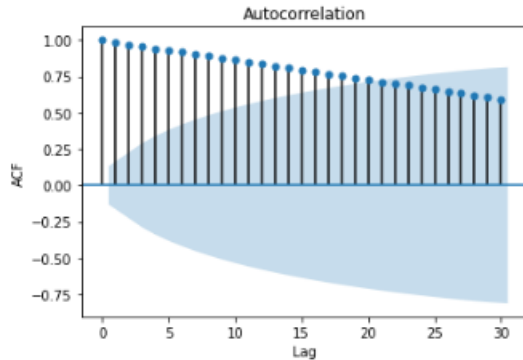
Independent Variables

- Gross Domestic Product(GDP)
- Interest Rates
- Unemployment Rate
- Federal Debt
- Annual goods exports and imports

Data Processing

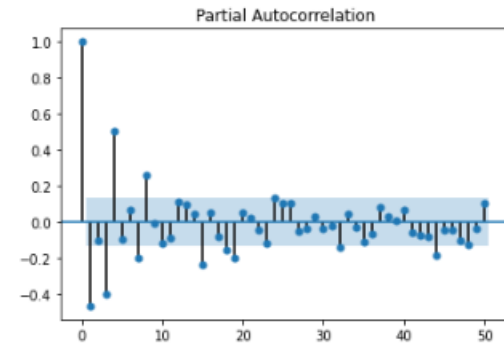
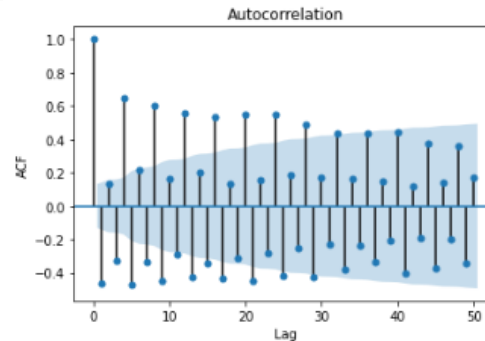
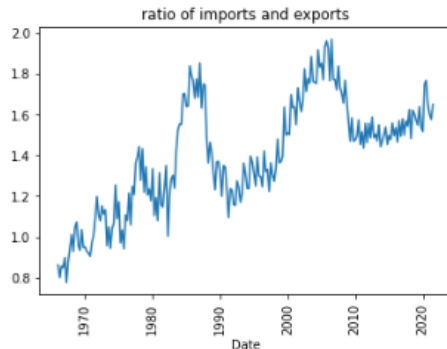
- Monthly data is converted to Quarterly data.
- Column names and series index are modified to be more user friendly.
- Data in a particular time frame is selected based on availability.

- ADF, ACF and PACF are used to check for stationarity of the data. Appropriate lag values for modeling is chosen.
- Data is made stationary by taking first/second difference. The stationarity is verified using the ADF test.

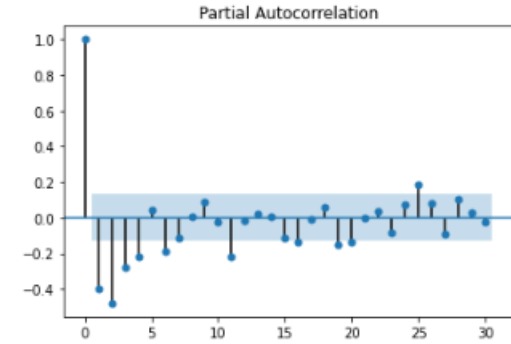
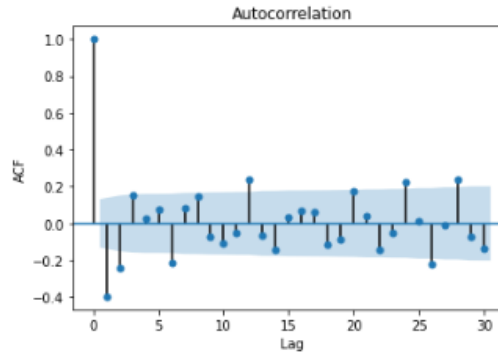
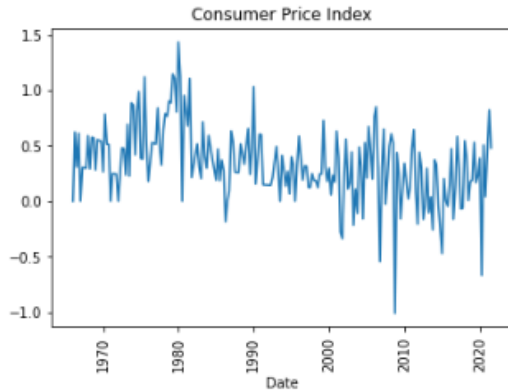


Univariate Analysis

- Univariate time series forecasting is done on the independent variables.
- Appropriate model is chosen based on the trend, autocorrelation and partial autocorrelation plots.
- AR and MA orders are inferred from these plots as well.
- Any seasonality observed in these plots is accounted for by using SARIMAX as shown below.



Multivariate Analysis: CPI Forecasting

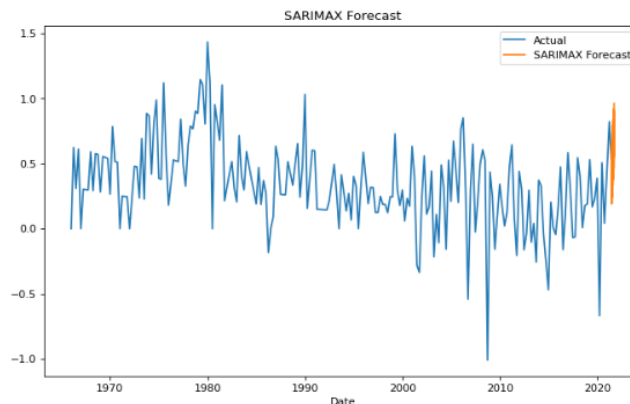
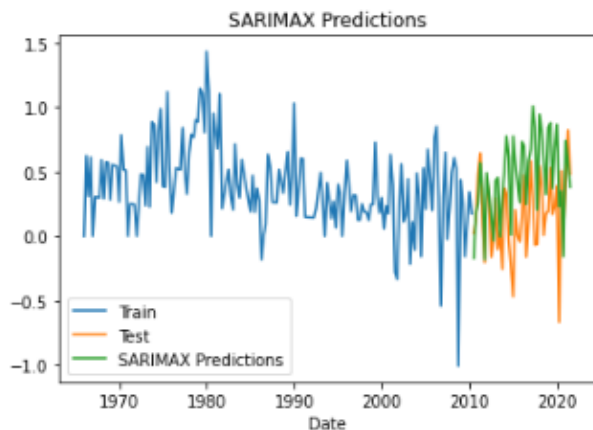


Multivariate time series forecasting using SARIMAX is performed. The orders chosen are (3,1,2) and the seasonality orders chosen are (3,1,2,12).

Results

- Predicted inflation rates closely match the actual values from the test data.
- Forecasted values seem to show an increase in inflation rate in near future and seems to align with the existing trend.
- Better investment/financial decisions can be made by companies and individuals based on inflation forecasts.

	mae_sarimax	mse_sarimax	rmse_sarimax
0	0.347584	0.189864	0.435734



Future Work

- This forecasting is based on chosen variables only, results may differ when other variables are considered. For example, Real personal consumption expenditures and industrial production rate.
- The results may get better if alternative models are chosen for forecasting independent variables based on performance.
- In this project we have chosen data within a particular time range. Better forecasting is possible when a larger time period of data is used.

References

- Ülke, V. (2016, December 17). *A comparison of time series and machine learning models for inflation forecasting: empirical evidence from the USA*. SpringerLink. https://link.springer.com/article/10.1007/s00521-016-2766-x?error=cookies_not_supported&code=670f68e8-1abf-423b-ad1c-738f836f3773
- Gustavo Silva, A., & Wagner Piazza, G. (2020, February 19). *Machine learning methods for inflation forecasting in Brazil: new contenders versus classical models*. [cemla.org](https://www.cemla.org/actividades/2020-final/2020-10-xxv-meeting-cbrn/Session%202/3.%20Machine%20Learning). [https://www.cemla.org/actividades/2020-final/2020-10-xxv-meeting-cbrn/Session%202/3.%20Machine Learning](https://www.cemla.org/actividades/2020-final/2020-10-xxv-meeting-cbrn/Session%202/3.%20Machine%20Learning).