**Introduction**

Time series analysis comprises methods for analyzing time series data in order to extract meaningful characteristics of the data. Time series forecasting is the use of a model to predict future values based on previously observed values. While regression analysis is often employed in such a way as to test relationships between one or more different time series, this type of analysis is not usually called "time series analysis", which refers in particular to relationships between different points in time within a single series. Interrupted time series analysis is used to detect changes in the evolution of a time series from before to after some intervention which may affect the underlying variable.

**Technical analysis and Methodology**

Seasonality is a very common feature of financial and economic time series, while most of the data announced publicly is seasonally adjusted that the seasonal patterns are already removed from the original data. Seasonal patterns are repeating data specifications in a specific frequency, such as higher inflation in 1st quarters and lower unemployment in 4th quarters. Seasonality should be considered to obtain more robust forecasts and analysis. Therefore, models that aim to forecast unemployment rates should consider their seasonal properties so as to obtain better mean equation estimations.

The characteristics of the data that should be used for time series future prediction are different from those of general machine learning models. A typical difference is that the data used for time series data is clearly ordered by the time the data occurs. Since the time is not repeated and recorded only in the increasing direction, the same data is not repeated again, and data that is always newly generated comes in only in the increasing direction of the time axis (x-axis). However, the case of general data is very different from time series data in that the same data is often observed and the independent variable (x-axis) of new data may increase or decrease.

In addition, time series data has characteristics such as trend, which is a long-term pattern, seasonality, which is a medium-term pattern, and autocorrelation, which is a correlation with previous data. After all, analyzing time series data means analyzing various characteristics of time series data such as trend, seasonality, and autocorrelation.

A comparative analysis was done for the forecast performances of different univariate time series methods with the purpose of providing future predictions of unemployment rate. In order to do that, several forecasting models (seasonal model autoregressive integrated moving average (SARIMA), self-exciting threshold autoregressive (SETAR), Holt–Winters, ETS (error, trend, seasonal), and LSTM (Long Short Term Memory) have been applied, and their forecast performances have been evaluated based on root mean squared error (RMSE).

**Comparing Models- Two stage modeling approach**

The most basic assumption of time series forecasting is that past patterns continue into the future. Based on this assumption, in the short-term future forecast, since the environment in which the data is generated is similar to the present, the uncertainty is small and the forecast can be well-predicted. However, as we move towards long-term future forecasting, the possibility of the environment in which data is generated is likely to change, and unpredictable situations occur, and as errors continue to accumulate, uncertainty about the forecast data is bound to increase.

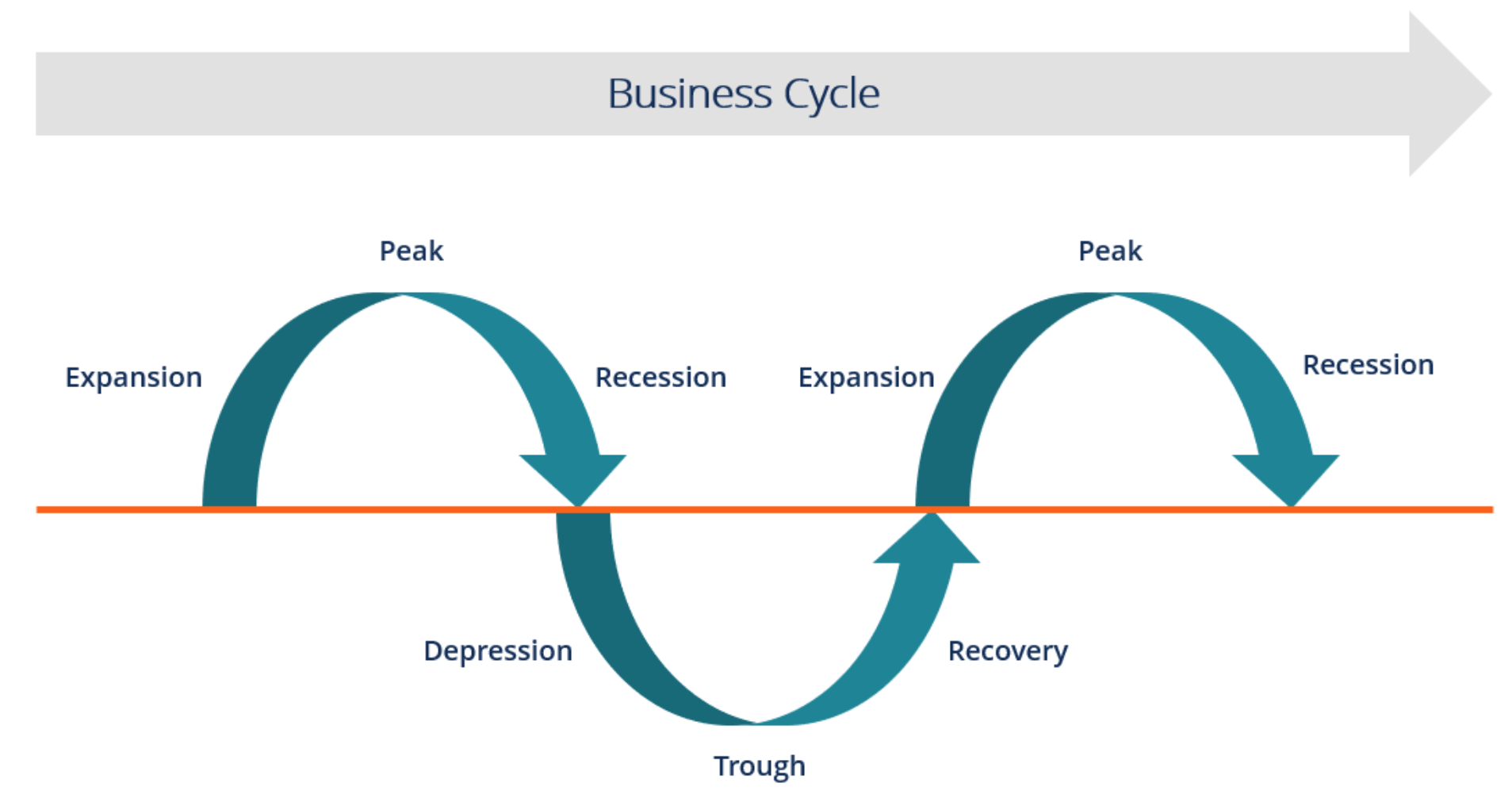
**Results of Modeling**

We compare the performance of various models and try to select the model with the best performance (least RMSE). Based on the in-sample forecast assessment of different methods, the forecast measures root mean squared error (RMSE), mean absolute error (MAE suggested that the LSTM model outperforms the other models.

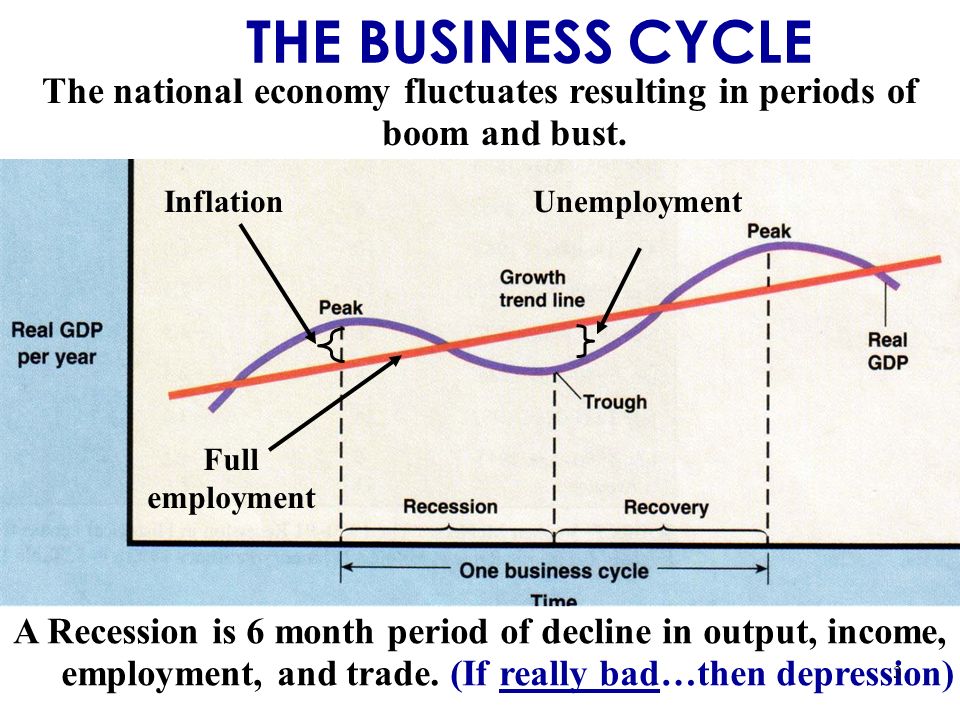
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| --- | --- | --- | --- |
| **UNEMPLOYMENT RATE** | | | |
| **Country** | **UE Rate** | **Upper Bound** | **Lower Bound** |
| Canada | 5.1 | 5.3 | 5.0 |
| France | 7.0 | 7.1 | 7.0 |
| Germany | 2.9 | 2.9 | 2.9 |
| Italy | 8.0 | 8.0 | 8.0 |
| Japan | 2.5 | 2.6 | 2.4 |
| United Kingdom | 3.8 | 3.9 | 3.7 |
| United States | 3.6 | 3.7 | 3.6 |

The unemployment follows the business cycles and positively correlated to inflation, economic growth. This is cyclic in nature. There could be moving averge associated with like quartley , 5 moving average eetc…

For each country the business cycle can vary and accordingly unemployment rate cyel



<https://www.google.com/search?q=business+cycle+inflation+and+unemployment+cycle&tbm=isch&ved=2ahUKEwjV15Oei-r_AhXqo2MGHVr1D6oQ2-cCegQIABAA&oq=business+cycle+inflation+and+unemployment+cycle&gs_lcp=CgNpbWcQDDoECCMQJzoHCAAQigUQQzoFCAAQgAQ6BggAEAgQHjoHCAAQGBCABDoECAAQHlCbBFjBNGCwQ2gBcAB4AIABxAGIAcgNkgEEMi4xM5gBAKABAaoBC2d3cy13aXotaW1nwAEB&sclient=img&ei=wlCeZNXuAurHjuMP2uq_0Ao&bih=722&biw=1536#imgrc=BzsztgfiSS17QM>



<https://www.learn-economics.co.uk/The-business-cycle.html>

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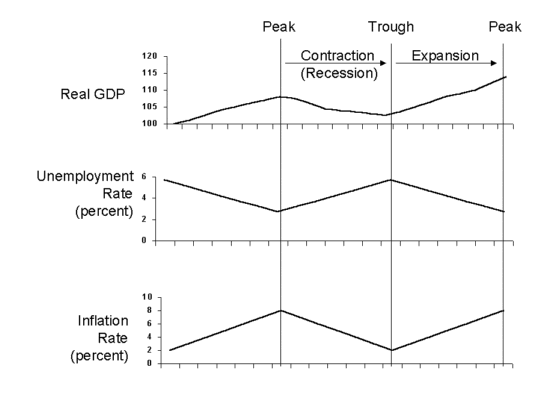
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