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FUTURE AND PAST: STUDY OF TIME SERIES FORECASTING

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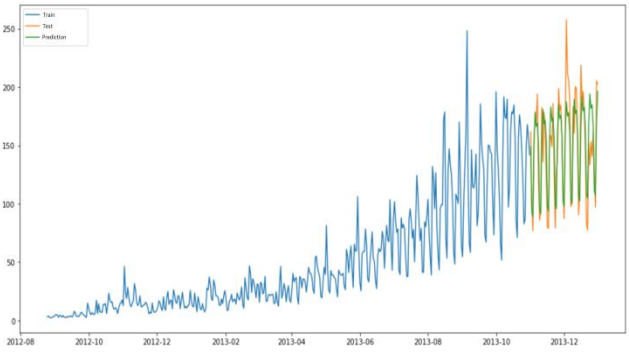
Abstract: Time series forecasting is done by collecting and analysing past observations to develop a suitable mathematical model that enhances the underlying data generating process for the series which is the base of predicting future statistics. Time series analysis comprises of methods for carefully studying time series data in order to extract useful statistics and other characteristics of the data. While all the numerous advanced tools and techniques are employed for data analysis such as data science, business intelligence, NLP, classical and quantum machine learning, deep learning, implementation of Artificial Intelligence, and IoT. One of the techniques frequently preferred for analysing financial data is statistical Time Series Analysis.

I. INTRODUCTION

Time series forecasting is an important area of machine learning that generally neglected. It is crucial because there are quite a lot of prediction problems that involve a time component. These problems are overlooked because it is this time component that makes time series problems more difficult to handle.

Forecasting, modelling and predicting time series is highly becoming popular in a number of scientific and non-scientific fields. Time series prediction is all about forecasting the coming future. Every second a large quantity of data is stored in servers across the world. This data is invaluable and can help us predict future.Forecasting time series is not always a straight forward process. There are a lot of techniques to build models that can calculate the estimate and forecast future time points. Similarly, the models can provide us with calculated decisions which in return can reduce the risk and increase the return. Additionally, building reliable and robust forecasting models are essential when predicting behaviours of market movements. The prediction making about the coming event in the classical statistical handling of time series data is called extrapolation.A lot of modern fields imply on the similar topic and refer to it as time series forecasting.



Graphical Representation of a Basic Time Series Forecast Model

The time series forecasting involves taking models fit on prehistoric data and using it to predict future observations. Descriptive models can borrow for the future. An important distinction in forecasting is that the future is completely unavailable and must only be estimated from what has already happened. The quality of a time series forecasting model is estimated by its performance at predicting the future. This is generally at the cost of being able to understand and explain why a specific prediction was made, confidence breaking and even better understanding the underlying causes behind the problem.

II. TIME SERIES ANALYSIS

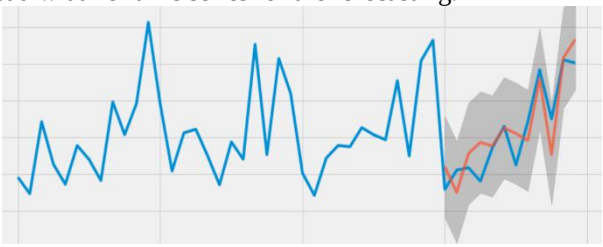
While using classic statistical approach, the major concern lies in the analysis of time series. Time series analysis consists of developing models that are best fitted tohold or describe an observed time series in order to take care of the underlying causes. This generally consists of creating assumptions about the form of the data and decomposing the time series into components of different constitution.The quality of a descriptive model is determined by how well it describes all available data and the interpretation it provides to better informs the problem domain. The main motive of time series analysis is to develop mathematical models that provide plausible descriptions from sample data.

Time-Series Analysis through various mode of data visualization

Time series can be deterministic or non-deterministic in nature. Deterministic time series always behave in an expected manner where as non-deterministic time series is stochastic or random in nature. As soon as the series is studied, a range of metrics can be calculated to understand its behaviour. These metrics include expected value (mean), variance, covariance, and correlation to name a few.

III. ARIMA MODEL

The most used method for the time-series forecasting is known as ARIMA, which basically appends to for Autoregressive Integrated Moving Average. It is the mixtureof three different models that is, AR, MA and I, where the "AR" reflects the evolving variable of interest is regressed on its own prior values, "MA" infers that the regression error is the linear combination of error terms values happened at various stages of time priory, and "I" shows the data values are replaced by the difference between their values and the previous values. The mixture of all the components of "ARIMA" tries to fit into the data of the model, and also ARIMA depends on the accuracy over a broad width of time series for the forecasting.

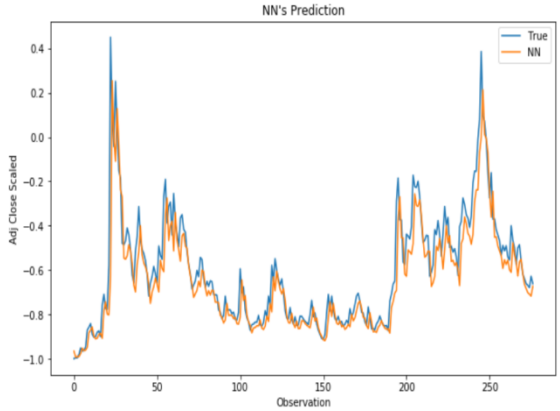


Graph Generated using ARIMA Model

ARIMA, as told before stands for the 'Auto Regressive Integrated Moving Average' which is basically a class of models that is given for a time series based on its own past quantities, that is, its own lags and the lagged values of the forecast errors, so that equation can be used to check future values. The presence of any 'non-seasonal' time series that shows the patterns and is not a random white noise can be used to model with ARIMA models. An ARIMA model is represented by 3 terms: p, d, q where, p is the AR term q is the MA termd is the number of differences required to make the time series stationary. The time series has seasonal changes of pattern, and then you need to add seasonal terms and it becomes SARIMA, short for 'Seasonal ARIMA'.

IV. TIME SERIES FORECASTING USING NEURAL NETWORKS

Artificial neural networks (ANNs) approach has been suggested as an alternative technique to time series forecasting and it gained immense popularity in last few years. The basic objective of ANNs was to construct a model for mimicking the intelligence of human brain into machine. Subsequently to the work of a human brain, the ANNs try to create similar regularities and designs in the input data learn from experience and then provide generalized results based on their known previous knowledge and all the pattern. Although the development of ANNs was mainly biologically motivated, but afterwards they have been applied in many different areas, especially for forecasting and classification purposes. Below we shall mention the salient features of ANNs, which make them quite favourite for time series analysis and forecasting. ANNs are the data-driven and self-adaptive models in nature. The need to specify a model form a particular model or to make any an assumption about the statistical distribution of the data; the given model is adaptively formed based on the features presented from the data. The approach is very useful for many situations which are practical, and where there is no theoretical guidance is provided for an appropriate data generation process. The ANNs are predominantly non-linear, which makes them more practical and appropriate in modeling all the difficult and hard data patterns, as opposed to various defined linear approaches, such as ARIMA methods. The number of instances, which suggest that ANNs are made with quite better analysis and forecasting than various linear models are many.



Basic Prediction Graph Using Neural Networks

V. IMPORTANCE OF PREVIOUS DATA

The time series data is mostly dependent on its previous values. The recent past values are good showcase of a variable's behaviour. The lagged values of the variable such as an exchange rate are regressed over one or more lagged values of the model to predict the current and future values of the variable. There is a lot of missing data which often filled with past data. This can also be statistically calculated from past data such as by taking average. Interrelationships of the connected data and then calculated. The relationships are then formulated into the models which are used to forecast and predict future time points. Sometimes, the weighted sum of present and past values is used to forecast future values.

APPLICATIONS

Time Series Forecasting has a lot of applications in the field of data science, business statistics etc. Some of the examples are as given below:-

- The forecasting of the corn yield in tons by state for each year.
- The forecasting whether an EEG trace in seconds can indicate if a patient is having a seizure or not.
- The forecasting of the closing price of the stock for each day.
- The forecasting of the birth rate at all the hospitals in a city each year.
- Forecasting the product sales in units sold each day in a store.
- Forecasting number of passengers travelling through a train station each day.
- Forecasting unemployment rate in a state for each quarter.
- Forecasting the utilization demand on a server each

hour.

- Forecasting size of the rabbit population in a state for each breeding season.
- Forecasting of the average price of gasoline in a city each day.

VI. CONCLUSION

As we know the time series forecasting is a fast growing area of research and as such provides many scope for future works. The most common of them is the Combining Approach, i.e. to combine a number of different and dissimilar methods to improve forecast accuracy. Works of a lot of people have been done towards this direction and various combining methods have been proposed inliterature. So, it is extremely crucial to understand time series analysis as it is used in nearly all fields; from finance to artificial intelligence to data science. The basics of time series along with an explanation of covariance stationary time series and seasonality have been explained. The ARIMA models can be used to forecast time series as explained. With the aim of further studies in time series modelling and forecasting, I conclude my research.

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