A COMPARITIVE STUDY ON TIME SERIES FORECASTING ALGORITHM ANALYSIS

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ABSTRACT :

Data science is a fast-growing field of study that has a multidimensional scope for all organizations and industries. Data science grows an important research area that incorporates mathematics, statistics, logical reasoning, algorithms, and machine learning programs to predict complex problems. One of the best and hot areas of research in data science is Time Series Forecasting. This research article gives a better understanding of time series algorithms and their analysis. The main observation of the study is to elaborate on the components, advantages, and examples of the data science time series forecasting.

*Key Words***:** Data, Data mining, Machine Learning, Data Science, Open source, Time series, Forecasting

1. INTRODUCTION

Data science is the field of study that deals with vast volumes of data using modern tools and techniques to find unseen patterns, derive meaningful information, and make business decisions. Predictive models can be developed with the help of machine learning algorithms. Data science uses complex machine learning algorithms to build predictive models. Many different business company data formats are used for analysis and to predict the desired results.

Data Science comes across the field of mathematics, statistical techniques, improved analytics, artificial intelligence (AI), and machine learning with specific subject matter expertise to uncover actionable insights hidden in an organization's data. These concepts can be used to manage decision-making and strategic planning[1]. In the upcoming era, data science filed has become good development for research and analytics based models and to generate new algorithms

This article consists of eight sections. The first section elaborates on time series forecasting definition. The second section describes the literature review of different articles. The Third summarizes a few examples of time series analysis. The fourth section gives short notes on the relevant component of forecasting. Followed by the three useful merits of time series. The next section gives a detailed comparison of time series forecasting algorithms. Finally, conclude

the time series forecasting algorithms in a detailed manner.

2. LITERATURE REVIEW

1.   Zhenyu Liu; Zhengtong Zhu; Jing Gao; Cheng Xu [7] describes prediction issues of time series, forecasting methods for classification, and different ways to solve problems in a real scenario like pre-processing, incremental model and parallel computing.

2. AayushJain; Tanay Sukhdeve; Himanshu   Gadia; Satya Prakash Sahu; Satya Verma [[8] .The author collected Covid-19 data set from API and used the ARIMA model forecasting method to predict the result. ARIMA method is used for multivariate analysis.

3.   Pragya Verma; Sai V Reddy; Lata Ragha; Debabrata Datta [9], The author elaborates on the study of algorithms for time series and gives a detailed comparison of algorithms. Three models MAE, MAPE, and RMSE are tested to predict the Air Quality Index.

4.   Ratnadip Adhikari, R. K. Agrawal"[5], The author illustrates the different methods of time series forecasting models ARIMA, SARIMA, and N-BEATS with relevant key concepts.

5. Hafiz Burhan Ul Haq1, Haroon Ur Rashid Kayani2, Saba Khalil Toor3, Sadia Zafar4, Imran Khalid [1] , The

author summarizes the basic concepts of time series, tools and techniques are elaborated.

3. TIME SERIES FORECASTING

This paper will follow a novel method to gain a good knowledge of the research topic. Series of observations to be recorded in the form of time series over a certain period. It is called time series. This type of analysis is very useful for business people and their growth. Scientific prediction and analysis of historical data based on time stamps are called time series forecasting. This forecasting attempt to create building models through past data to predict future strategic decision-making. The main focus of time series forecasting is to analyze statistics and modeling to get good future value over a while**.**

4.   EXAMPLES OF TIME SERIES FORECASTING

There a lot of examples from a range of companies to observe the time series analysis and predict the forecasting more concrete.[4]

Temperature : The First example of time series analysis is Different temperature changes day by day or in a month.

Stock price : The Second example of time series forecasting is to predict the future value of stock price over a particular period time. Especially closing stock price can be forecasted Every day. In a department store, Units sold in a particular product can be measured in each day.

Health care : The Third example of time series is to predict the spread of Covid-19 with the help of key techniques.

Fraud Detection : The fourth example of time series is to find the occurrences of each irregular transaction in a certain bank.

Unemployment : The Fifth example of time series is Forecasting unemployment for a state each quarter.

5. COMPONENTS OF TIME SERIES

The Component plays an important role in time series analysis. Four components are listed and elaborated[4]

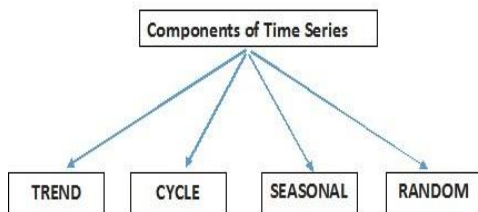**Trends** : Trends components describe how the value increase or decreases in a given period of time. One of the best example is drug sales have substantially increased during this period of time.

Cycle : A Cycle is a long- term pattern that has a waveform. Original Data having no duplicate to be collected in the prescribed format with certain time intervals. For example,In a particular company have reputed component of growth, recession, and recovery.

Seasonality. It is a significant aspect of time series analysis. For Example, ice cream sales to be very higher in the summer months and very lower in the winter months.

Random : One of the best components is random walk-in time series. Prediction of current and previous values are equal with the help of random.

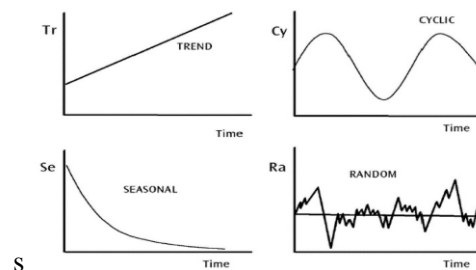

Figure 1 : Components of Time Series

Figure 2 : Time Series Analysis

6. ADVANTAGES OF TIME SERIES FORECASTING

A) Time Series Analysis Helps You Identify Patterns

Users can identify the pattern with the help of chats. Simply plot the data on a line chat based on sales of a product from January to December. Monthly sales and the reports are recorded in the form of tables and chats. The following figure elaborates on the sales report of a particular product using a monthly pattern or year – to - year pattern. The following figure stated the sales price is higher the month of November and December and to be lowest in the month of January and February. In this way, time series analysis helps to identify the pattern with the help of a chart and show the prediction.[5]

Figure 3 : Pattern Identification

B) Time Series Analysis Creates the Opportunity to Clean Your Data

The figure shows the sales analysis for the particular product for each month. But few gaps are noted in the missing values in the time series in a chart. We analyse why missing values and how to get improvement. Missing values are identified and observed.so it would be very easy to *impute* those missing values.
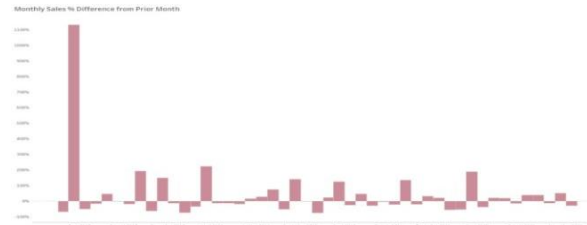

Figure 4 : Cleaning Data

C). Time Series Forecasting Can Predict the Future

In the following figure, the blue line is denoted by the forecasting of sales in a particular year. It exactly gives the increasing sales values in a given set of data and even shows the seasonal dips and spikes that we have come to expect.

Figure 5 : Predict the values

7. COMPARISON OF TIME SERIES FORECASTING ALGORITHMS

In this following table gives a detailed note on time series forecasting algorithms

S.NO	ALGORITHM	OBSERVATION	MODEL	RESULT & EXAMPLE
1	Autoregressive AR)	Predicts future behavior based on past data	statistical model	Values that precede and succeed them. **EX :**To predict a stock's future prices
2	Autoregressive ntegrated Moving Average ARIMA)	With the help of Past data, time series may be used to predict	statistical analysis model	Future value predictions are measured with the help of formulas. Because errors are observed .**EX:** Forecast a company's earnings based on past periods.
3	Seasonal Autoregressive ntegrated Moving Average SARIMA)	additional set of autoregressive and moving average components	direct modeling of the seasonal component of the series	External data in our forecast. **EX:** Electricity load forecasting, gold price, oil price, outdoor temperature, exchange rate.
4	Exponential Smoothing (ES)	One of the best method for a single variable	time-series data analysis.	Old Prediction are loaded with a graphically reducing ratio **EX:** Sales of Books
5	XGBoost	Best on a wide range of challenging machine learning problems.	Regressive Models	walk-forward validation, k-fold cross validation. **EX:** daily female births dataset,
6	Prophet	It is a freely available resources created by facebook	additive model	Automatic forecasting of a single variable time series data, implementation supports seasonality, trends **EX:** Forecasting car sales

7	LSTM (Deep Learning)	order of items in a series are dependent	recurrent neural network	To solve time series forecasting problems.
8	DeepAR	LSTM-based recurrent neural network that is trained on the historical data of *ALL* time series in the data set	probabilistic forecasting model.	better performance than the standard ARIMA and ETS methods. **Ex** e-commerce site that sells a plethora of products
9	N-BEATS	custom Deep Learning algorithm	revolutionary model	Links like successor and predecessor are a single value forecasting
10	Temporal Fusion Transformer Google)	novel attention-based architecture	Tailoring Model	Better execution range forecasting with illustratable ideas into secular evoluation.

8. CONCLUSIONS

Nowadays data science grows as an important research area that incorporates mathematics, statistics, logical reasoning, algorithms, and machine learning programs. This research article summarizes the development of data science and its algorithms. We observe and concentrate on how successful carriers can be developed in the data science field. The main beauty of this field is used to grow all businesses. At the end of this article, we can conclude that there are several techniques, applications and algorithms available for performing Time series analysis- related tasks by data scientists.

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