INDIAN INSTITUTE OF TECHNOLOGY (BHU) VARANASI

Project report

A Project on Technological Intervention in Tourism industry

Under the supervision of Prof. Lakshay

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Introduction

People love to travel and explore other countries worldwide, enjoying the culture of different countries and visiting various places. This sows the seed of the tourism industry.

Success in the tourism industry is enjoyed mainly by the commerce sector and other sectors too, like political, cultural, regional, and environmental sectors.

According to the source (Statista, n.d.)(tourism.gov.in 2019), the travel and tourism sector in India contributed around 6.9 percent to the total GDP of India.

According to the dataset we collected from (Indiastat.com, n.d.), in 1999-90, there were an estimated 0.3 million tourist arrivals in India. It rose to over a 10.8million arrivals in 2019, a 36-fold increase in 30 years. Hence this industry has grown dramatically over the past few years and will continue to grow.

Why are Technological Interventions needed in the Tourism Industry?

Technology and travel are interconnected. The technological advantage helps us in the way we travel, to choose the best holiday place, to what to do once we are at the destination. When we tried to find the data on how many people plan their vacation on Internet, we found from Google travel Analytics that 74% of travellers did so.

Technology is so important in tourism marketing that you can easily say that there would be no modern tourism marketing without it**.**

People enjoy travelling and are very interested in new technology which assists in making travel organized and comfortable. This interest shown by the people has given rise to developments in social media, apps, blogs, and other similar platforms and tools. These tools have introduced automation to remove redundant tasks and as a result aided

the tourism and hospitality sectors and has also reduced human labour and also opened new areas which were previously not possible before. This not only helped to cut labour costs, but it has also helped reduce customer service concerns. Similarly, as the industry got more concerned about this trend, the industry started responding by modifying its business model and product offering to attract this targeted audience and provide better services. Tourists and tourist service providers are the two main players in tourism. The service providers include travel agencies, logistics, and transport services like airlines-railways-road transport and other vehicle leasing services too. This also extends to hospitality industries such as hotels, businesses associated with Airbnb, cruise lines, and restaurants.

The tourist services providers have to care about the tourists as they are increasingly cautious and demanding about which companies they use. The great challenge for providers is attracting tourists, meeting their expectations, and exceeding them. To do so they all turn towards technology. Technology reduces redundant tasks, reduces human labour and overworking, and errors made across the board are also reduced greatly.

Then, because there are so many visitors visiting the country, a massive amount of data is generated, and technology assists in providing marketers with access to this data. As the service providers must make decisions, build strategies, and plan, they can use the data offered by technology to develop effective marketing strategies rather than relying simply on intuition. Such use of technology has helped in catching the attention of tourists and has proven to be one of the most effective strategies for many businesses and service providers. (Hewage et al. 2018)The help provided by these data is soo good that many companies are investing and finding ways to gather much amount of improved data to help them make strategies. (Shabbir and Gardezi 2020) (Bibby et al. 2021)In other words, technologies enable stakeholders/service providers to make the best decisions possible based on available data. .

Consequences of Covid-19 on the Tourism Industry

The outbreak of coronavirus, a fatal and deadly disease, has caused heavy loss of life of people all around the world, causing many health-related problems. And as a result financial and economic sectors also shared heavy losses. Lockdown was imposed on the entire county and every type of travel-trade-commerce was either completely stopped or was working at a minimum rate.

As history suggests whenever there is a pandemic or epidemic or any such kind of viral outbreak, there are drastic drops in the travel and tourism industry. (Behsudi 2021) (Gössling, Scott, and Hall 2020) Viruses and diseases are mostly spread by tourists and travellers as they become vectors for the disease. (cdc.gov 2020) (Wilder, n.d.) The fear of getting infected negatively impacts a traveller's behavior and mental health and increases the chances of cancellation of tours and trips. (Zenker and Kock 2020, #)

In India, it had a major impact on all the major sectors namely economic, finance, health, education, government sectors, and other numerous small sectors. The epidemics also had a great impact on agriculture, transportation, food production, and manufacturing. Also, such a reduction in economic activities caused an increase in the prices of food items, transportation, and service, which also contributed to a loss in travel and tourism. (Indiastat.com, n.d.)(Wilder, n.d.) (Gössling, Scott, and Hall 2020) (Jena 2020) (Mittal and Sharma 2021)

From 2002-to 2003, the Severe Acute Respiratory Syndrome (SARS) virus came as a pandemic and resulted in diminished international travel in affected areas. It also created international anxiety because of the virus' novel nature. (Wilder, n.d.) (Dombey 2004)

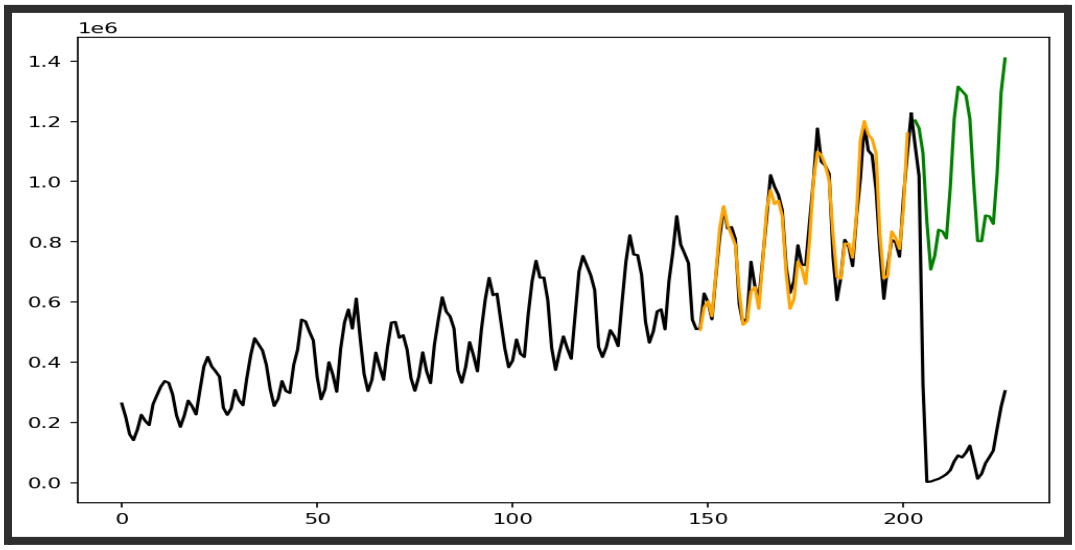
Camel flu caused by The Middle East Respiratory Syndrome (MERS) virus came in

2012 and caused heavy economic and heath damage in many countries. (Joo et al. 2019) The recovery of the tourism sector from such pandemics is also slowed as travel restrictions are imposed to contain the pandemic, funding from the government is decreased and major focus is given to revitalizing the damaged economic and health sector. (Joo et al. 2019, #)

After the COVID-19 outbreak, all the work had to be done at home. This has caused a loss of many jobs which can not be done from home, like production, goods, transportation, manufacturing, and various other works. This resulted in a reduction in purchasing power of the majority of people causing a loss of candidature for tourism. (J.Vázquez-Martínez, -Mediano, and Rodríguez, n.d.)

Communication and transportation works have also been greatly affected due to the coronavirus pandemic. Due to the epidemic, we have found a large downfall in sales and revenues of the airline companies because of the cancellation of flights and it can even reduce to 20 - 80% of flights. In February 2021, covid cases were increasing worldwide and therefore precautions were taken by all the countries to prevent the spread of coronavirus in the second wave. The revenue of passenger kilometers, which are down 74.7 percent in February 2021 compared to February 2019. (a pre-crisis period). Many limitations on public transportation and cross-border movement were established in an attempt to contain the spread of the coronavirus, which impacted the whole transportation and tourism business, including the cruise industry. The industry that was adversely and severely affected due to the coronavirus pandemic was the restaurant and hotel industry. Since the tourists' destinations were greatly affected by the coronavirus, many people cancelled their tickets causing huge losses to the resorts and hotels. Consequently, the hotel rooms remained empty, and almost nil customers in the resorts. This shows how adversely the hotels, restaurants, and resort industry have been affected either causing a low wage to the workers of the restaurants and hotels or they have lost their jobs.

According to Economic Times, in India, (*The Economic Times* 2022) (tourism.gov.in 2019) 21.5 million people in the Indian tourism sector lost their jobs due to COVID-19. According to the source (Jus 2021) (Keelery 2022) (Ministry Of Tourism Government of India 2020) Indian travel and tourism contribution to GDP was 6.9% in 2019 and by 2020, that figure shrunk to 4.7%. In 2019, travel and tourism contribution to world GDP was 10.4%, but by 2020, it was reduced to 5.5 percent a 53% decrease. (WorldTravel and Tourism Council 2020) Domestic tourist expenditure was also reduced to 45 percent, while overseas visitor spending by 69.4%. (Ministry Of Tourism Government of India 2020)



(In the above graph, green represents predicted tourist arrival values, while **black** represents tourist arrival.)

The LSTM model we made predicted 23 million foreign visitors, but the actual figure was 4 million. On Monthly basis, there was an average loss of about 8 lakhs in the years 2020-21.

Recovery of Tourism Industry

COVID-19 has shut down/severely compromised all the industries and especially the tourism industry. The world has not seen anything like this in its entire history and all big- small sectors are struggling to survive and make it through the pandemic. And consequently, the pandemic has impacted tourism demand and tourism supply.

Various steps have been taken worldwide to recover and control the prevalent pandemic. Steps like social segregation, crowd avoidance, and imposition of domestic and foreign travel restrictions have been taken and quarantine measures were implemented. However, such restrictions have had an impact on the amount of travel, tourism, and hospitality.

Hence the elimination of such limitations will be required for the tourism sector to revive. Government must put forward some initiatives to look into the crisis and help in building the industry too; some financial help can be given to small-scale local workers working in this industry. It will be optimal to develop and promote tourism in locations where social distancing can be maintained to revive the sector as soon as possible.

Though the government will seek to improve the broader economy, the tourism industry should also be given special attention and efforts should be made to uplift the industry. Tourism businesses may be eligible for financial incentives or subsidies from the government. Loans, tax breaks or guarantee schemes, low-interest loans, and temporary VAT reductions, among other things can also be provided by the state.

Technology is one of the most important aspects in the recovery of the tourism industry after the pandemic. In the tourism sector, robotics, automation, artificial intelligence and other similar advanced technologies can be used for improved performance and reduced costs in businesses. In hotels and restaurants, technology linked with mobile can be used it will also make it easier to maintain social distancing and provide contactless service. Technologies, softwares, applications, and other similar systems can be used for gathering information about the spread of the disease.

Machine Learning and the tourism industry

Tourism forecasting requires the identification of tourism demand determinants. These are divided into two categories; economic and non-economic influences. Both quantitative and qualitative elements influence tourism demand. Several financial features are related to tourism demand, like population, income, cost of living, transportation expenses, and the volume of trade between destination and origin countries. Tourist mood, policy uncertainty, quality of natural resources, and weather-related issues are non-economic factors.

India has always been a popular tourist destination for years. India's immense tourism growth potential needs accurate tourism demand forecasting methods. Many applications of AI and deep learning have been used in this industry for a very long time and Forecasting is one of them. Machine learning, deep learning, and other AI algorithms are applied over a dataset and are used in Forecasting. There are many forecasting models currently used, such as ARIMA, XGBoost, LSTM, SVR, and other machine learning methodologies. The combination of autoregression and moving averages is defined as ARIMA. Before going to any suitable techniques to implement, one must ensure some patterns in the data like trends and seasonality. Travelling is made easier by modern technology. You can use smartphone apps to book flights and hotels, fine restaurants and entertainment, and pay for everything online.

All activities result in the generation of a lot of data which is very helpful in determining information about tourist arrivals. Many Industries use Big Data solutions and use it to improve their services and make things easier for customers and more manageable for them. Aside from simply analyzing this data to identify consumer patterns, machine learning, and AI are used to forecast future events, which aids in the resolution of problems before they occur. Data has become the world's most valuable

asset and a crucial driver of progress. Machine learning's impact on tourism is largely aimed toward client pleasure and engagement.

How Forecasting Can Help Tourism Industry

"Forecasting" refers to predicting the future. It is critical in the planning process to be able to forecast future developments. Because a strategy is devised based on specific assumptions. These assumptions are made based on predictions. Accurate forecasting is critical when designing a marketing plan, especially in marketing. Customers' behaviour or specific moves planned by competitors may be predicted by the prediction. One must also consider government policies or general socioeconomic, legal, or environmental issues that contribute to unusual tendencies. For example, the number of individuals travelling to specific destinations will vary depending on the season.

We can forecast using statistics, but the key advantage of employing machine learning is that it does not make any assumptions about the data, such as linearity, normal distribution, and non-collinearity.

Methodology

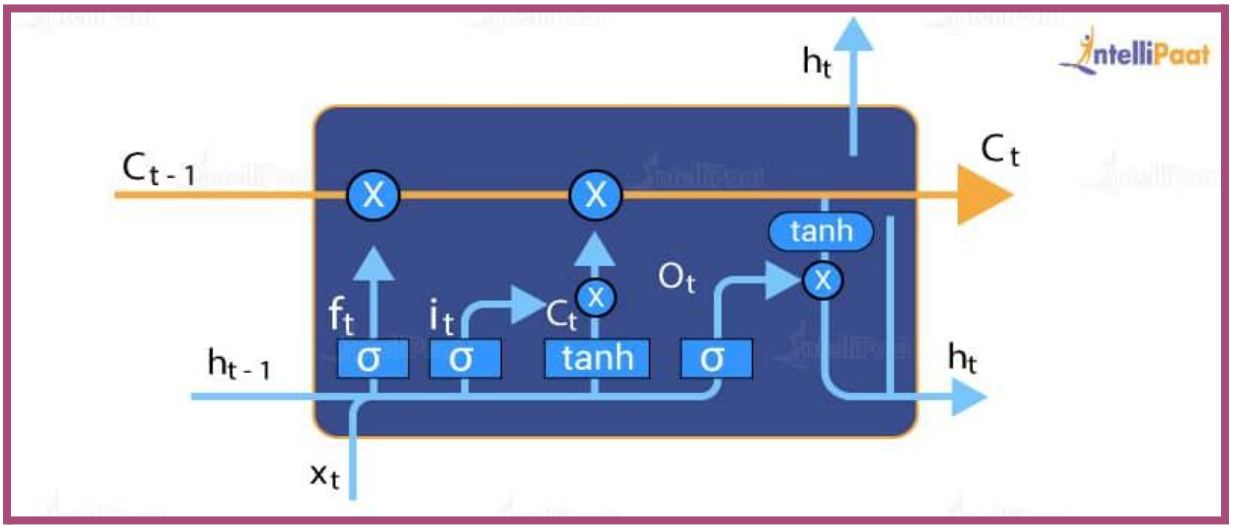
We forecasted tourist arrivals in India using a dataset of monthly foreign tourist arrivals from (Statista.com 2022).

Description of the dataset: We utilized data from 2002 to 2018 to assess and forecast monthly tourist arrivals in India.

Models:

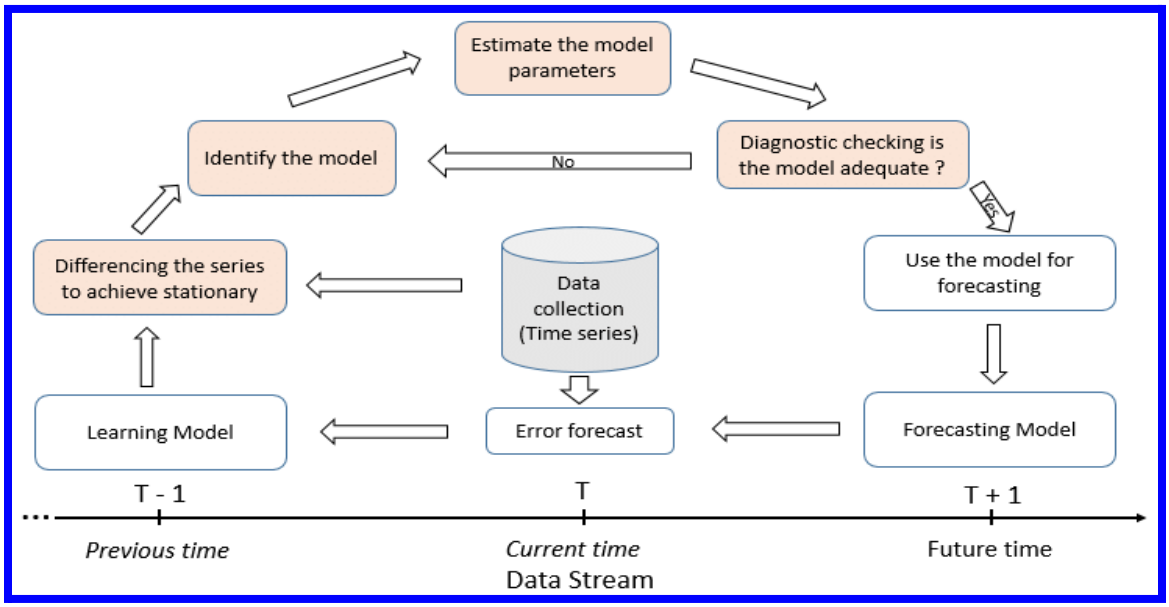
We have used 3 models: **LSTM** (Long-Short Term Memory), **ARIMA,** and **XGBoost**.

1. **LSTM**: The LSTM is a sort of RNN (recursive network) that stores data. The vanishing gradient problem can be solved with the LSTM algorithm. (Hochreiter and Schmidhuber 1997) Persistent memory is achieved via a recurrent neural network, also known as an RNN. A memory cell known as a 'cell state,' which maintains its state throughout time, is at the heart of an LSTM model. An LSTM, which is controlled by gates, can add or delete information from the cell state. If necessary, these gates allow data to flow into and out of the cell. A sigmoid neural network layer and a pointwise multiplication operation help the method. (admin 2019) (Hochreiter and Schmidhuber 1997) (Wikipedia, n.d.)



(Fig shows the basic architecture of the LSTM model)

2. **ARIMA**: ARIMA model forecasts the given time series based on its historical values. It can be used for any non-seasonal time series. (Wikipedia 2022)One of the main features of this model is that it collects data over a succession of continuous regular intervals. A custom version of this model can be built to get predictions over the number of seasons. The model must be given data from numerous seasons, with seasonal changes taken into consideration. This is accomplished using SARIMA. For example, rather than measuring the actual values, the model used to estimate stock prices represents the differences between the values in a series. (Wikipedia 2022)(Master's in Data Science, 2020)



(Fig shows the basic architecture of the ARIMA model)

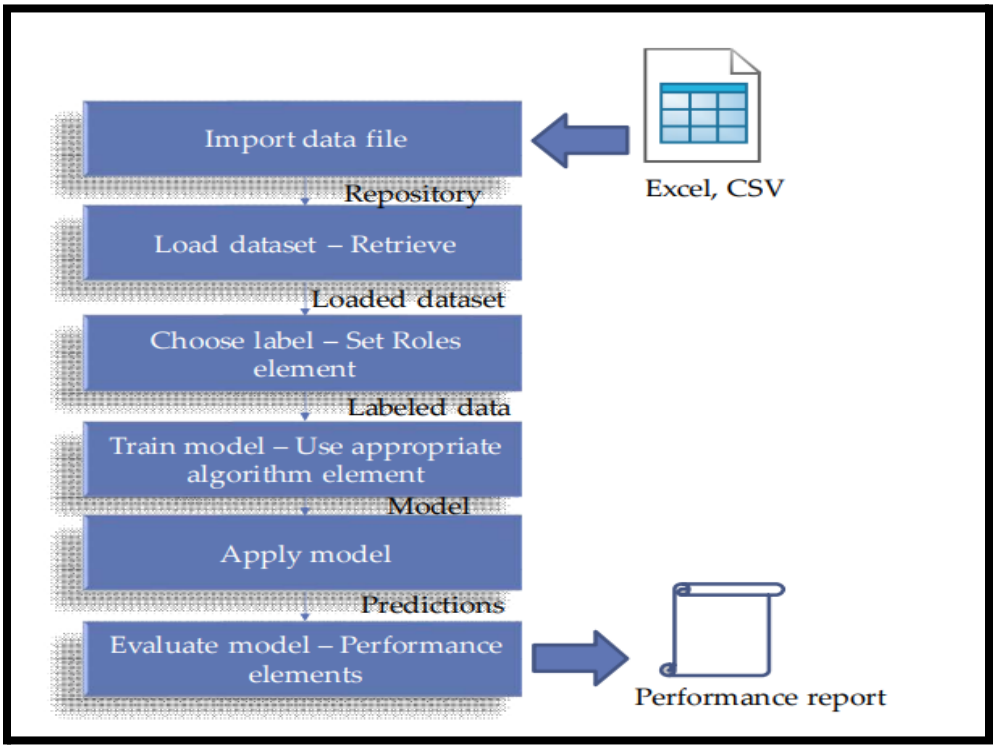
3. **XGBoost:** XGBoost is a package for regularizing gradient boosting. Extreme gradient boosting is termed XGBoost.(readthedocs.io 2021) The primary purpose is to speed up and improve the gradient boosting decision trees by distributing them. We can train models fastly using this library. Generally, whenever time series analysis is required, ARIMA models are usually used, which are mainly based on regression analysis. If we perform regression using XGBoost, we can

expect better results in less time than the ARIMA model. (Verma 2022) (Tseng 2018) (readthedocs.io 2021)

When we optimize the model using SGD (scikit-learn.org, n.d.), then the model's architecture remains fixed. The only thing we can optimize is the parameters P rather than this gradient boosting. (Tseng 2018) It doesn't assume this static architecture will find the best function that best approximates the data. In this way, gradient boosting helps models train faster and more accurately.

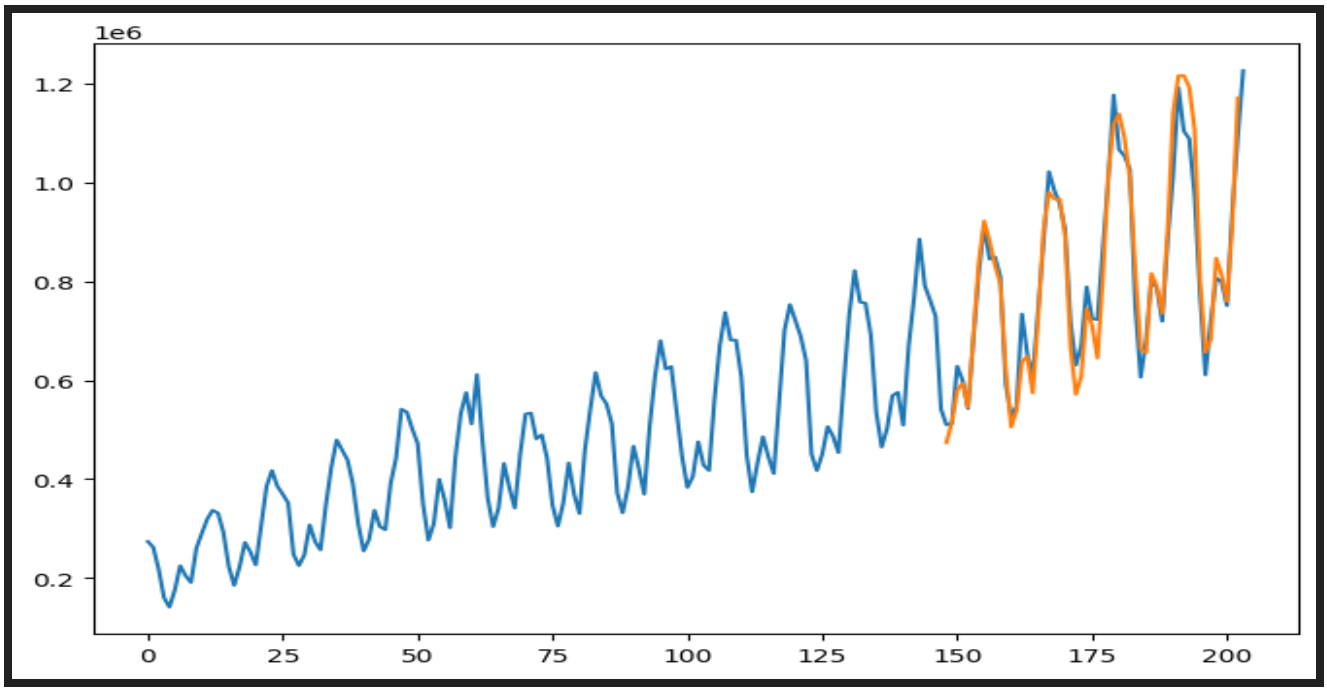
ARIMA	**LSTM**
ARIMA is a linear regression model that uses its lags as predictors as it is a linear regression model. These work well when the predictors are not correlated and are independent of each other. AR model is dependent on its lags, and MA models are dependent only on the lagged forecast errors. (Prabhakaran 2020) Eqn : Output = constant + Linear combination Lags of Y (up to p lags) + Linear combination of Lagged forecast error(up to q lags).	There is a succession of dependence among the input variables in time-series datasets. Recurrent Neural Networks are extremely effective at dealing with input variable dependencies. The Long Short-Term Memory (LSTM) is a type of Recurrent Neural Network (RNN) capable of storing and learning from a large number of observations. (tensorflow.org/ 2022)

Workflow:



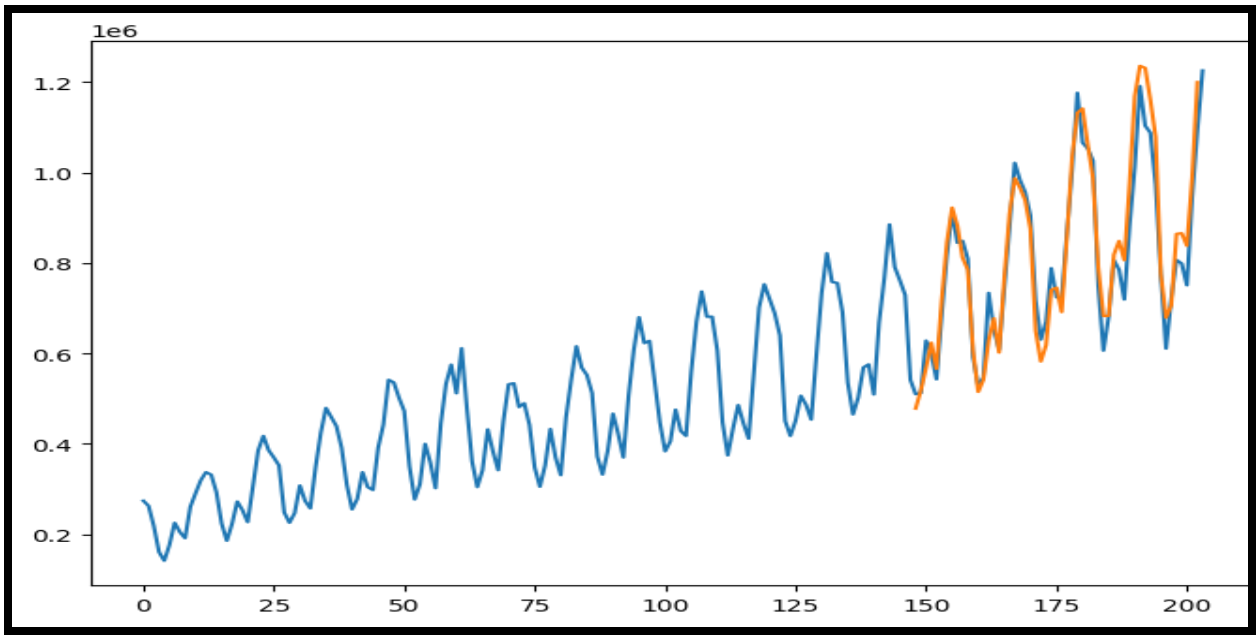
Model Performance On Dataset

1. **LSTM**: With a wide range of input variables, LSTM excels at modelling problems. This is particularly useful in time series forecasting, where traditional linear algorithms can be difficult to adapt to multivariate or multiple input situations. A stacked LSTM architecture is an LSTM model that consists of many LSTM layers. The top LSTM layer communicates a sequence rather than a single value to the bottom LSTM layer. Stacked LSTM is a viable strategy for handling difficult sequence prediction issues while also improving model accuracy. The LSTM model was trained, and the RMSE was about 42,000-46,000. The source code can be found here.



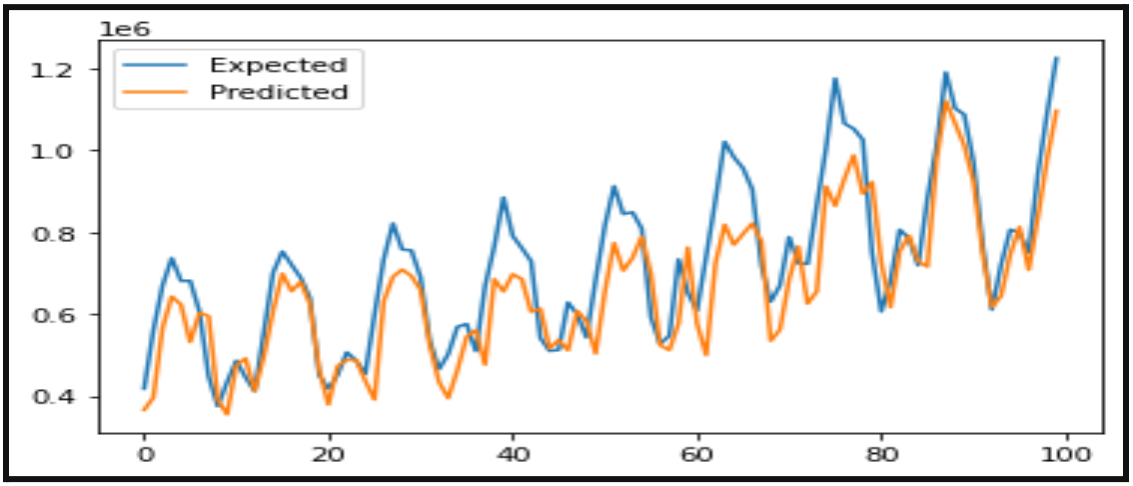
(Fig, shows the results obtained using the LSTM model, here blue line indicated the actual values and the orange line shows the predicted values over the test dataset)

2. **ARIMA**: We used the same dataset and p as 3, d as 1, q as 0, and achieved an RMSE of about 62 thousand. **This** is the source code. The ARIMA approach has three main processes: diagnostic control, identification, and estimation. The first stage, called diagnostic control, entails applying stationarity control to a set of time-series data. A stationary time series possesses time-dependent statistical features including mean, variance, and covariance. Stationarity is required while building the ARIMA model, as it allows for valuable and realistic estimations. If a time series is not stationary, the requisite degree of difference (d) is applied to make it stationary, and the stationarity is then evaluated again. This process is repeated until a consistent series emerges. A positive integer determines the degree of difference (d). If the difference is computed (d) times, the ARIMA model's integration parameter is set to (d). The stationary data is then used to carry out the identification process. The parameters (p) and (q) of autoregressive (AR) and moving average (MA) transactions are calculated using this technique.



(Fig, shows the results obtained using the ARIMA model, here blue line indicated the actual values and the orange line shows the predicted values over the test dataset)

3. **XGBoost**: We used the same dataset, applied XGBoost, and achieved RMSE of about1 lakh. **This** is the source code.



(Fig, shows the results obtained using the XGBoost model, here blue line indicated the actual values and the orange line shows the predicted values over the test dataset)

Sr No.	Name Of the Model	RMSE (Root mean squared error) (In Thousand)
1	LSTM (Long Short Term Memory)	42-46
2	ARIMA (Auto-Regressive Integrated Moving averages)	62
3	XGBoost	100

Hence **LSTM model outperforms the ARIMA, XGBoost model**, possible reasons for that may be the following:

- First of all, the data is non-stationary and has been tested using an Augmented Dickey-Fuller Test.

```
adfuller_test(df['values'])
```

```
ADF Test Statistic : 0.47340825047942153
p-value : 0.9840420538524736
#Lags Used : 14
Number of Observations Used : 189
weak evidence against null hypothesis, time series has a unit root, indicating it is non-stationary
```

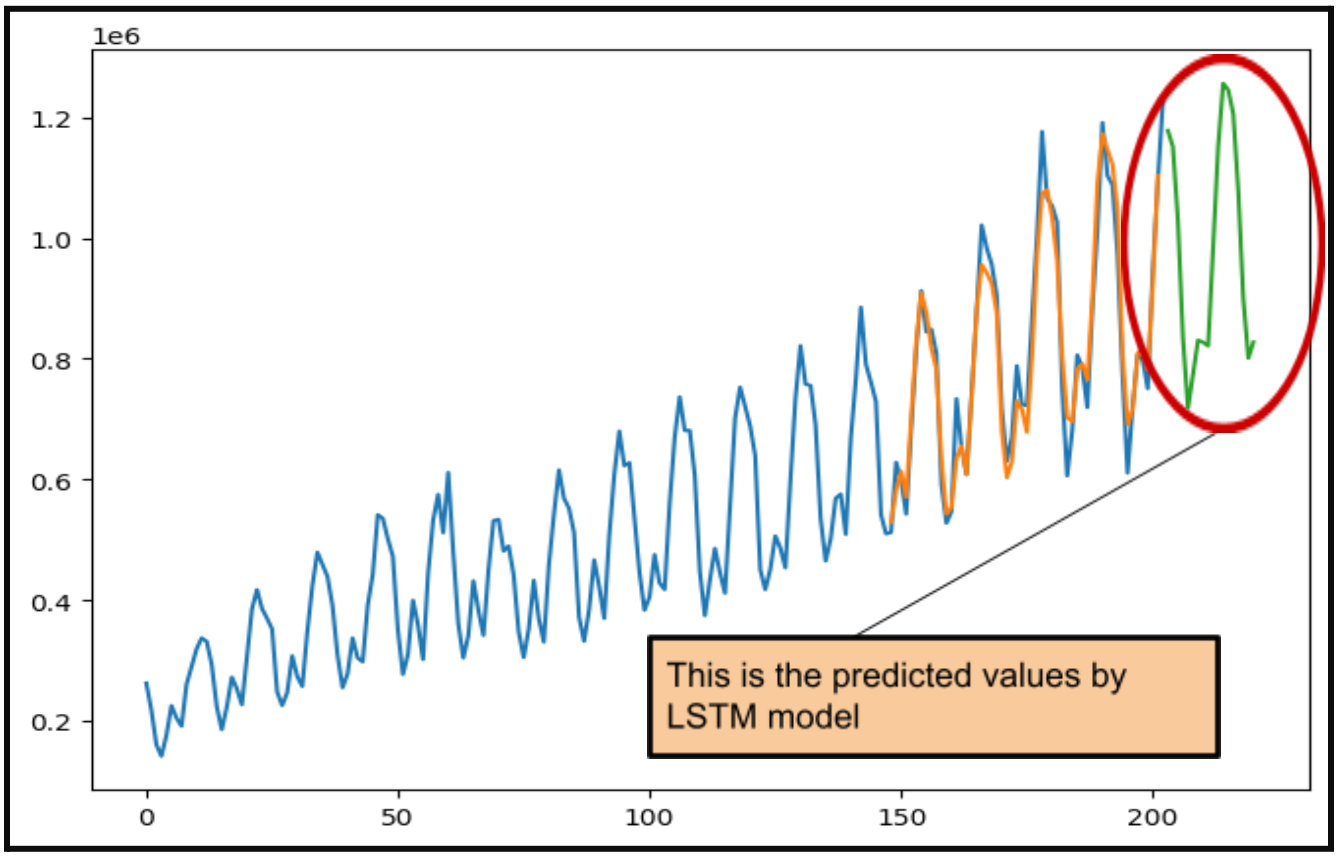
So, we cannot use ARIMA; instead, we will be using the SARIMA model, which will be capable of capturing the seasonality component of the dataset for the forecasting of the same by making the dataset stationary.

```
adfuller_test(df['fake_val'].dropna())
```

```
ADF Test Statistic : -3.2923456807045324
p-value : 0.015224109045492817
#Lags Used : 14
Number of Observations Used : 177
strong evidence against the null hypothesis(Ho), reject the null hypothesis. Data has no unit root and is stationary
```

- ARIMA models are linear, while LSTM models are non-linear and hence have more capability to capture seasonality.
- In comparison to ARIMA, LSTM is designed to store prior information, making it more efficient. It has three gates: input gate, output gate, and forget gate. The forget gate is particularly important since it aids neurons in determining what to exclude from the most recent data stored in memory.

Prediction Of Tourist Arrival Using LSTM model :



(Source; The green portion of the graph indicates the forecasting of tourist arrivals for the next 24 months, the blue portion reflects the number of monthly tourist arrivals from 2002 to 2016, and the orange portion is the prediction based on the test dataset on which we trained our model.)

Summary:

It is required for the quantitative analysis of the tourism industry to consider the modern Machine Learning algorithms to solve the tourism industry problems efficiently. It is vital to analyze the aftereffects of covid on the tourism industry and roughly estimate the tenure required for the industry to rebuild again. We can use machine learning techniques to solve such kinds of problems. One of the significant problems of the Tourism industry, i.e., tourist demand forecasting, can be solved using machine learning algorithms using some machine learning models, LSTM, ARIMA, and XGBoost has been implemented, and found that LSTM outperforms the rest two models, and achieved the least RMSE because of its internal structure LSTM is supposed to perform well for this function. Using the same LSTM model, we can easily forecast the tourism demand for the next 24 months using the monthly tourist arrivals from 2002 to 2018.

Future works:

- *Above models can be improved further to improve accuracy.*
- *Comparison/analysis/prediction with more models is possible.*
- *As we all are very much aware of the covid 19 outbreak which had a negative impact on the tourism industry it can be possible to use the google search queries for the accumulation of more data for the prediction of the recovery of the tourism industry due to covid 19. We can use the LSTM model for the prediction of the time tenure for the industry to be on the track. Mathematics behind the approach, we can use other models but it will be better to use an autoregressive exogenous model.*

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