Time Series Forecasting – Shoe Sales Prediction

Rehan Roy, Amit Pathak ,
Shubhradip Ghosh , Kalash Daf

28/03/2023

Abstract- Predicting sales in a shoe industry is a typical job due to unpredictable demand for products. Many models are suggested for forecasting the product in the literature over the past few decades. Most shoe manufacturing organizations are in a continuous effort for increasing their profits and reducing their costs. Exact sales forecasting is certainly an inexpensive way to meet the organization goals.

1.0 Problem Statement-

The difficulty of correctly estimating shoe demand in order to manage inventories and boost sales. While avoiding overstocking, which may result in excess inventory and lower profit margins, retailers must make sure they have the proper number of shoes available to match client demand.Predicting customer demand for various shoe kinds, which might change based on elements including seasonality, fashion trends, and consumer preferences, is difficult. As a result, there may be stockouts of popular shoe types or an overabundance of less well-liked shoe styles on the marketplace.Retailers could improve their inventory management after precise sales prediction models have been created, ensuring that they have the appropriate quantity of shoes on hand to fulfill client demand while reducing the danger of stockouts or surplus inventory. As a result, the company may see an uptick in sales, more customer satisfaction, and larger profit margins.

2.0 Business Needs Assessment-

Given the unfortunate pandemic that has caused many people to buy goods online rather than in stores, there has been a significant decline for retail stores and vendors. So, it is vital for them to manage their inventory appropriately and maximize their selling strategies by investing in more in-demand items and offering promotions on products that are typically grouped together in order to increase their earnings to avoid such things in the future.
Also, the pandemic has significantly changed the tastes of the consumer. With the use of this method, we intend to give small enterprises useful data insights and income-generating possibilities.

3.0 Target Specification-

Here are some target specifications for the footwear market in India:

1. Demographics: All age groups, genders, and economic levels are represented in the target population for the Indian footwear industry. The youth demographic, which includes college students and young professionals, is the greatest consumer category, nonetheless.
2. Style and design: Indian shoppers are seeking fashionable, comfortable shoes that complement their personal style and way of life. The market is flooded with popular designs, hues, and patterns that draw inspiration from conventional Indian culture.
3. Comfort and quality: Indian consumers are increasingly searching for supportive, comfy footwear. Consumers think carefully about quality and durability when choosing footwear.

4. Price range: The Indian footwear industry has both high-end and entry-level products. Although customers are ready to pay more for luxury brands, there is still a sizable market for reasonably priced footwear that offers good value.
5. Distribution channels: While offline retail establishments still hold the lion's share of the Indian footwear market, online retail platforms are quickly gaining ground. In India, footwear businesses are rapidly using e-commerce websites, social media networks, and mobile applications as distribution methods.

4.0 External Search-

I took help from few websites for for analyzing the need of this system and also to find how this system is used across the globe currently.Few of the websites are mentioned below:

1. Shoe Sales Prediction
2. Advantages of sales prediction
3. India Footwear Market

5.0 Benchmarking -

Several online retailers, like Adidas, Nike, and Fila, employ similar strategies to boost sales while also giving customers a pleasant shopping experience. Benchmarking often entails comparing project procedures and performance indicators to either successful recently completed projects or industry best standards and practices. For this, it is necessary to continually look for ways to incorporate better methods that provide better outcomes.

6.0 Applicable Patents-

1. Indian Patent No. 301150 - Method for generating customer profiles and providing personalized recommendations for online shopping.
2. Indian Patent No. 343764 - System and method for predicting product demand and optimizing inventory management.
3. Indian Patent No. 342021 - System and method for predicting customer behavior and providing targeted marketing recommendations.
4. Indian Patent No. 335441 - System and method for predicting sales trends and optimizing pricing strategies.
5. Indian Patent No. 345236 - System and method for analyzing customer feedback and improving product recommendations.

7.0 Applicable Regulations-

Here are few regulations related to the sales forecasting model:

1. Data collection and Privacy of Regulations of Customers.
2. Employment Schemes and laws created by government
3. Quality Control Orders (QCO) for leather and non-leather footwear

4. Data privacy laws: The use of customer data to develop a sales forecasting model must comply with data privacy laws and regulations, such as the Personal Data Protection Bill (PDPB) and the General Data Protection Regulation (GDPR) in the European Union.
5. Intellectual property laws: The sales forecasting model may incorporate proprietary
6. Intellectual property laws: The sales forecasting model may incorporate proprietary algorithms, software, or other intellectual property that is subject to copyright or patent laws. The use of such intellectual property must comply with relevant laws and regulations, and may require licensing agreements or other legal arrangements.
7. Antitrust laws: The use of a sales forecasting model must comply with antitrust laws and regulations that prohibit anti-competitive practices, such as price-fixing or market allocation agreements.
8. Consumer protection laws: The use of a sales forecasting model must comply with consumer protection laws and regulations that prohibit false or misleading advertising or other deceptive practices.
9. Factory License is a must-have requirement for production-based entities running a footwear business under The Factory Act, 1948

8.0 Applicable Constraints-

There are few challenges which needs to be faced before developing the actual solution, few of them are as below:

1. Lack of initial data to perform algorithms.
2. Convincing all vendors to use this technique of selling over traditional means.
3. Lack of technical knowledge of vendors.

9.0 Concept Generation and Development-

Following are some steps:-

1. Understand the problem: The first step is to understand the problem and what data you have available. What type of shoes are being sold? How often are they sold? What factors affect sales, such as seasonality or promotions? What data do you have available to work with?
2. Identify variables: Once you understand the problem and data available, identify the variables that affect shoe sales. These may include time, seasonality, promotions, price, and inventory levels.
3. Gather data: Collect historical sales data for the shoes in question, as well as any other relevant data, such as promotions or changes in pricing. You may also need to gather external data such as weather or economic indicators if they have a significant impact on shoe sales.
4. Clean and prepare data: The data you collect may be incomplete or contain errors. Clean and prepare the data so it can be used for analysis. This may include removing outliers, imputing missing data, and normalizing the data.

5. Choose a forecasting model: There are several types of forecasting models that can be used for time series data, including ARIMA, SARIMA, Prophet, and LSTM. Choose a model that is appropriate for your data and problem.
6. Train the model: Once you have chosen a model, train it using historical data. This will enable the model to learn the patterns and relationships in the data.
7. Evaluate the model: After training the model, evaluate its performance using metrics such as mean squared error or mean absolute error. If the model is not performing well, adjust the parameters or try a different model.
8. Make predictions: Once the model is trained and validated, use it to make predictions for future shoe sales. These predictions can be used for inventory planning, pricing decisions, and marketing campaigns.
9. Monitor performance: As new data becomes available, continue to monitor the model's performance and update it as needed to ensure it remains accurate.

In [1]:
```
import numpy as np
import pandas as pd
import seaborn as sns
from matplotlib import pyplot as plt
```

In [2]:
```
df = pd.read_csv(r"C:\Users\imreh\Desktop\Feynn Internship\Shoe-Sales.csv")
```

In [3]:
```
df.head()
```

Out[3]:

	YearMonth	Shoe_Sales
0	1980-01	85
1	1980-02	89
2	1980-03	109
3	1980-04	95
4	1980-05	91

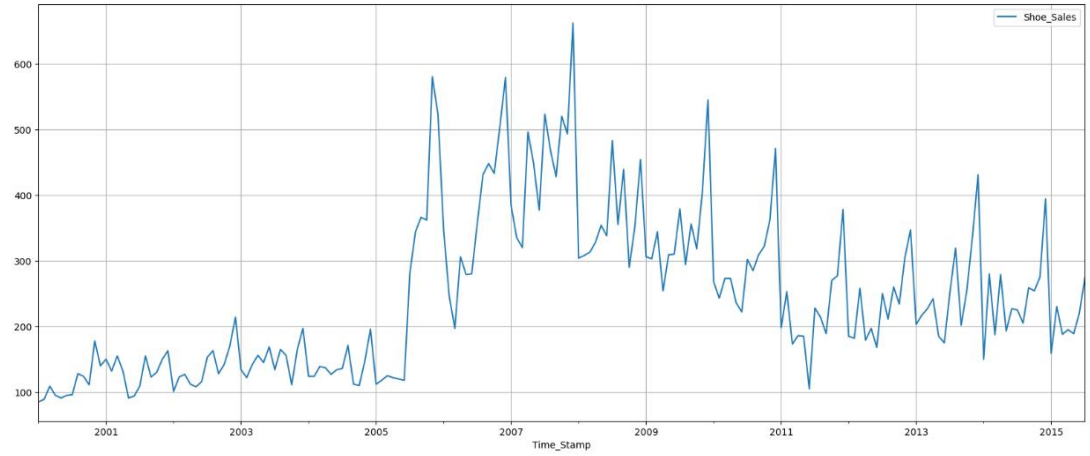
In [4]:
```
date = pd.date_range(start='1/1/2000', end='8/1/2015', freq='M')
date
```

Out[4]:
```
DatetimeIndex(['2000-01-31', '2000-02-29', '2000-03-31', '2000-04-30',
               '2000-05-31', '2000-06-30', '2000-07-31', '2000-08-31',
               '2000-09-30', '2000-10-31',
               ...
               '2014-10-31', '2014-11-30', '2014-12-31', '2015-01-31',
               '2015-02-28', '2015-03-31', '2015-04-30', '2015-05-31',
               '2015-06-30', '2015-07-31'],
              dtype='datetime64[ns]', length=187, freq='M')
```

In [8]:
```
# The following code is to set the subsequent figure sizes

from pylab import rcParams
rcParams['figure.figsize'] = 20,8
```

In [9]:
```
df.plot()
plt.grid();
```

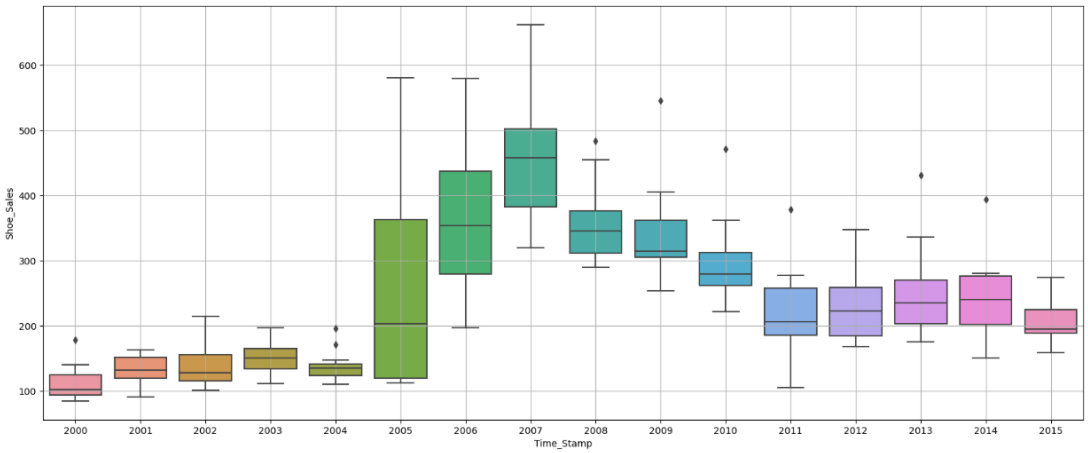


In [10]:
```
df.describe()
```

Out[10]:

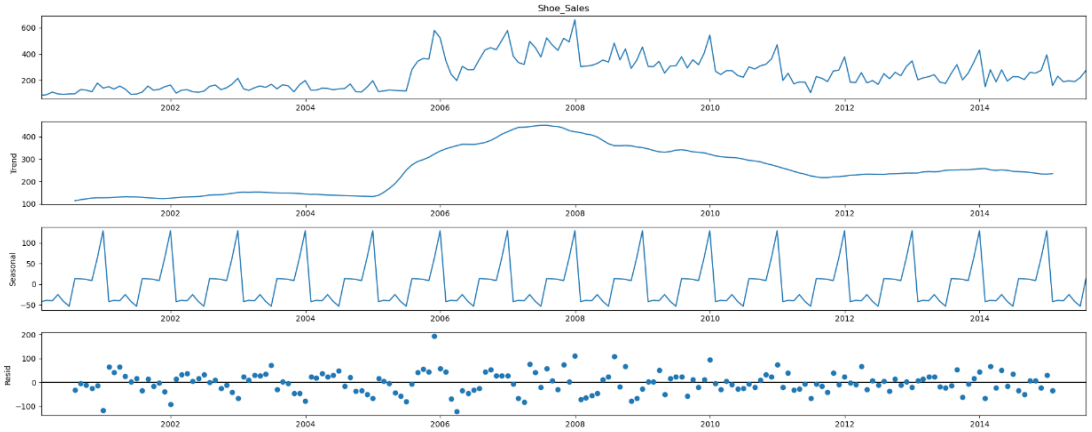
	Shoe_Sales
count	187.000000
mean	245.636364
std	121.390804
min	85.000000
25%	143.500000
50%	220.000000
75%	315.500000
max	662.000000

In [11]:
```
sns.boxplot(x = df.index.year,y = df['Shoe_Sales'])
plt.grid();
```

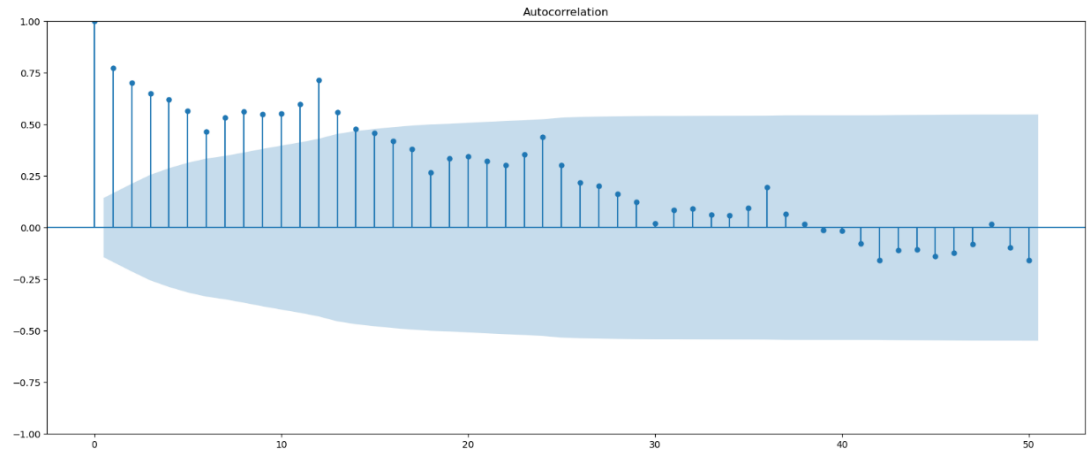


In [20]:
```
from statsmodels.tsa.seasonal import seasonal_decompose
import statsmodels.api as sm
from statsmodels.tsa.stattools import kpss
```

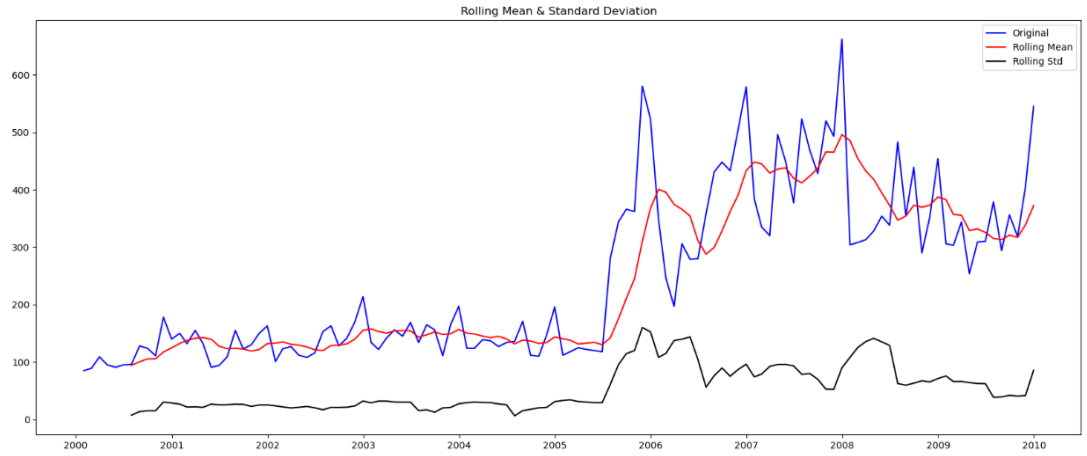
In [21]:
```
decomposition = seasonal_decompose(df['Shoe_Sales'],model='additive')
decomposition.plot();
```



In [31]:
```
from statsmodels.graphics.tsaplots import plot_acf, plot_pacf
plot_acf(df['Shoe_Sales'],lags=50)
plot_acf(df['Shoe_Sales'].diff().dropna(),lags=50,title='Differenced Data Autocorrelation')
plt.show()
```



```
In [36]: test_stationarity(train['Shoe_Sales'])
```




```
Results of Dickey-Fuller Test:
Test Statistic                  -1.004094
p-value                          0.751768
#Lags Used                      13.000000
Number of Observations Used    106.000000
Critical Value (1%)             -3.493602
Critical Value (5%)             -2.889217
Critical Value (10%)            -2.581533
dtype: float64
```

10.0 Final Product Prototype-

Rehan Roy:

https://github.com/Rehan20/Feynn-Labs-Internship/tree/main/Project%203

Shrubradip Ghosh::

https://github.com/shubradip/customer-segmentation-/blob/main/Time%20Series%20Forecasting%20Prediction%20for%20Shoe-Sales.py

Amit Pathak:

https://github.com/sap1996/final-project

A. Feasibility-

Within a few months, this project can be developed and made available to the public as SaaS.

B. Viability-

There will always be small firms that may utilise this service to improve their sales and data warehousing skills as the shoe industry expands in India and throughout the world. So, it will be possible to live in the long run, although advancements will be required when new technologies are developed.

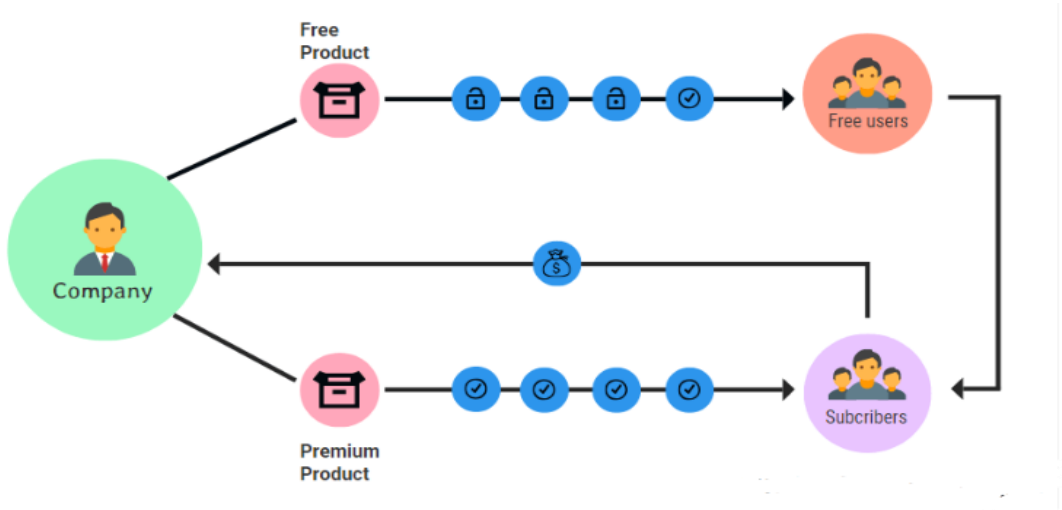
C. Monetization-

This service can be immediately published as a service that businesses may utilise, making it directly monetizable.

11.0 Business Model-

It is ideal to use a Subscription-based business model for this service, wherein certain initial services will be provided free of charge to help customers stick around and expand the customer base. According to the user demands and user kinds, they will subsequently be charged a membership fee in order to keep using the service for their business, which will also help increase user conversion rates by offering customisation options appropriate for each group.

1. Basic Plan: Access to fundamental features including tools for inventory management and demand forecasting as well as historical sales data analysis may be included in this plan. It could have a cheap monthly cost, making it appropriate for small enterprises.
2. Pro Plan: This plan may come with more sophisticated capabilities including real-time sales data analysis, tailored customer suggestions, and targeted marketing tools. It can have a greater monthly cost, making it appropriate for bigger companies or those seeking more sophisticated services.
3. Enterprise Plan: Designed for large companies with specific requirements, this plan may be altered to add features like specialised support, API access, and bespoke machine learning models. Based on the particular needs of the business, the price for this plan may be adjusted.



12.0 Conclusion-

In this study, a variety of forecasting techniques are utilised to estimate how much of the product will be sold in the future. The prediction error will be used to choose the forecasting technique. The more precise the forecasting process, the lower the forecast error. This study's particular goal was to determine the most accurate quantitative forecasting technique for the shoe industry based on practical usability and accuracy.
This study found that because of factors like weather and particular festivals, many real-life forecasting situations were more complicated and challenging. For production, facility

monitoring, seasonal employment, short-term and long-term planning, these predictions can offer useful information.