TIME SERIES ANALYSIS FOR CAR SALES FORECASTING USING PROPHET

A UG PROJECT PHASE-1 REPORT

Submitted to

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

In partial fulfillment of the requirements for the award of the degree of

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IN

COMPUTER SCIENCE AND ENGINEERING

Submitted by

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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CERTIFICATE OF COMPLETION
UG PROJECT PHASE-1

This is to certify that the UG Project Phase-1 Report entitled **"TIME SERIES ANALYSIS FOR CAR SALES FORECASTING USING PROPHET"** is being submitted by **K. SRIDIVYA (H.NO:20UK5A0512),MD. HANIF (H.NO:20UK5A0516), J. SAIKUMAR(H.NO:19UK1A05P4), K. UMAMAHESHWAR (H.NO:18UK1A05B5)** in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Computer Science and Engineering to Jawaharlal Nehru Technological University Hyderabad during the academic year 2022-23, is a record of work carried out by them under the guidance and supervision.

Mr. N.RAVI — Project Guide

Dr. R. NAVEEN KUMAR — Head of the Department

EXTERNAL

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ABSTRACT

Forecasting or Predicting the sale value helps the investors to invest in such a time where profits can be maximum. This project provides guidance to individuals who are willing to invest or buy a car and help them in knowing the price of a day using the prophet library. It is built on the monthly sales data from 1960 - 1968. Time series analysis is made on the data for accurate predictions.

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1. INTRODUCTION

Introduction

Any data associated with the time that is dependent on time-related matters can be termed as time-series data. In such type of data, we can see trends, nonstationarity, and seasonality based on a daily, weekly, yearly basis. This type of data is adversely affected when any of these above parameters are hampered. Now, being a data scientist who is involved in the analysis of time series it is his/her duty to analyze the data and then make valuable predictions out of it so that the same can be used as a benchmark model to make future predictions or forecastings.

The answer to this question is the Facebook Prophet library. This was launched by Facebook as an API for carrying out the forecasting related things for time series data. The library is so powerful that it has the capability of handling stationarity within the data and also seasonality related components. By stationarity, we mean that there should be constant mean, variance, and covariance in the data if we divide the data into segments with respect to time and seasonality means thesame type of trend the data is following if segregated based on time intervals.

Overview

Forecasting or Predicting the sale value helps the investors to invest in such a time where profits can be maximum. This project provides guidance to individuals who are willing to invest or buy a car and help them in knowing the price of a day using the prophet library. It is built on the monthly sales data from 1960 - 1968. Time series analysis is made on the data for accurate predictions.

Purpose

In our article we'll try to explain how time series analysis forecasting methods can be used for typical business tasks: finding hidden patterns, detecting trends in sales over the years, predicting sales over the years, and predicting sales in the future. This library offers n number of parameters to play around with and tune our model with higher efficiency for eg. specifying holidays, daily seasonality, Fourier transformations, etc. So, without wasting much time let's take a look at this library by implementing the same with the help of Python.

2. LITERATURE SURVEY

Existing Problem

Seher Arslankya in his research paper implemented time series analysis and artificial neural network methods to estimate sales for future months for the leading company in the automotive industry in Turkey. He examined the monthly data between January 2011 and July 2016 using multiple regression, moving average and artificial neural network model. Furthermore, he compared MAPE values for all models, which resulted in the ANN model giving the best result. Arnis Kirshners did a comparative analysis of short time series processing methods intending to scrutinize these methods' ability to be used when analyzing short time series. The author has analyzed the moving average Method, exponential smoothening, and exponential smoothening with development trends resulting from moving average having the smallest squared error value but with large forecast smoothening for initial data. Shamsul Masum elucidates on time series forecasting and its classification and approaches and strategies of time series forecasting. Furthermore, the author has demonstrated how an inappropriate point to point rolling forecast strategy leads to unrealistic outcomes and supports his argument with a comparative analysis of Tamal Datta Chaudhuri proposed six different forecasting methods for predicting the time series index of the healthcare sector.

Proposed Solution

The author has demonstrated a decomposition approach of time series for data from January 2010 to December 2016 and illustrated how the decomposition results provide us with useful insights into the and properties exhibited by time series. The author observed that results from the ARIMA model with a horizon of 12 months came out to be the best model with the lowest RSME value, while the Holt Winters method with a horizon of 12 months has the highest RSME value. Jaydip Sen, in his research paper, uses the Time series - decomposition based Method to analyze the past of the Indian realty sector and predict its future. He uses time series forecasting methods in R programming language to determine future results. He uses time series index value data of the Indian realty sector for six years from 2010-2016 month wise. The methods used for accurate predictions are: Holt Winters exponential smoothening and Autoregressive Integrated Moving Average. He analyses the results from the above-mentioned broad concepts and observes, which is the best one.

3. THEORITICAL ANALYSIS

He analyses the results from the above mentioned broad concepts and observes, which is the best one. With the result obtained, he argues that these can be immensely useful for portfolio managers and stock traders to buy or sell stocks at the correct time. Samita sood elaborates how time series forecasting can be deployed in determining the future development of the Indian tourism industry from past secondary data. The author uses the data for the number of tourists in India from 1980 to 2020 and uses models such as ARIMA and Holt Winter to forecast foreign tourist travel and compare the two models' accuracy. On the basis of MAPE and RMSE, the authors conclude that Holt Winter is a more accurate model than ARIMA in this particular situation. William R Huss implements univariate estimation techniques such as Holt winter exponential smoothing, Multiple regression, Linear regression to study the load on 49 largest electric utilities in the United States and forecast the load for future planning.

The author uses electric utility data from 1972 to 1982, and the results indicate that for shorter periods, Holt Winters Exponential smoothing method is highly accurate, and for more extended periods, extrapolation of Linear regression horizons proves to be efficient. Deepa, in this paper, reviews, and forecasts the Indian Motorcycle market using Time series forecasting. The author uses SARIMA (Seasonal autoregressive Integrated Moving Method) and Holt Winters Method for prediction. The author compares several years' data and uses MAE and MAPE method to determine which model is more accurate and concludes that both the models are pretty significant but Holt Winters method is numerically more precise than the SARIMA model.

Hardware /Software designing

Hardware requirement: Laptop.

Software requirement: Python -3.9, Spyder, Juypter Notebook, Anaconda Prompt, FbProphet.

4. EXPERIMENTAL INVESTIGATIONS

Milestone 1: Data Collection

ML depends heavily on data, without data, a machine can't learn. It is the most crucial aspect that makes algorithm training possible. In Machine Learning projects, we need a training data set. It is the actual data set used to train the model for performing various actions.

You can collect datasets from different open sources like kaggle.com, data.gov; UCI machine learning repository etc. The dataset used for this project was obtained from Kaggle.

Milestone 2: Data Pre-processing

Data Pre-processing includes the following main tasks

- Importing the libraries.
- Importing the dataset.
- Analyse the data.
- Taking care of Missing Data.
- Data Visualisation.
- Splitting Data into Train and Test.

Milestone 3: Model Building

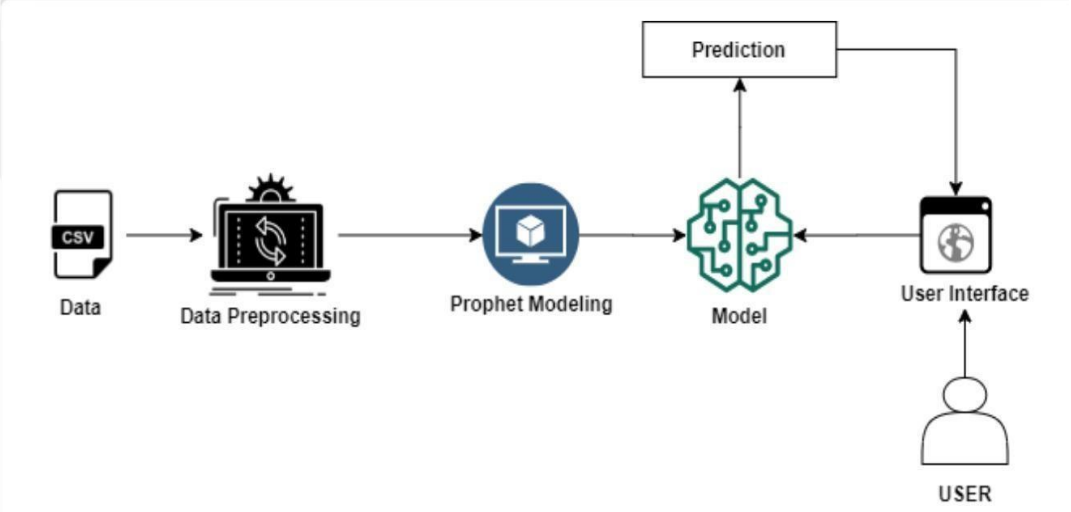
The model building process involves setting up ways of collecting data, understanding and paying attention to what is important in the data to answer the questions you are asking, finding a statistical, mathematical or a simulation model to gain understanding and make predictions. Model Building Includes:

- Import the model building libraries.
- Initialising the model.
- Training the model.
- Model Evaluation.
- Save the Model.

Milestone 4: Application Building

- Create an HTML File.
- Build python code.
- Run the app in local browser.
- Show casting the prediction on UI.

PROJECT ARCHITECTURE



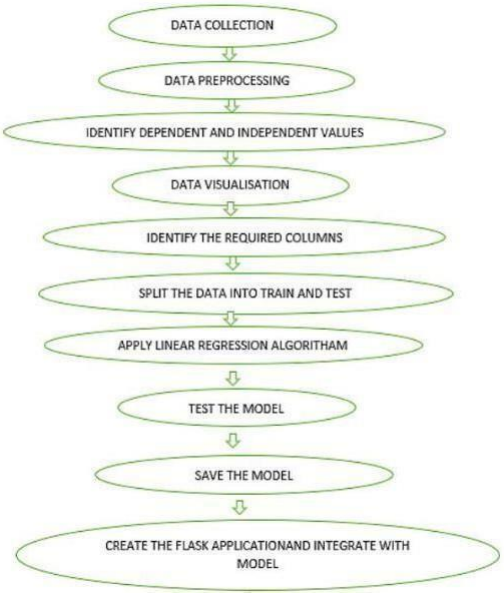
Project Architecture

PROJECT FLOW:

- User interacts with the UI (User Interface) to upload the input features.
- Uploaded features/input is analysed by the model which is integrated.
- Once a model analyses the uploaded inputs, the prediction is showcased on the UI.

5. DESIGN

5.1. FLOWCHART:



Flowchart

6. CODE SNIPPETS

6.1MODELCODE

Data Preprocessing

Data Pre-processing includes the following main tasks:

- Importing the required libraries
- Importing the dataset
- Analyze the data
- Resampling the dataset
- Preprocessing the data
- Taking care of Missing Data
- Prophet Library naming convention
- Data visualization

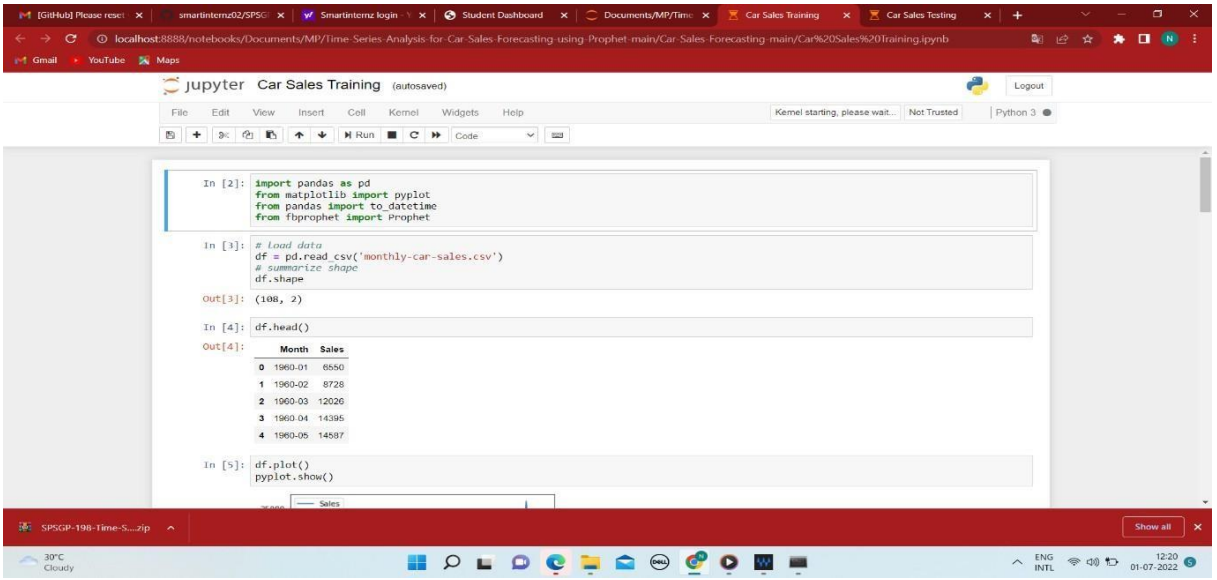


Figure 1: .ipynb code describing importing libraries.

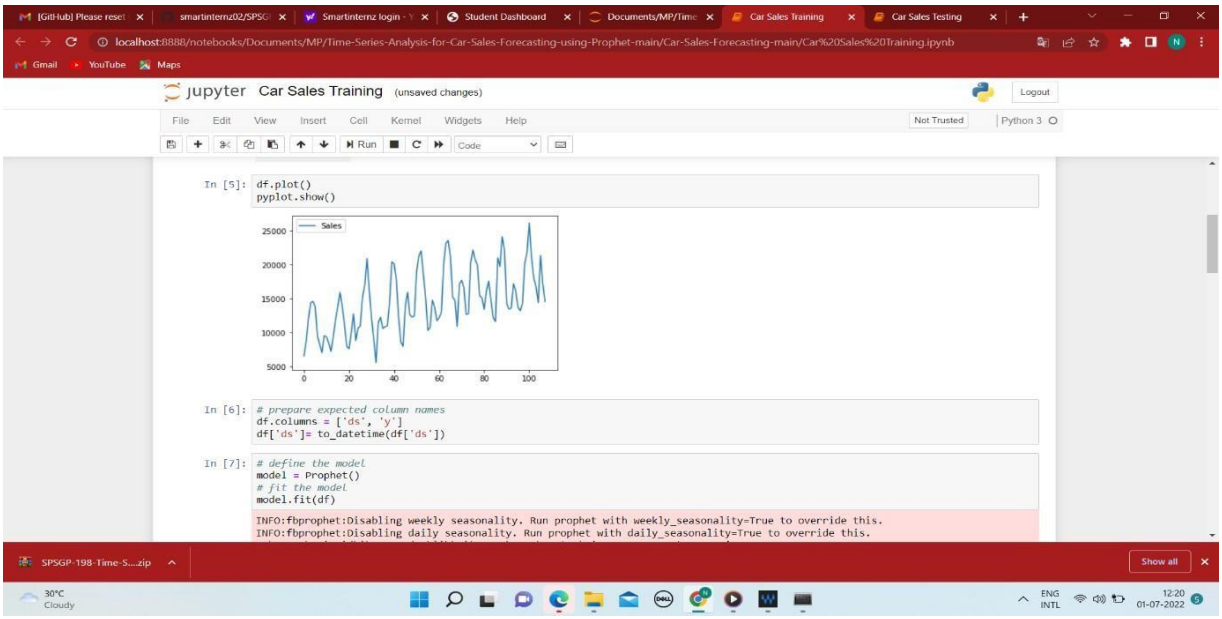


Figure 2: .ipynb code describing Graph.

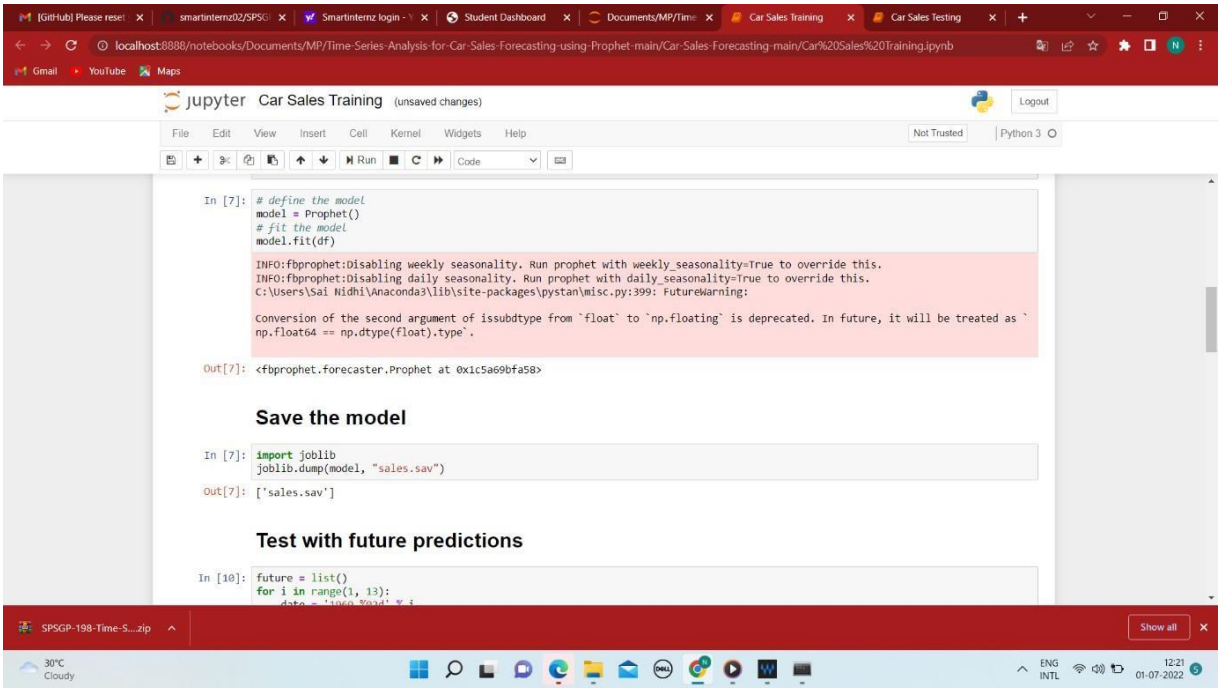


Figure 3: .ipynb code describing the model.

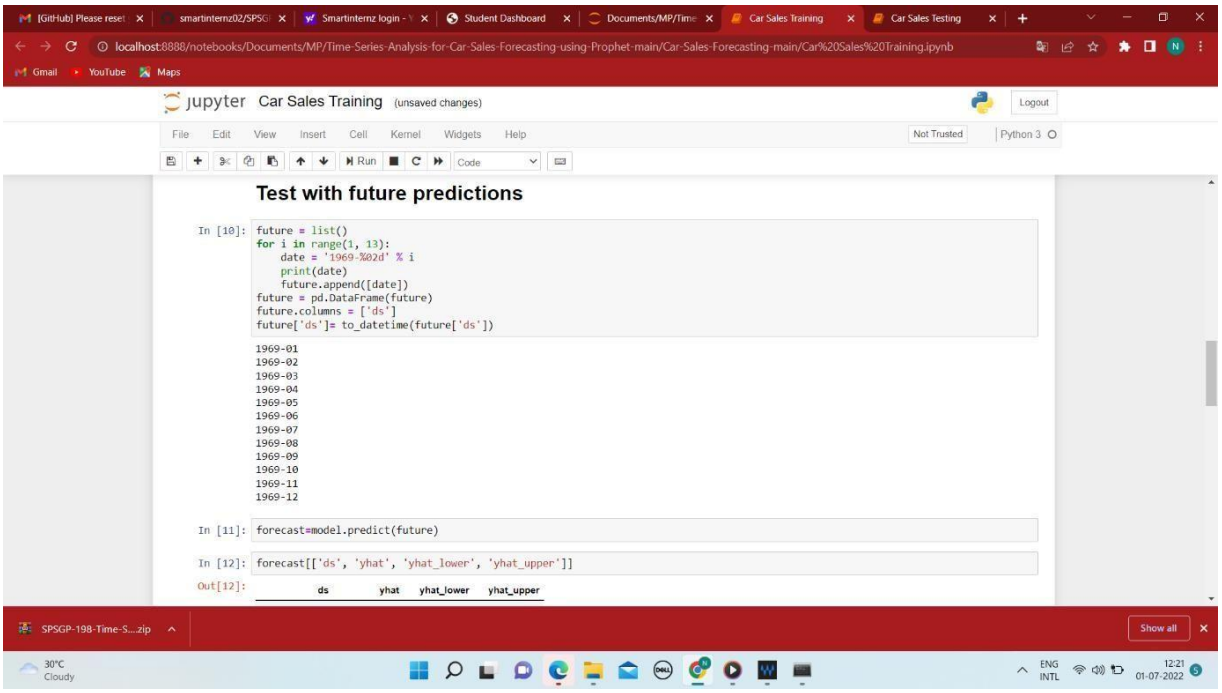


Figure 4: .ipynb code describing test with future predictions.

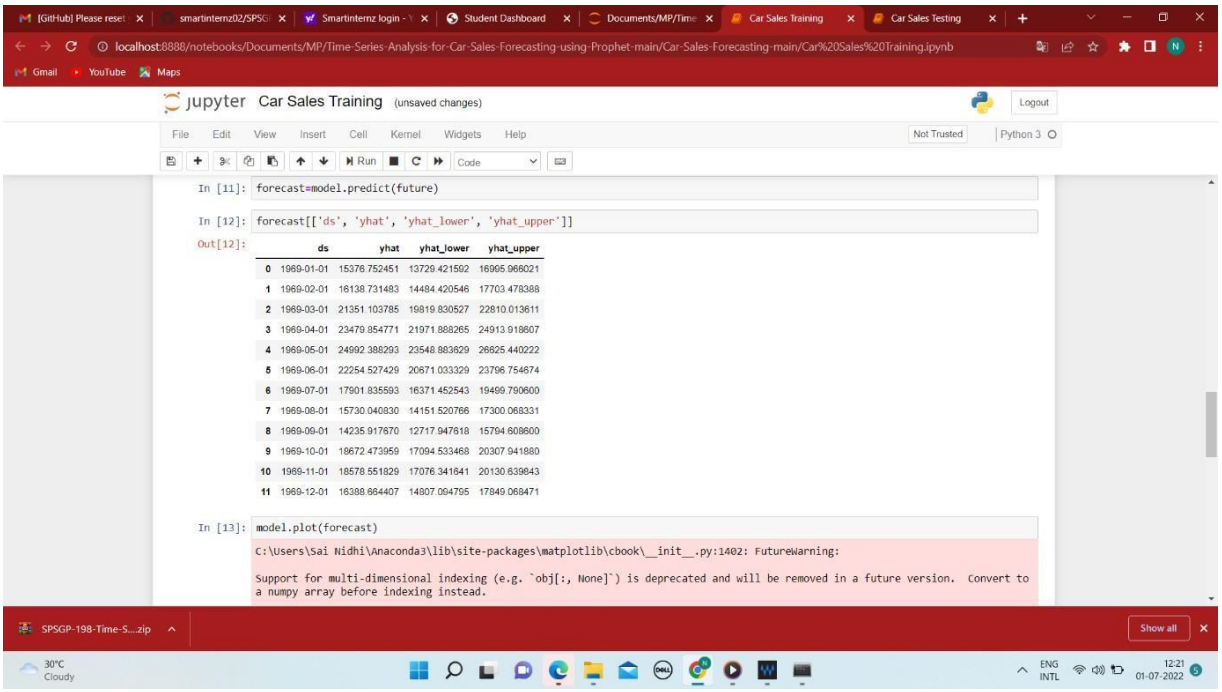
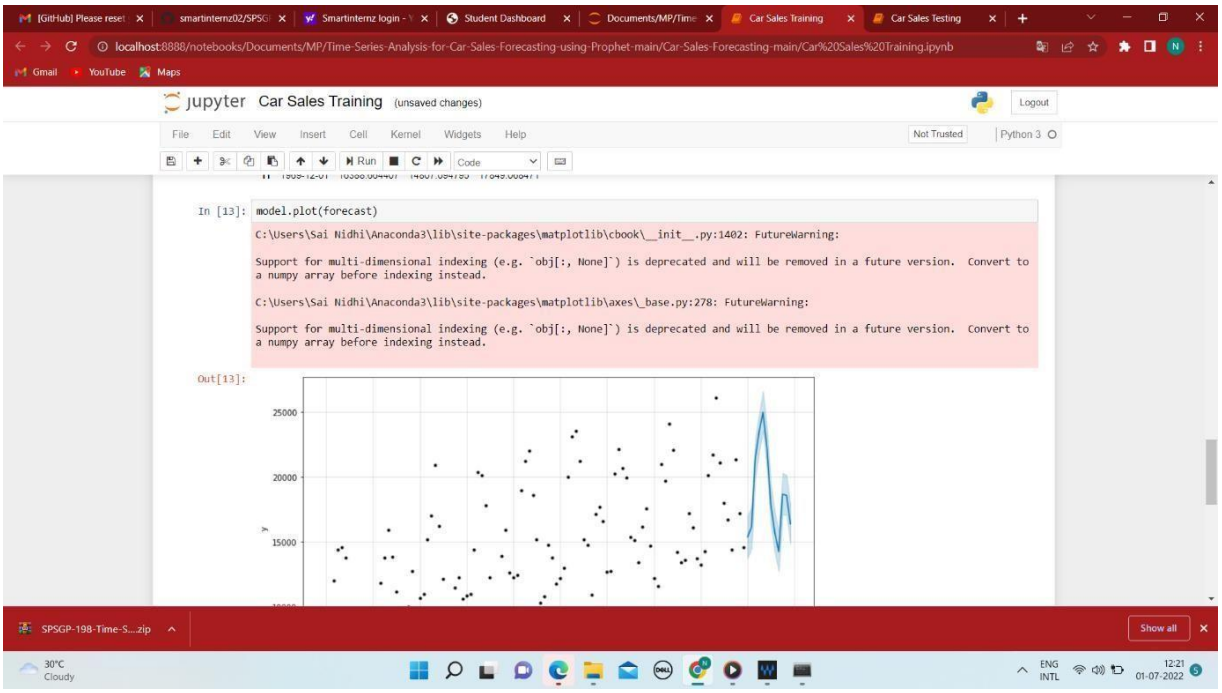
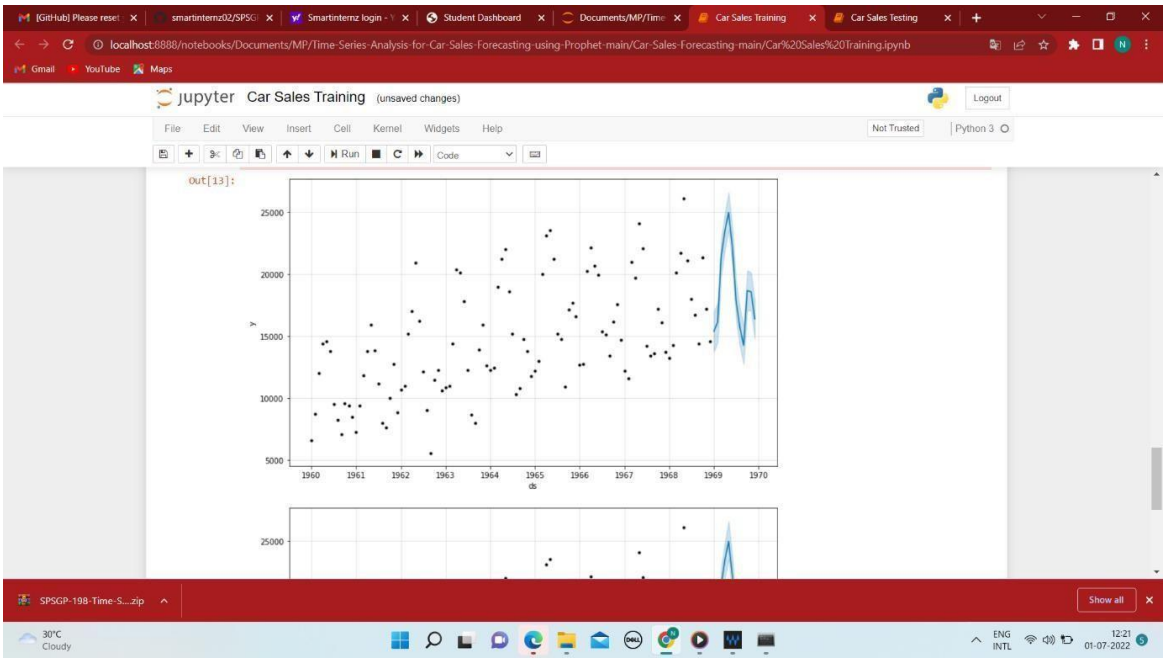


Figure 5: .ipynb code describing the forecasting.


jupyter Car Sales Training (unsaved changes)
In [13]: model.plot(forecast)
C:\Users\Sai Nidhi\Anaconda3\lib\site-packages\matplotlib\cbook__init__.py:1402: FutureWarning:
Support for multi-dimensional indexing (e.g. `obj[:, None]`) is deprecated and will be removed in a future version. Convert to a numpy array before indexing instead.
C:\Users\Sai Nidhi\Anaconda3\lib\site-packages\matplotlib\axes_base.py:278: FutureWarning:
Support for multi-dimensional indexing (e.g. `obj[:, None]`) is deprecated and will be removed in a future version. Convert to a numpy array before indexing instead.
Out[13]:
25000
20000
15000
y


jupyter Car Sales Training (unsaved changes)
Out[13]:
25000
20000
15000
10000
5000
y
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
ds

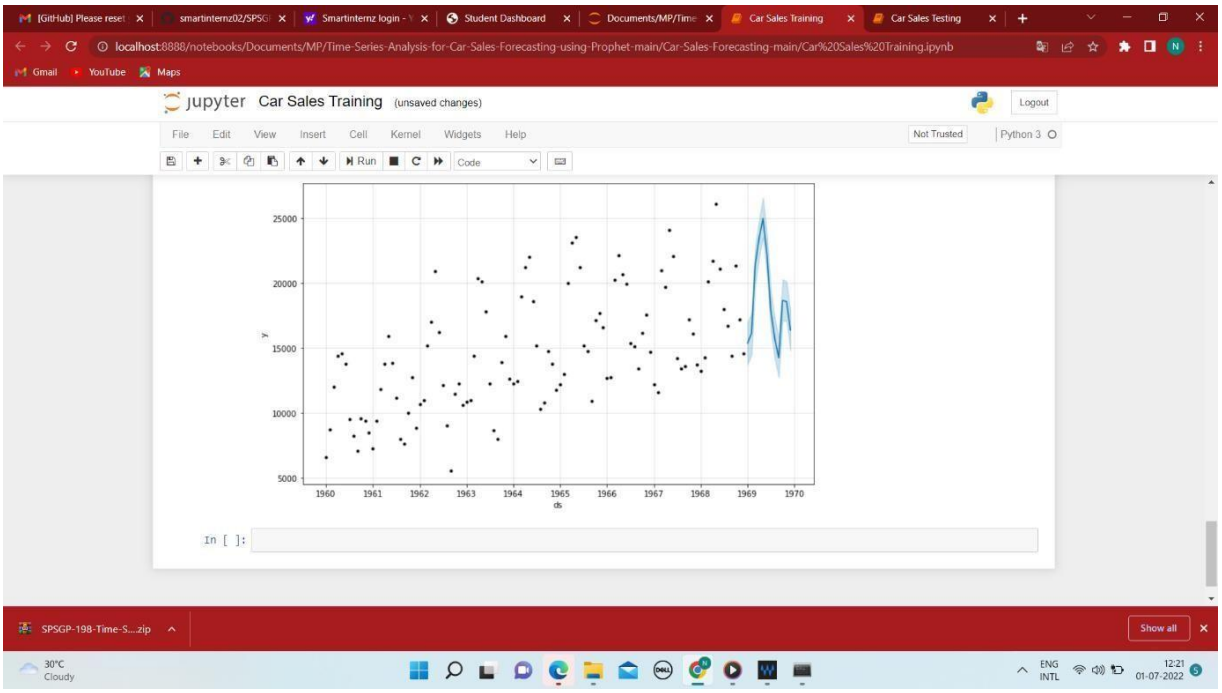


Figure 6: .ipynb code describing Scatter Plot of Forecasting.

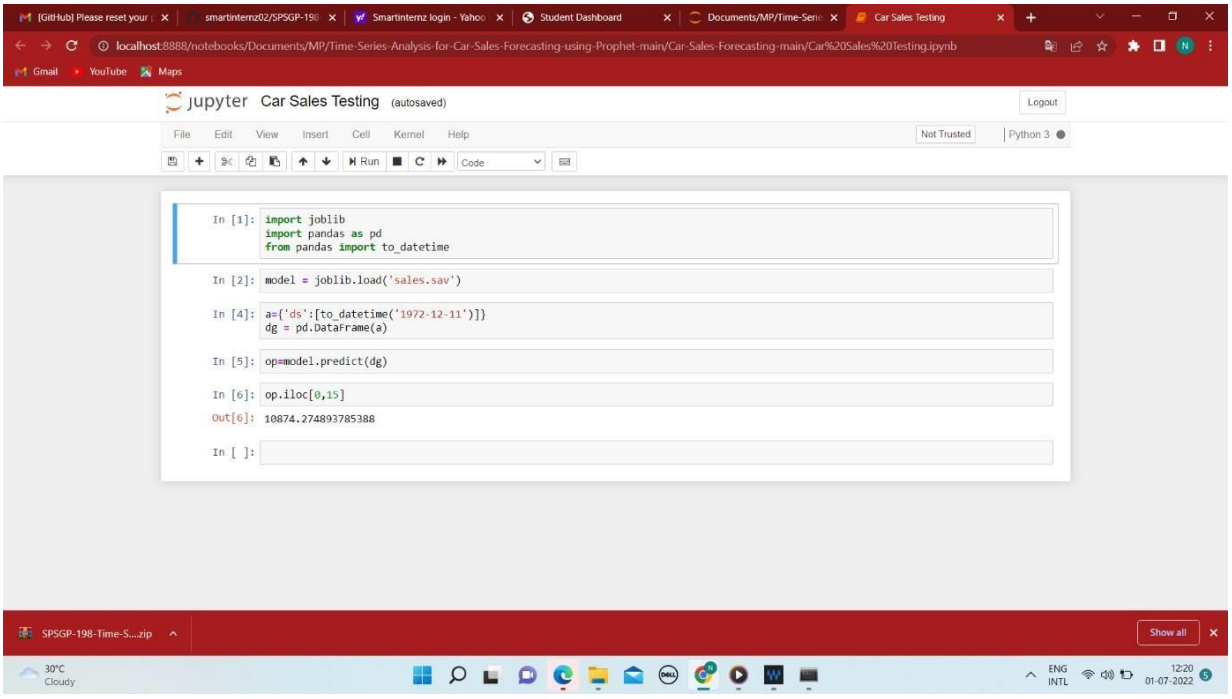


Figure 7: .ipynb code describing the Saving Model.

6.2HTML CODE AND PYTHON CODE

1. app.py code:

Editor - C:\Users\BHAVANI\Desktop\major project\fbprophet\Flask\app.py

temp.py | app.py | predict.html

```python
import joblib
import pandas as pd
from flask import Flask, request, render_template
#from gevent.pywsgi import WSGIServer
import os
import fbprophet

app = Flask(__name__)
model = joblib.load('sales.sav')

@app.route('/')
def home():
    return render_template('predict.html')

@app.route('/predict',methods=['POST'])
def y_predict():
    if request.method == "POST":
        ds = request.form["date"]
        a={"ds":[ds]}
        ds=pd.DataFrame(a)
        prediction = model.predict(ds)
        print(prediction)
        output=round(prediction.iloc[0,15])
        print(output)
        return render_template('predict.html',output="The sale value on selected date is {} thousands".format(output))
    return render_template("predict.html")
#port=os.getenv('VCAP_APP_PORT','8080')

if __name__ == "__main__":
    # app.secret_key=os.urandom(12)
    # app.run(debug=true,host='0.0.0.0',port=port)
    app.run(debug=False)
```

Figure 8 : .python code used for rendering all the HTML pages.

2. predict.html:

Editor - C:\Users\BHAVANI\Desktop\major project\fbprophet\Flask\templates\predict.html

temp.py | app.py | predict.html

```html
<!DOCTYPE html>
<html >

<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <title> Car Sales Forecasting</title>
  <link href='https://fonts.googleapis.com/css?family=Pacifico' rel='stylesheet' type='text/css'>
<link href='https://fonts.googleapis.com/css?family=Arimo' rel='stylesheet' type='text/css'>
<link href='https://fonts.googleapis.com/css?family=Hind:300' rel='stylesheet' type='text/css'>
<link href="https://cdn.bootcss.com/bootstrap/4.0.0/css/bootstrap.min.css" rel="stylesheet">
    <script src="https://cdn.bootcss.com/popper.js/1.12.9/umd/popper.min.js"></script>
    <script src="https://cdn.bootcss.com/jquery/3.3.1/jquery.min.js"></script>
    <script src="https://cdn.bootcss.com/bootstrap/4.0.0/js/bootstrap.min.js"></script>
<link href='https://fonts.googleapis.com/css?family=Open+Sans+Condensed:300' rel='stylesheet' type='text/css'>
<link href='https://fonts.googleapis.com/css?family=Merriweather' rel='stylesheet'>
<link href='https://fonts.googleapis.com/css?family=Josefin Sans' rel='stylesheet'>
<link href='https://fonts.googleapis.com/css?family=Montserrat' rel='stylesheet'>
<link href="{{ url_for('static', filename='css/final.css') }}" rel="stylesheet">
<style>
.header {
            top:0;
            margin:0px;
            left: 0px;
            right: 0px;
            position: fixed;
            background-color: #28272c;
            color: white;
            box-shadow: 0px 8px 4px grey;
            overflow: hidden;
            padding-left:20px;
            font-family: 'Josefin Sans';
            font-size: 2vw;
            width: 100%;
            height:8%;
            text-align: center;
        }

body {

  background-color:#ffffff;
```

Editor - C:\Users\BHAVANI\Desktop\major project\fbprophet\Flask\templates\predict.html

temp.py | app.py | predict.html

```
38
39 body {
40
41   background-color:#ffffff;
42   background-position: 0px 0px;
43   }
44
45 .container {
46   margin-top:40px;
47   padding: 16px;
48 }
49 #inp{
50     width: 100%;
51     margin-bottom: 10px;
52     background: rgba(255,255,255,255);
53     border: none;
54     outline: none;
55     padding: 10px;
56     font-size: 13px;
57     color: #000000;
58     text-shadow: 1px 1px 1px rgba(0,0,0,0.3);
59     border: 1px solid rgba(0,0,0,0.3);
60     border-radius: 4px;
61     box-shadow: inset 0 -5px 45px rgba(100,100,100,0.2), 0 1px 1px rgba(255,255,255,0.2);
62     -webkit-transition: box-shadow .5s ease;
63     -moz-transition: box-shadow .5s ease;
64     -o-transition: box-shadow .5s ease;
65     -ms-transition: box-shadow .5s ease;
66     transition: box-shadow .5s ease;
67 }
68
69
70 </style>
71 </head>
72
73 <body style="font-family:Montserrat;overflow:scroll;">
74
75 <div class="header">
76  <div style="width:50%;float:left;font-size:2vw;text-align:left;color:white; padding-top:1%;padding-left:3%;">Forecasting the Car Sales Value</div>
77
78 </div>
```

Editor - C:\Users\BHAVANI\Desktop\major project\fbprophet\Flask\templates\predict.html

temp.py | app.py | predict.html

```
70 </style>
71 </head>
72
73 <body style="font-family:Montserrat;overflow:scroll;">
74
75 <div class="header">
76 <div style="width:50%;float:left;font-size:2vw;text-align:left;color:white; padding-top:1%;padding-left:3%;">Forecasting the Car Sales Value</div>
77
78 </div>
79 <div class="container">
80        <div id="content" style="margin-top:2em">
81        <div class="container">
82          <div class="row">
83            <div class="col-sm-6 bd" style="text-align:justify;">
84             <span style="font-size:25px;line-height:60px;"><b>Predict the Sale Value</b><br></span>
85             Forecasting or Predicting the sale value helps the investors to invest in such a time where profits can be maximum. This application helps you in
86              <br>
87                <img src="https://image.freepik.com/free-vector/buying-renting-new-used-speedy-sports-car_3446-651.jpg" style="height:450px;width:550px"class='
88            </div>
89            <div class="col-sm-6">
90                <div>
91                <br>
92                    <h4>Specify the Date for Prediction:  </h4><br>
93            <form action = "{{url_for('y_predict')}}" method="post">
94                <input type="date" name="date" id="inp" ><br><br>
95                <center><input type="submit" name="Predict" style="background: #384b59;color:#fff;width:20%;"></center>
96            </form>
97            <br><br>
98            <span style="font-size:22px;">{{output}}
99
100        </div>
101           </div>
102
103         </div>
104       </div>
105       </div>
106    </div>
107 </body>
108
109 </html>
110
```

Figure 9 : predict.html page is the code for home page of our Web Application

7. CONCLUSION

Forecasting of Predicting the value helps the investors to invest in such a time where profits can be maximum. This application helps you in predicting the sale value of a day. It is built on the monthly sales data from 1960-1968.Time series analysis is made on the data for accurate predictions.

Running Of Flask Application

- Open the anaconda prompt from the start menu.
- Navigate to the folder where your app.py resides.
- Now type the “python app.py” command.
- It will show the local host where your app is running on http://127.0.0.1.5000/
- Copy that local host URL and open that URL in the browser. It does navigate you to where you can view your web page.

Your UI will look like

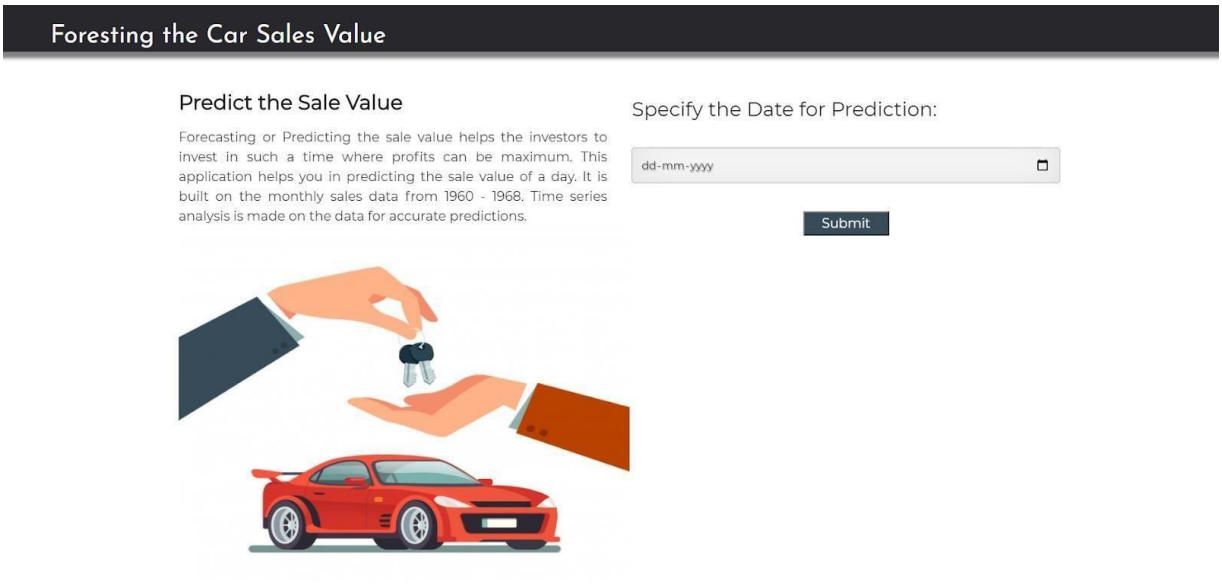


Figure 10: Input page (Which takes inputs from User)

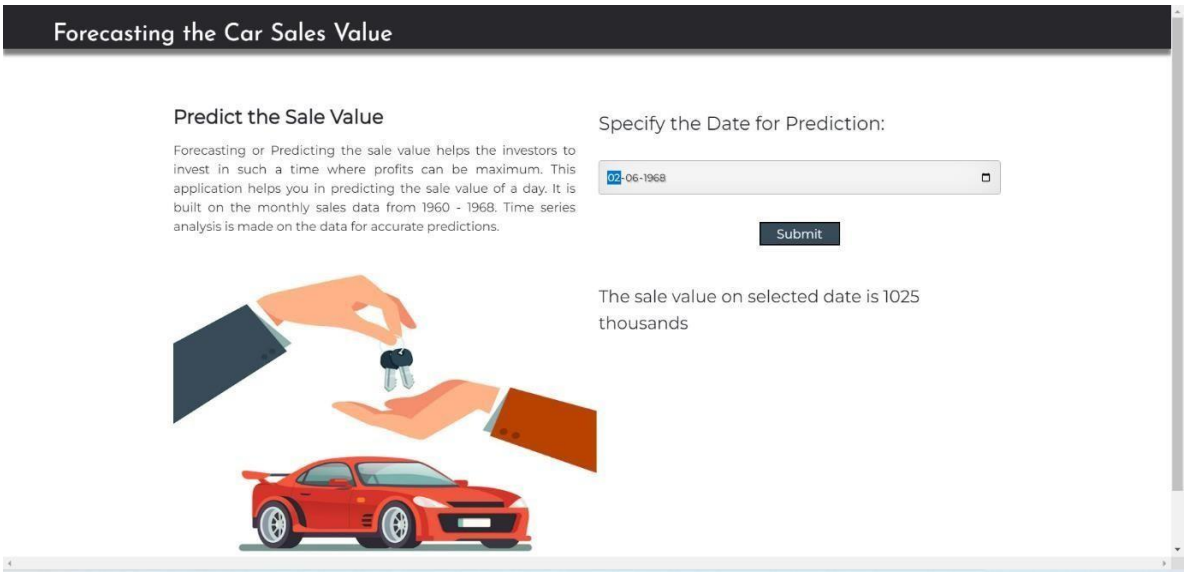


Figure 11: Output page(when user enters some particular date it gives result)

- Select the date you would like to predict and click on submit.
- The output prediction will be like.

8. APPLICATIONS

1. Time series in Financial and Business Domain

Most financial, investment and business decisions are taken into consideration on the basis of future changes and demands forecasts in the financial domain. Time series analysis and forecasting essential processes for explaining the dynamic and influential behaviour of financial markets.Policymakers and business experts use financial forecasting to make decisions about production, purchases, market sustainability, allocation of resources, etc.In investment, this analysis is employed to track the price fluctuations and price of a security over time. For instance, the price of a security can be recorded;

- For the short term, such as the observation per hour for a business day, and
- For the long term, such as observation at the month end for five years.

Time series analysis is extremely useful to observe how a given asset, security, or economic variable behaves/changes over time.

2.Time series in Medical Domain

Medicine has evolved as a data-driven field and continues to contribute in time series analysis to human knowledge with enormous developments. In the medical domain, it is important to examine the transformation of behaviour over time as compared to derive inferences depending on the absolute values in the time series. For example, to diagnose heart rate variability in occurrence with respiration based on the sensor readings is the characteristic illustration of connecting time series with case-based monitoring.

However, time series in the context of the epidemiology domain has emerged very recently and incrementally as time series analysis approaches demand recordkeeping systems such that records should be connected over time and collected precisely at regular intervals.As soon as the government has placed sufficient scientific instruments to accumulate good and lengthy temporal data, healthcare applications using time series analysis have resulted in huge prognostication for the industry as well as for individuals' health diagnoses.

Medical Instruments

Time series analysis has made its way into medicine with the advent of medical devices such as

- Electrocardiograms (ECGs), invented in 1901: For diagnosing cardiac conditions by recording the electrical pulses passing through the heart.
- Electroencephalogram (EEG), invented in 1924: For measuring electrical activity/impulses in the brain.

These inventions made more opportunities for medical practitioners to deploy time series for medical diagnosis.With the advent of wearable sensors and smart electronic healthcare devices, now persons can take regular measurements automatically with minimal inputs, resulting in a good collection of longitudinal medical data for both sick and healthy individuals consistently.

3.Time Series in Astronomy

One of the contemporary and modern applications where time series plays a significant role are different areas of astronomy and astrophysics, Being specific in its domain, astronomy hugely relies on plotting objects, trajectories and accurate measurements, and due to the same, astronomical experts are proficient in time series in calibrating instruments and studying objects of their interest. Time series data had an intrinsic impact on knowing and measuring

anything about the universe, it has a long history in the astronomy domain, for example, sunspot time series were recorded in China in 800 BC, which made sunspot data collection as well-recorded natural phenomena.

Similarly, in past centuries, time series analysis was used

- To discover variable stars that are used to surmise stellar distances, and
- To observe transitory events such as supernovae to understand the mechanism of the changing of the universe with time.

Such mechanisms are the results of constant monitoring of live streaming of time series data depending upon the wavelengths and intensities of light that allows astronomers to catch events as they are occurring. In the last few decades, data-driven astronomy introduced novel areas of research as astroinformatics and astrostatistics; these paradigms involve major disciplines such as data mining, machine learning and computational intelligence. And here, the role of time series analysis would be detecting and classifying astronomical objects swiftly along with the characterization of novel phenomena independently.

4.Time series in Forecasting Weather

Anciently, the Greek philosopher Aristotle researched weather phenomena with the idea to identify causes and effects in weather changes. Later on, scientists started to accumulate weather-related data using the instrument “barometer” to compute the state of atmospheric conditions, they recorded weather-related data on intervals of hourly or daily basis and kept them in different locations. With the time, customized weather forecasts began printed in newspapers and later on with the advancement in technology, currently forecasts are beyond the gneral weather conditions. In order to conduct atmospheric measurements with computational methods for fast compilations, many governments have established thousands of weather forecasting stations around the world.These stations are equipped with highly functional devices and are interconnected with each other to accumulate weather data at different geographical locations and forecast weather conditions at every bit of time as per requirements.

5.Time series in Business Development

Time series forecasting helps businesses to make informed business decisions, as the process analyzes past data patterns it can be useful in forecasting future possibilities and events in the following ways;

- **Reliability:** When the data incorporates a broad spectrum of time intervals in the form of massive observations for a longer time period, time series forecasting is highly reliable. It provides elucidate information by exploiting data observations at various time intervals.
- **Growth:** In order to evaluate the overall financial performance and growth as well as endogenous, time series is the most suitable asset. Basically, endogenous growth is the progress within organizations' internal human capital resulting in economic growth. For example, studying the impact of any policy variables can be manifested by applying time series forecasting.
- **Trend estimation:** Time series methods can be conducted to discover trends, for example, these methods inspect data observations to identify when measurements reflect a decrease or increase in sales of a particular product.
- **Seasonal patterns:** Recorded data points variances could unveil seasonal patterns & fluctuations that act as a base for data forecasting. The obtained information is significant for markets whose products fluctuate seasonally and assist organizations in planning product development and deliveryrequirements.

9. ADVANTAGES

1. Time series forecasting is of high accuracy and simplicity.

2. It can be used to analyze how the changes associated with the data point picked correlate with changes in other variables during the same time span.

3. Statistical techniques have been developed to analyze time series in such a way that the factor that influences the fluctuation of the series may be identified and handled.

4. It can give good ouput with less variables. As regression models fail with less variables, time series models will work better and effectively.

10. DISADVANTAGES

1. Time series models can easily be overfitted, which lead to false results.

2. It works well with short term forecasting but does not work well with long term forecasting.

3. It is sensible to outliers, if the outliers are not handled properly then it could lead to wrong predictions.

4. The different elements that impact the fluctuations of a series cannot be fully adjusted by the time series analysis.

5. Expensive computation cost.

6. The big challenge is during the training period.

11.FUTURE SCOPE

Time Series forecasting is the use of a model to forecast future events based on known past events to predict data points before they are measured predicting the sale value helps the investors to invest in such a time where profits can be maximum. The scope of time series is huge and so is huge and so is the field of time series analysis.

12.BIBLIOGRAPHY

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13.HELP FILE

PROJECT EXECUTION (LOCAL ENVIRO 7 NMENT):

STEP-1: go to **Start,** search and launch **ANACONDA NAVIGATOR.**

STEP-2: After launching of **ANACONDA NAVIGATOR,** launch **JUPYTER Notebook,** Open **"Major project Code" IPYNB file** then run all cells, a pickle file will be generated.

STEP-3: Create a folder named **FLASK** on the **DESKTOP.** Extract the pickle file into this Flask Folder.

STEP-4: Extract the html file (Predict.html) and python file (app.py, temp.py) into the **FLASK Folder**.

STEP-5: Then go back to **ANACONDA NAVIGATOR** and the launch the **SPYDER.**

STEP-6: After launching Spyder, give the path of **FLASK FOLDER** which you have created on the DESKTOP.

STEP-7: Open all the app.py, temp.py and html file present in the Flask Folder.

STEP-8: After running of the app.py, open **ANACONDA PROMPT** and follow the below Steps:

cd File path 7 click enter

python app.py 7 click enter (We could see running of files).

STEP-9: Then open **BROWSER,** at the URL area type---**"localhost:5000".**

STEP-10: Home page of the project will be displayed.

STEP-11: Here Forecasting the Car Sales Value page is displayed, we can predict the sale value of a day**.**

STEP-12: Then gives Specify the Date for Prediction in the format of DD-MM-YYYY or select from the Calender. Now Click on **"SUBMIT".**