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Regression Analysis on Automobile Dataset: Business Analytics/ Predictive Analysis

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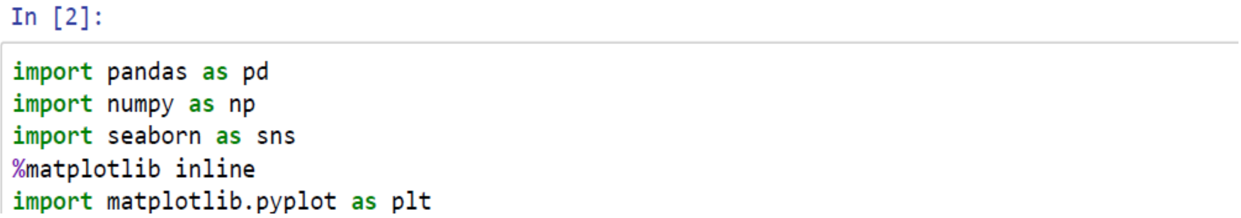
Abstract: The new discipline of the twenty-first century is business analytics. A rising number of company operations, including business intelligence, are now managed by machine learning algorithms. The majority of BI systems offer more functionality than just data gathering and reporting. Using the capabilities of predictive analytics, they could potentially offer insights or optimization ideas. In this paper, data collecting comes first. Any gathered or provided data can be examined, and conclusions can be made as necessary. The gathered or provided data is typically in its unprocessed or raw form. Pre-processing data helps to format the data into a usable form by removing noise and redundancy, as well as missing values and non-numerical values. Data analysis and visualization are carried out to improve the statistical analysis of given data. Logistic regression is carried out on the data since it contains lot of columns with categorical values. Accuracy, precision, and f1 score of the model have been measured. Various conclusions can be drawn from this interdependent data set and can be stored as historical data for future analysis. Linear Regression is also carried out on the data set and r-squared values noted. R-squared is a statistical measure of how close the data are to the fitted regression line. For the automotive business, an ML model is created using both logistic regression and linear regression. The manufacturers and sales department can identify their product in the market of the twenty-first century thanks to the help of this business intelligence model.

Keywords: Business Analytics (BA)/ BI (Business Intelligence), Machine Learning, Data pre-processing, Logistic regression, accuracy, precision, and f1 score, linear regression, data analysis and visualization, R-squared, Business Intelligence.

I.INTRODUCTION

Platforms for business intelligence (BI) assist firms in compiling and presenting data from a variety of sources. Users of BI platforms can design reports and dashboards that aid in their data-based insight-gathering. For instance, the auto industry (automobile segment) consists of numerous manufacturers operating in the market. They may keep track of the contracts each month and use the CRM data to see which kind of VEHICLE generates the most business for them. A user can generate a report from this data using a business intelligence platform, which will assist the company in making more educated judgements about the kinds of customers to target with advertising. We have identified several fields in the data set

i. Engine size
ii. Engine power
iii. Sale amount
iv. Resale amount
v. Vehicle type
vi. Total price in units
vii. Manufacturer



```
In [2]:

import pandas as pd
import numpy as np
import seaborn as sns
%matplotlib inline
import matplotlib.pyplot as plt
```

Figure 1 shows the Python code to import libraries.

II. PROBLEM STATEMENT

The production and marketing of their products on the market comprise the primary duties of the automobile industry. Reports must be consulted for data. To analyse the acquired data statistically and graphically, data analysis and visualisation must be done. The data set requires the application of logistic regression (categorical). To be evaluated are the model's accuracy, precision, and f1 score. It is necessary to do linear regression on the data set and record the r-squared values. From the prepared report, conclusions should be drawn.

III. METHODOLOGY

A. Importing Libraries [2]

Figure 1 shows the Python code to import libraries. We have used three libraries

- ‘numpy’ is a package for scientific computing with Python. This library is imported as ‘np’ and will be used throughout the project.
- ‘pandas’is for data manipulation and analysis. panadas is an open source, BSD- licenced library providing easy-to-use data structures and data analysis tools.pandas is imported as pd.
- ‘matplotlib.pyplot’ is a collection of command style functions that make matplotlib work like MATLAB. It is imported as plt
- ‘seaborn’ is a Python data visualization library based on matplotlib for attractive and informative statistical graphics.

B. Importing data

Figure 2 shows the Python code to import data from respective directory/ file and assigning it to DataFrame df. The data stored in CSV format is being imported. [3] [4]

C. Checking for NaN

It is very essential in data pre-processing to check for NaN. In this attempt we could identify few NaN. Figure 3 shows the python code to check for NaN.

D. Manipulating NaN values

It is essential to remove the NaN values. This can be done by

- Removing the entire column containing many NaN values
- Forward fillna method
- Backward fillna method
- Mean method

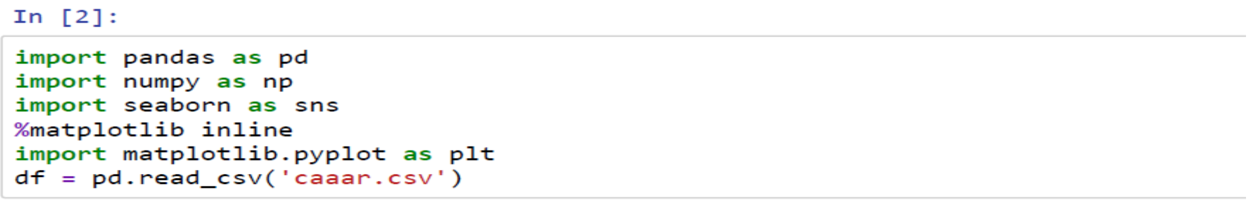
Figure 4 shows the technique of forward fillna method and figure 5 shows the method of dropping the column.

E. Plotting a Heatmap

Correlation between the fields of the recorded data is analysed by plotting a heatmap. The values may be negative or positive and the magnitude plays a key role in designing various predictive models in AI. Figure 6 shows a heatmap and correlation model.

F. Splitting the data into train and test sets. Figure 7 shows the python code to split the data set into train and test data.

G. Applying logistic regression on the split data. Figure 8 shows logistic regression on given data set.



```
In [2]:
import pandas as pd
import numpy as np
import seaborn as sns
%matplotlib inline
import matplotlib.pyplot as plt
df = pd.read_csv('caaar.csv')
```

Figure 2 shows the Python code to import data and assigning it to DataFrame df

H. In statistics, linear regression is a linear approach to modelling the relationship between a scalar response and one or more explanatory variables (or independent variables).[5] Linear regression is carried out on the data set. R^2 value or score is also measured. Figure 3 shows the linear regression plot.

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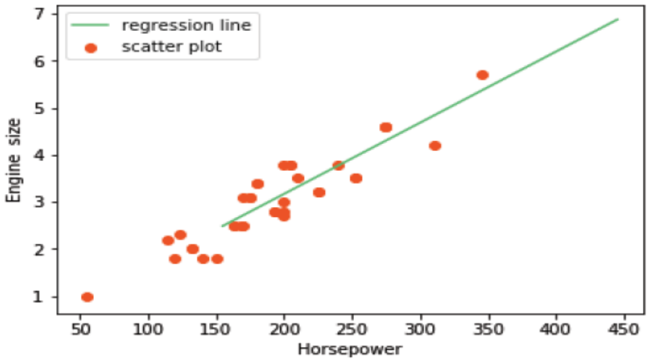
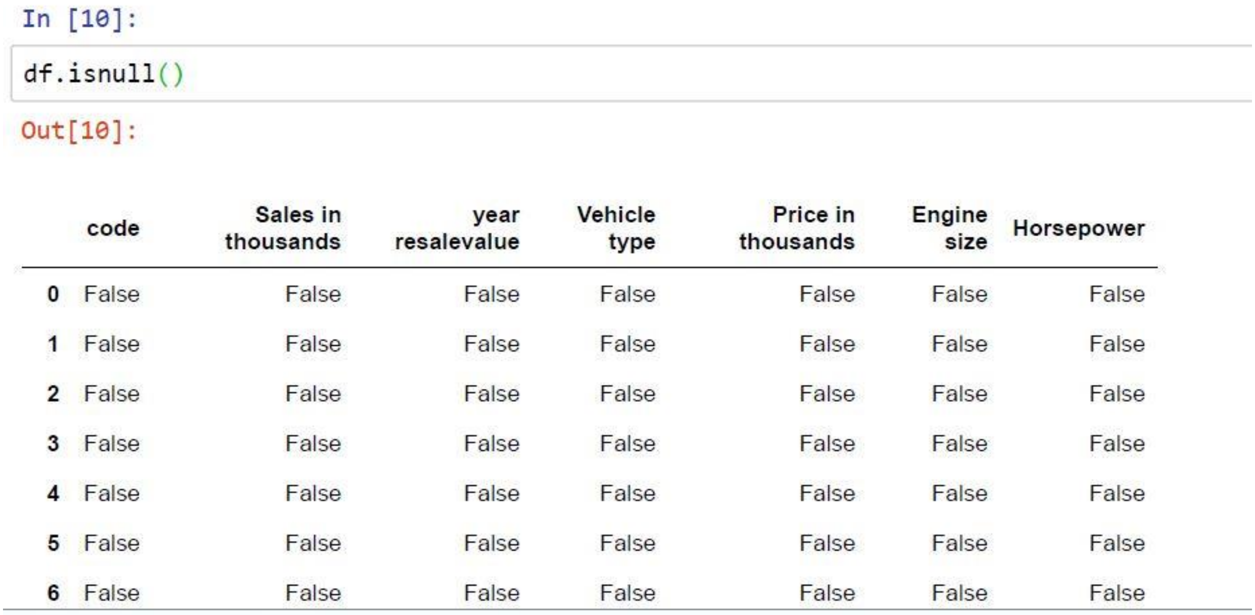


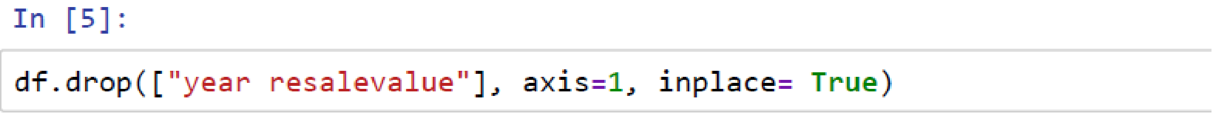
Figure 9 shows the linear regression plot



```
In [10]:
df.isnull()
Out[10]:
```

	code	Sales in thousands	year resalevalue	Vehicle type	Price in thousands	Engine size	Horsepower
0	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False
3	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False
5	False	False	False	False	False	False	False
6	False	False	False	False	False	False	False

Figure 3 shows the Python code to check for NaN.



```
In [5]:
df.drop(["year resalevalue"], axis=1, inplace= True)
```

Figure 5 shows the method of dropping the column

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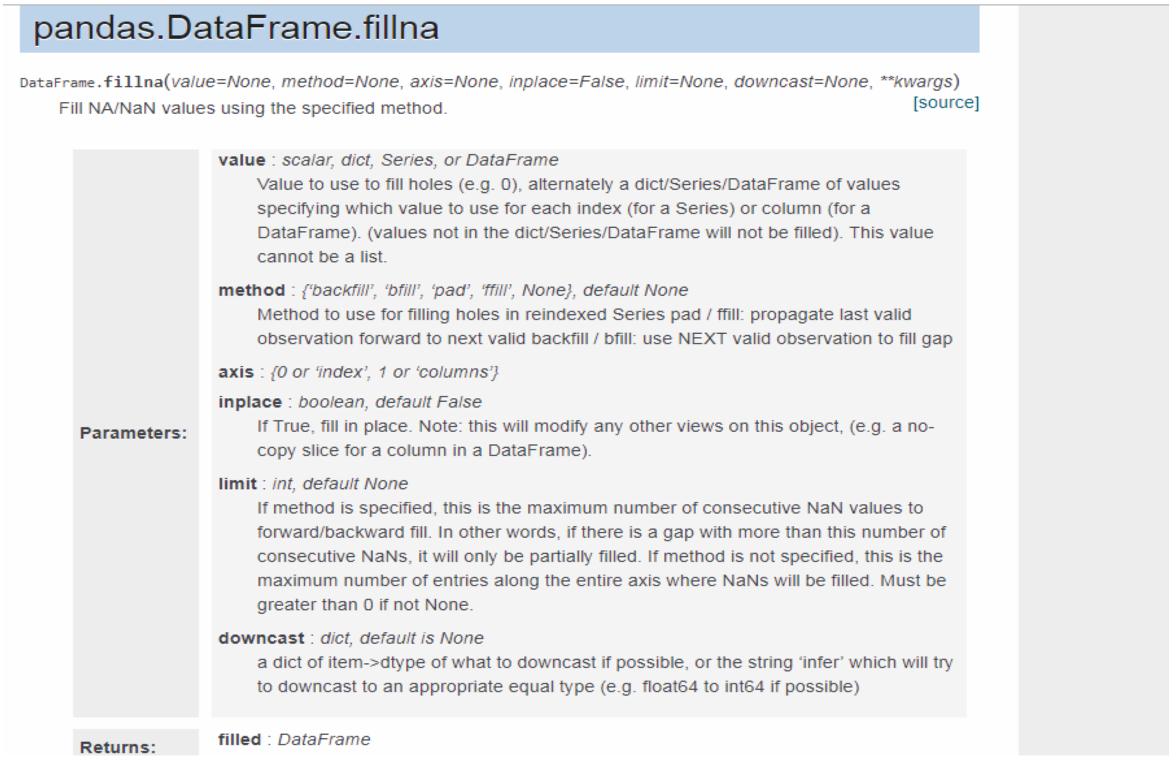


pandas.DataFrame.fillna

`DataFrame.fillna(value=None, method=None, axis=None, inplace=False, limit=None, downcast=None, **kwargs)` [source]

Fill NA/NaN values using the specified method.

Parameters:

value : *scalar, dict, Series, or DataFrame*
Value to use to fill holes (e.g. 0), alternately a dict/Series/DataFrame of values specifying which value to use for each index (for a Series) or column (for a DataFrame). (values not in the dict/Series/DataFrame will not be filled). This value cannot be a list.

method : *{'backfill', 'bfill', 'pad', 'ffill', None}, default None*
Method to use for filling holes in reindexed Series pad / ffill: propagate last valid observation forward to next valid backfill / bfill: use NEXT valid observation to fill gap

axis : *{0 or 'index', 1 or 'columns'}*

inplace : *boolean, default False*
If True, fill in place. Note: this will modify any other views on this object, (e.g. a no-copy slice for a column in a DataFrame).

limit : *int, default None*
If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None.

downcast : *dict, default is None*
a dict of item->dtype of what to downcast if possible, or the string 'infer' which will try to downcast to an appropriate equal type (e.g. float64 to int64 if possible)

Returns:

filled : *DataFrame*

Figure 4 shows the technique of forward fillna method

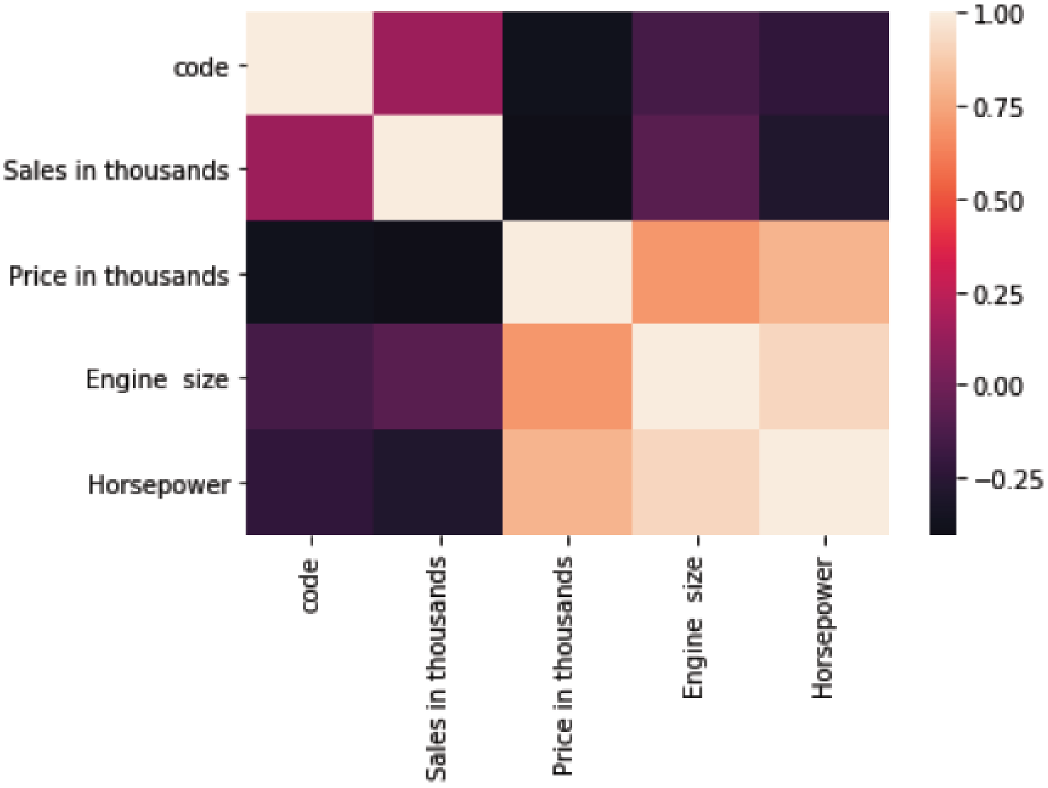
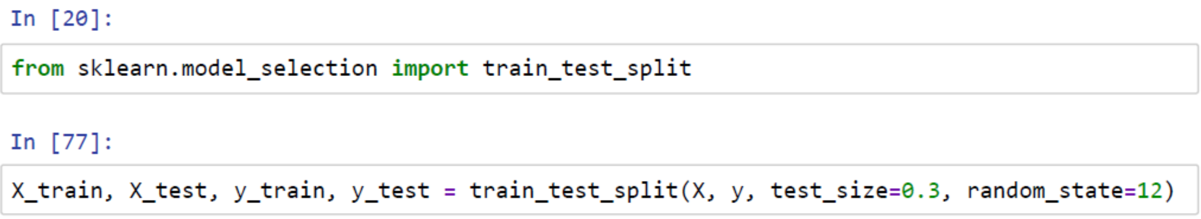


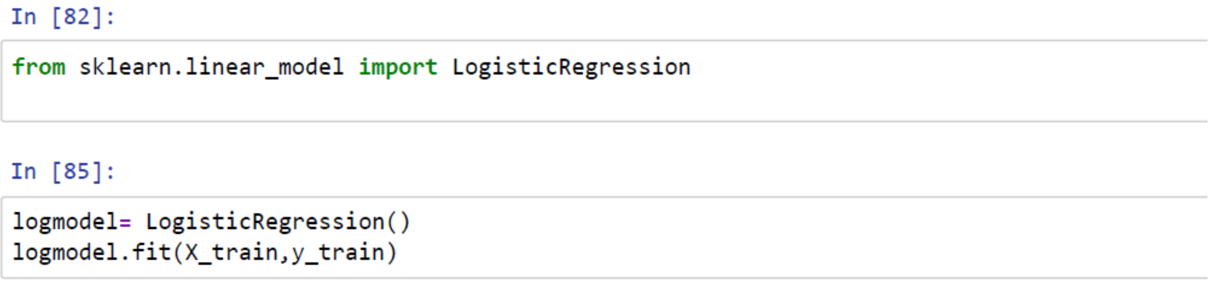
Figure 6 shows a heatmap and correlation of the model.



```
In [20]:
from sklearn.model_selection import train_test_split

In [77]:
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=12)
```

Figure 7 shows the python code to split the data set into train and test data.



```
In [82]:
from sklearn.linear_model import LogisticRegression

In [85]:
logmodel= LogisticRegression()
logmodel.fit(X_train,y_train)
```

Figure 8 shows logistic regression on given data set.

IV. DATA VISUALIZATION

Data visualization is an integral part of data analytics and Machine Learning. When there is a huge data set, manual analytics becomes almost impossible. Data visualization plays a vital role in analysis in such situation. It involves use of various plots – bar graph, pie charts, box plots, line graphs and many more. Figure 10 and figure 11 includes a bar graph of horse power anda plot of engine size respectively.

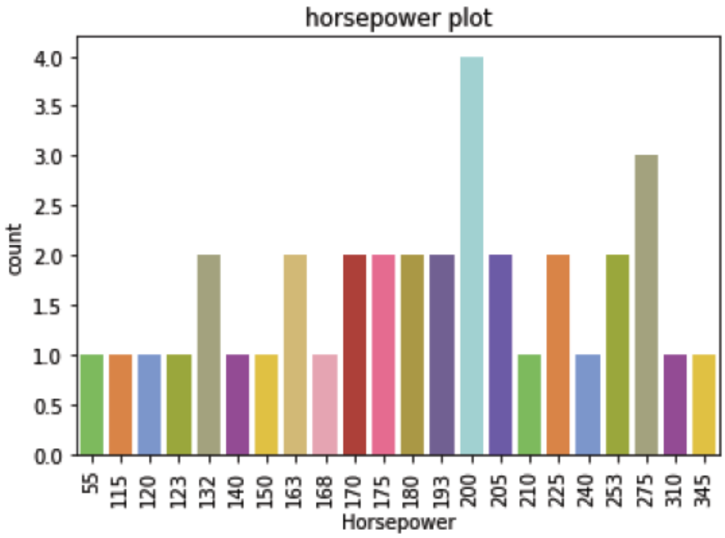


Figure 10 shows a bar graph of horsepower.

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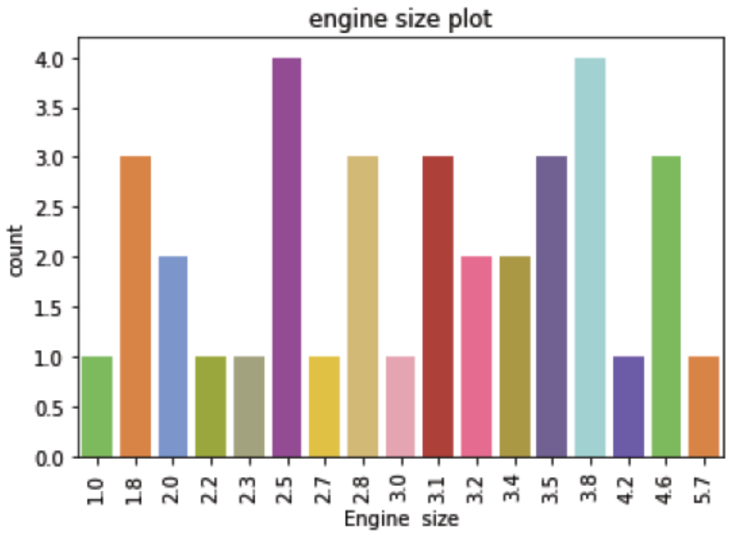
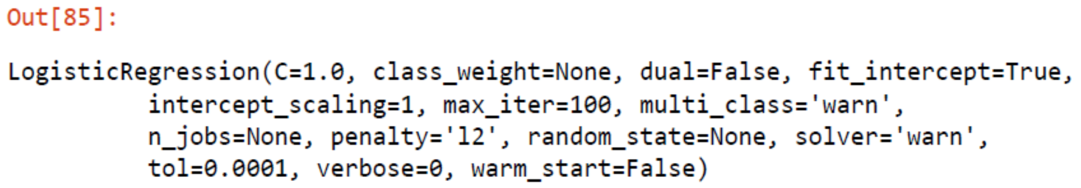


Figure 11 shows a bar graph of engine size.

V. Results

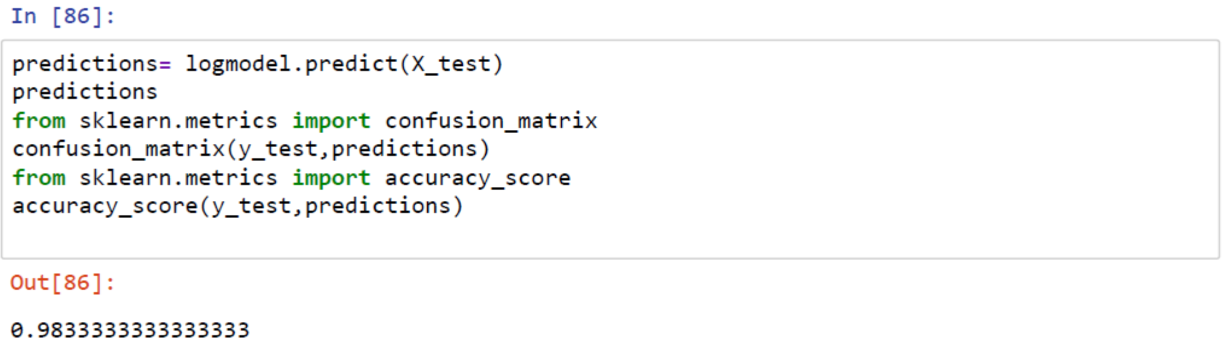
After analysing the heatmap and figuring out the correlation between different columns/ physiological parameters, Logistic regression needs to be carried out to create a prediction model. Figure 12 shows the results of logistic regression model. Figure 13 shows the Accuracy score of the designed model. From this data, precision, f1 score and reliability can be calculated. Figure 14 shows the R-squared calculation for the linear regression model.[6-9]



```
Out[85]:

LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
          intercept_scaling=1, max_iter=100, multi_class='warn',
          n_jobs=None, penalty='l2', random_state=None, solver='warn',
          tol=0.0001, verbose=0, warm_start=False)
```

Figure 12shows the results of logistic regression model



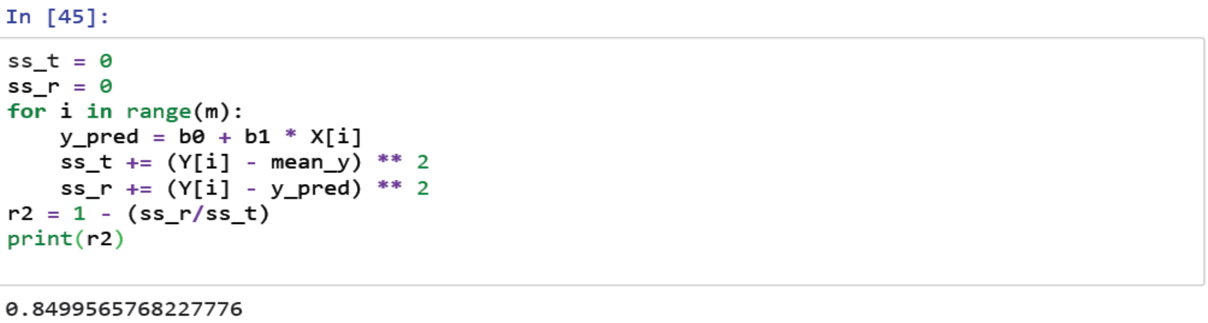
```
In [86]:

predictions= logmodel.predict(X_test)
predictions
from sklearn.metrics import confusion_matrix
confusion_matrix(y_test,predictions)
from sklearn.metrics import accuracy_score
accuracy_score(y_test,predictions)

Out[86]:

0.9833333333333333
```

Figure 13 shows the Accuracy score of the designed model.



```
In [45]:

ss_t = 0
ss_r = 0
for i in range(m):
    y_pred = b0 + b1 * X[i]
    ss_t += (Y[i] - mean_y) ** 2
    ss_r += (Y[i] - y_pred) ** 2
r2 = 1 - (ss_r/ss_t)
print(r2)

0.8499565768227776
```

Figure 14 shows the R-squared calculation.

VI. CONCLUSIONS

Proactive automakers have kept track of their sales information. To draw conclusions, data analytics had to be applied to the data, taking into account both historical and current trends. The objective was to increase or create the company's profit while developing a visualisation model with tools like seaborn, matplotlib, and pandas for data analysis. To conduct the analysis and reach the conclusions, a Python program was written and run on the Jupyter platform. Successful data pre-processing and data visualisation have led to a number of findings. On the data set, linear regression is used. R ^{2} value or score is also measured. Logistic regression is carried out on the data since it contains lot of columns with categorical values. Accuracy, precision, and f1 score of the model have been measured. The accuracy of the model was measured to be about 98.3333%.

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GUIDE

VISHESH S born on 13th June 1992, hails from Bangalore (Karnataka) and has completed B.E in Telecommunication Engineering from VTU, Belgaum, Karnataka in 2015. He has also completed his MBA in e-Business and PG Diploma in International Business. He also worked as an intern under Dr. Shivananju BN, former Research Scholar, Department of Instrumentation, IISc, Bangalore. His research interests include Embedded Systems, Wireless Communication, BAN and Medical Electronics. He is also the Founder and Managing Director of the corporate company Konigtronics Private Limited. He has guided over a thousand students/interns/professionals in their research work and projects. He is also the co-author of many International Research Papers. Many international students (from more than 12 countries) are also working for his research projects.