21112010
Gulafshan
LAB-1
SEM -4

AIM
-To perform EDA and do perform data transformation and analysis and feauture engineering also to clean the webscrapped data for comprehensible understanding and transformation

OBJECTIVE

1. *Create a well-formatted Jupyter Notebook Document to present your findings (2 marks), and create a short description about the dataset (1 Mark)*
2. *Illustrate Feature Scaling, Encoding/Transformation, Engineering, Generation, using the existing set of features in the dataset, and prepare it for Model Building (3 Marks)*
3. *Perform Statistical Data Analysis on the Dataset, and present your observations (3 Marks)*
4. *Extend your Exploratory Data Analysis (EDA) to different problem statements, and find solutions to at least six formulated questions (3 Marks)*
5. *Prepare your Dataset for applying Linear Regression Model, by making use of "Price" as the target variable. Export the prepared dataset, and upload the same along with the submission(3 Marks)*

APPROACH
1)Data Cleaning
2)Data Manipulation
3)Data Transformation
4)Feature Enginnering and Scaling
5)Linear Regression Model Building
6)Exploratory Data Analysis

PROBLEM STATEMENT
To clean and assort to visualise and depict the data for comprehensive insight deductions

OBSERVATIONS
ALL OBSERVATIONS HAVE BEEN SUBSEQUENTLY ADDED WITH EACH PLOT

COMPLETION

- **All Done**

Importing Libraries

In [27]:

```
import pandas as pd
import matplotlib as mb
import seaborn as sns
from sklearn.preprocessing import StandardScaler, OneHotEncoder
from sklearn import preprocessing
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
from matplotlib import rcParams
import seaborn as sns
import warnings
warnings.filterwarnings("ignore")

```

In [3]:

```
df=pd.read_excel("C:/Users/GULAFSHAN/Downloads/Lab01_Dataset (1).xlsx")
```

In [7]:
```
display(df.head())

display(df.tail())
```

	CarModel	AgeOfCar	Price	OdoMeterReading	Unnamed: 4	DealingType	GearSystem	NoOfOwners
0	Ford Figo Aspire 1.5 TDCi Trend	8	574998.75	152620	Diesel	Broker	Manual	First Owner
1	Mahindra Scorpio SLE BSIV	11	656250.00	149000	Diesel	Direct Owner	Manual	First Owner
2	Tata Manza Club Class Quadrajet90 LS	9	250000.00	104000	Diesel	Direct Owner	Manual	First Owner
3	Toyota Corolla Altis 1.8 VL AT	13	437500.00	84000	Petrol	Direct Owner	Automatic	Third Owner
4	Tata Indigo CS eLS BS IV	12	225000.00	124000	Diesel	Direct Owner	Manual	First Owner

	CarModel	AgeOfCar	Price	OdoMeterReading	Unnamed: 4	DealingType	GearSystem	NoOfOwners
4335	Hyundai EON Era	9	362500.0	16000	Petrol	Broker	Manual	First Owner
4336	Hyundai Grand i10 1.2 Kappa Asta	6	625000.0	54000	Petrol	Direct Owner	Manual	First Owner
4337	Maruti Ritz LXi	7	343750.0	164000	Petrol	Direct Owner	Manual	First Owner
4338	Honda Amaze VX Diesel BSIV	5	975000.0	36114	Diesel	Broker	Manual	First Owner
4339	Honda Brio VX	9	431250.0	62000	Petrol	Broker	Manual	First Owner

Analysis

In [8]:
```
df.columns = df.columns.str.replace("Unnamed: 4", "FuelType")
display(df.head())
```

	CarModel	AgeOfCar	Price	OdoMeterReading	FuelType	DealingType	GearSystem	NoOfOwners
0	Ford Figo Aspire 1.5 TDCi Trend	8	574998.75	152620	Diesel	Broker	Manual	First Owner
1	Mahindra Scorpio SLE BSIV	11	656250.00	149000	Diesel	Direct Owner	Manual	First Owner
2	Tata Manza Club Class Quadrajet90 LS	9	250000.00	104000	Diesel	Direct Owner	Manual	First Owner
3	Toyota Corolla Altis 1.8 VL AT	13	437500.00	84000	Petrol	Direct Owner	Automatic	Third Owner
4	Tata Indigo CS eLS BS IV	12	225000.00	124000	Diesel	Direct Owner	Manual	First Owner

In [5]:
```
print("Shape of The Dataset: ",df.shape)
```

```
Shape of The Dataset:  (4340, 8)
```

In [6]:
```
display(df.isnull().sum())
```

```
CarModel          0
AgeOfCar          0
Price             0
OdoMeterReading   0
Unnamed: 4        0
DealingType       0
GearSystem        0
NoOfOwners        0
dtype: int64
```

In [9]:
```
display(df.describe())
```

	AgeOfCar	Price	OdoMeterReading
count	4340.000000	4.340000e+03	4340.000000
mean	9.909217	6.301591e+05	70215.777419
std	4.215344	7.231859e+05	46644.102194
min	3.000000	2.500000e+04	4001.000000
25%	7.000000	2.609372e+05	39000.000000
50%	9.000000	4.375000e+05	64000.000000
75%	12.000000	7.500000e+05	94000.000000
max	31.000000	1.112500e+07	810599.000000

In [10]:
```
display(df.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4340 entries, 0 to 4339
Data columns (total 8 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   CarModel         4340 non-null   object 
 1   AgeOfCar         4340 non-null   int64  
 2   Price            4340 non-null   float64
 3   OdoMeterReading  4340 non-null   int64  
 4   FuelType         4340 non-null   object 
 5   DealingType      4340 non-null   object 
 6   GearSystem       4340 non-null   object 
 7   NoOfOwners       4340 non-null   object 
dtypes: float64(1), int64(2), object(5)
memory usage: 271.4+ KB

None
```

In [11]:
```
display(df.nunique())
```

```
CarModel           1491
AgeOfCar             27
Price               445
OdoMeterReading     770
FuelType              5
DealingType           3
GearSystem            2
NoOfOwners            5
dtype: int64
```

In [12]:
```
count_row = df.shape[0]
count_col = df.shape[1]
print("Total Rows: ", count_row)
print("Total Columns:", count_col)
print("*"*25)
```

```
Total Rows:  4340
Total Columns: 8
*************************
```

In [13]:

```
display(df.isnull().sum())
```

```
CarModel           0
AgeOfCar           0
Price              0
OdoMeterReading    0
FuelType           0
DealingType        0
GearSystem         0
NoOfOwners         0
dtype: int64
```

In [14]:

```
#Checking for dupicate values
display(df.nunique())
```

```
CarModel           1491
AgeOfCar             27
Price               445
OdoMeterReading     770
FuelType              5
DealingType           3
GearSystem            2
NoOfOwners            5
dtype: int64
```

In [15]:

```
display(df.max())
```

```
CarModel           Volvo XC60 D5 Inscription
AgeOfCar                                  31
Price                             11125000.0
OdoMeterReading                       810599
FuelType                              Petrol
DealingType                 Trustmark Broker
GearSystem                            Manual
NoOfOwners                       Third Owner
dtype: object
```

In [17]:

```
display(df.columns)
```

```
Index(['CarModel', 'AgeOfCar', 'Price', 'OdoMeterReading', 'FuelType',
       'DealingType', 'GearSystem', 'NoOfOwners'],
      dtype='object')
```

In [20]:

```
display(df['CarModel'].value_counts())
```

```
Maruti Swift Dzire VDI                          69
Maruti Alto 800 LXI                             59
Maruti Alto LXi                                 47
Maruti Alto LX                                  35
Hyundai EON Era Plus                            35
                                                ..
Maruti Ertiga VDI Limited Edition                1
Maruti Swift Dzire Tour LDI                      1
Skoda Octavia Ambiente 1.9 TDI MT                1
Skoda Rapid 1.6 MPI Active                       1
Ford EcoSport 1.5 TDCi Titanium Plus BE BSIV     1
Name: CarModel, Length: 1491, dtype: int64
```

In [21]:

```
display(df['FuelType'].value_counts())
```

```
Diesel      2153
Petrol      2123
CNG           40
LPG           23
Electric       1
Name: FuelType, dtype: int64
```

In [22]:

```
display(df['NoOfOwners'].value_counts())
```

```
First Owner             2832
Second Owner            1106
Third Owner              304
Fourth & Above Owner      81
Test Drive Car            17
Name: NoOfOwners, dtype: int64
```

In [23]:

```
display(df['GearSystem'].value_counts())
```

```
Manual       3892
Automatic     448
Name: GearSystem, dtype: int64
```

In [24]:

```
display(df['DealingType'].value_counts())
```

```
Direct Owner        3244
Broker               994
Trustmark Broker     102
Name: DealingType, dtype: int64
```

Transformation

Feature Engineering

In [30]:

```python
label_encoder =preprocessing.LabelEncoder()

df['Encoded_FuelType'] = label_encoder.fit_transform(df['FuelType'])

df['Encoded_DealingType'] = label_encoder.fit_transform(df['DealingType'])

df['Encoded_GearSystem'] = label_encoder.fit_transform(df['GearSystem'])
print("-"*25)
display(df['GearSystem'].unique())
display(df['Encoded_GearSystem'].unique())
print("-"*25)

display(df['DealingType'].unique())
display(df['Encoded_DealingType'].unique())
print("-"*25)

display(df['FuelType'].unique())

display(df['Encoded_FuelType'].unique())
```

```
-------------------------

array(['Manual', 'Automatic'], dtype=object)

array([1, 0])

-------------------------

array(['Broker', 'Direct Owner', 'Trustmark Broker'], dtype=object)

array([0, 1, 2])

-------------------------

array(['Diesel', 'Petrol', 'CNG', 'Electric', 'LPG'], dtype=object)

array([1, 4, 0, 2, 3])
```

In [31]:

```
encoder = OneHotEncoder(handle_unknown='ignore')

encoder_df = pd.DataFrame(encoder.fit_transform(df[['NoOfOwners']]).toarray())
encoder_df.rename(columns = {1: "Fuel_Diesel", 4:"Fuel_Petrol", 0: "Fuel_CNG", 2:"Fuel_Electric", 3:"Fuel_LPG"}, inplace = True)

encoded_df = df.join(encoder_df)
display(encoded_df.head())
```

	CarModel	AgeOfCar	Price	OdoMeterReading	FuelType	DealingType	GearSystem	NoOfOwners	Encoded_FuelType	Encoded_DealingType	Encoded_GearSystem	Fuel_CNG	Fuel_Diesel	Fuel_Electric	Fuel_LP
0	Ford Figo Aspire 1.5 TDCi Trend	8	574998.75	152620	Diesel	Broker	Manual	First Owner	1	0	1	1.0	0.0	0.0	0
1	Mahindra Scorpio SLE BSIV	11	656250.00	149000	Diesel	Direct Owner	Manual	First Owner	1	1	1	1.0	0.0	0.0	0
2	Tata Manza Club Class Quadrajet90 LS	9	250000.00	104000	Diesel	Direct Owner	Manual	First Owner	1	1	1	1.0	0.0	0.0	0
3	Toyota Corolla Altis 1.8 VL AT	13	437500.00	84000	Petrol	Direct Owner	Automatic	Third Owner	4	1	0	0.0	0.0	0.0	0
4	Tata Indigo CS eLS BS IV	12	225000.00	124000	Diesel	Direct Owner	Manual	First Owner	1	1	1	1.0	0.0	0.0	0

Linear Regression Model

In [32]:

```
data = encoded_df
data = data.drop(['CarModel','FuelType',
         'DealingType', 'GearSystem', 'NoOfOwners'], axis = 1)
```

In [33]:

```
display(data.head())
```

	AgeOfCar	Price	OdoMeterReading	Encoded_FuelType	Encoded_DealingType	Encoded_GearSystem	Fuel_CNG	Fuel_Diesel	Fuel_Electric	Fuel_LPG	Fuel_Petrol
0	8	574998.75	152620	1	0	1	1.0	0.0	0.0	0.0	0.0
1	11	656250.00	149000	1	1	1	1.0	0.0	0.0	0.0	0.0
2	9	250000.00	104000	1	1	1	1.0	0.0	0.0	0.0	0.0
3	13	437500.00	84000	4	1	0	0.0	0.0	0.0	0.0	1.0
4	12	225000.00	124000	1	1	1	1.0	0.0	0.0	0.0	0.0

In [34]:

```python
y = data['Price']

X = data.drop('Price', axis = 1)

X= data.drop('Price', 1)
Y= data.Price

X_train, X_test, y_train, y_test = train_test_split(X, Y, train_size=0.7, test_size=0.3, random_state=100)
```

In [36]:

```python
lm = LinearRegression()
lm.fit(X_train, y_train)
```

Out[36]:

```
LinearRegression()
```

In [39]:

```python
y_pred = lm.predict(X_test)
print(r2_score(y_true=y_test, y_pred = y_pred))
```

```
0.4433208986398238
```

Min_Max Scaling

In [15]:

```python
#Feature scaling for Age of car
scaler_age = StandardScaler()
scaler_age.fit(df[['AgeOfCar']])
scaler_age.transform(df[['AgeOfCar']])
```

Out[15]:

```
array([[-0.4529729 ],
       [ 0.2587948 ],
       [-0.215717  ],
       ...,
       [-0.69022881],
       [-1.16474061],
       [-0.215717  ]])
```

In [16]:

```python
df.AgeOfCar
```

Out[16]:

```
0        8
1       11
2        9
3       13
4       12
        ..
4335     9
4336     6
4337     7
4338     5
4339     9
Name: AgeOfCar, Length: 4340, dtype: int64
```

Feature Scaling for Price

In [17]:

```
scaler_price = StandardScaler()
scaler_price.fit(df[['Price']])
scaler_price.transform(df[['Price']])
```

Out[17]:

```
array([[-0.07628294],
       [ 0.03608182],
       [-0.52573333],
       ...,
       [-0.39608368],
       [ 0.47689064],
       [-0.27507734]])
```

Feature scaling for Odometer Reading

In [18]:

```
scaler_omr = StandardScaler()
scaler_omr.fit(df[['OdoMeterReading']])
scaler_omr.transform(df[['OdoMeterReading']])
```

Out[18]:

```
array([[ 1.76686256],
       [ 1.68924466],
       [ 0.7243813 ],
       ...,
       [ 2.01086578],
       [-0.73119012],
       [-0.17615784]])
```

ENCODING/TRANSFORMATION

ENCODING AND TRANSFORMATION

In [19]:

```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()


df['GearSystem_LE']= le.fit_transform(df['GearSystem'])

df['GearSystem_LE'].unique()


```

Out[19]:

```
array([1, 0])
```

In [20]:

```python
df
```

Out[20]:

	CarModel	AgeOfCar	Price	OdoMeterReading	Unnamed: 4	DealingType	GearSystem	NoOfOwners	GearSystem_LE
0	Ford Figo Aspire 1.5 TDCi Trend	8	574998.75	152620	Diesel	Broker	Manual	First Owner	1
1	Mahindra Scorpio SLE BSIV	11	656250.00	149000	Diesel	Direct Owner	Manual	First Owner	1
2	Tata Manza Club Class Quadrajet90 LS	9	250000.00	104000	Diesel	Direct Owner	Manual	First Owner	1
3	Toyota Corolla Altis 1.8 VL AT	13	437500.00	84000	Petrol	Direct Owner	Automatic	Third Owner	0
4	Tata Indigo CS eLS BS IV	12	225000.00	124000	Diesel	Direct Owner	Manual	First Owner	1
...	...	...	...	...	...	...	...	...	...
4335	Hyundai EON Era	9	362500.00	16000	Petrol	Broker	Manual	First Owner	1
4336	Hyundai Grand i10 1.2 Kappa Asta	6	625000.00	54000	Petrol	Direct Owner	Manual	First Owner	1
4337	Maruti Ritz LXi	7	343750.00	164000	Petrol	Direct Owner	Manual	First Owner	1
4338	Honda Amaze VX Diesel BSIV	5	975000.00	36114	Diesel	Broker	Manual	First Owner	1
4339	Honda Brio VX	9	431250.00	62000	Petrol	Broker	Manual	First Owner	1

4340 rows × 9 columns

In [21]:

```python
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()


df['DealingType_LE']= le.fit_transform(df['DealingType'])

df['DealingType_LE'].unique()

```

Out[21]:

```
array([0, 1, 2])
```

In [ ]:

```python

```

In [22]:

```

from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()

df['']
```

```
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
File ~\anaconda3\lib\site-packages\pandas\core\indexes\base.py:3621, in Index.get_loc(self, key, method, tolerance)
   3620 try:
-> 3621     return self._engine.get_loc(casted_key)
   3622 except KeyError as err:

File ~\anaconda3\lib\site-packages\pandas\_libs\index.pyx:136, in pandas._libs.index.IndexEngine.get_loc()

File ~\anaconda3\lib\site-packages\pandas\_libs\index.pyx:163, in pandas._libs.index.IndexEngine.get_loc()

File pandas\_libs\hashtable_class_helper.pxi:5198, in pandas._libs.hashtable.PyObjectHashTable.get_item()

File pandas\_libs\hashtable_class_helper.pxi:5206, in pandas._libs.hashtable.PyObjectHashTable.get_item()

KeyError: ''

The above exception was the direct cause of the following exception:

KeyError                                  Traceback (most recent call last)
Input In [22], in <cell line: 4>()
      1 from sklearn.preprocessing import LabelEncoder
      2 le = LabelEncoder()
----> 4 df['']

File ~\anaconda3\lib\site-packages\pandas\core\frame.py:3505, in DataFrame.__getitem__(self, key)
   3503 if self.columns.nlevels > 1:
   3504     return self._getitem_multilevel(key)
-> 3505 indexer = self.columns.get_loc(key)
   3506 if is_integer(indexer):
   3507     indexer = [indexer]

File ~\anaconda3\lib\site-packages\pandas\core\indexes\base.py:3623, in Index.get_loc(self, key, method, tolerance)
   3621     return self._engine.get_loc(casted_key)
   3622 except KeyError as err:
-> 3623     raise KeyError(key) from err
   3624 except TypeError:
   3625     # If we have a listlike key, _check_indexing_error will raise
   3626     #  InvalidIndexError. Otherwise we fall through and re-raise
   3627     #  the TypeError.
   3628     self._check_indexing_error(key)

KeyError: ''
```

GENERATION

In [ ]:

```
df['price_age_correlation']=df['Price'] /df['AgeOfCar']
```

In [ ]:

```

df
```

LINEAR REGRESSION MODEL

In [ ]:

```
#IMPORTING REQUIRED LIBRARIES
```

In [ ]:

```
df.info()
```

In [ ]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score
```

In [ ]:

```
X = df[['AgeOfCar','OdoMeterReading','GearSystem_LE','price_age_correlation']]
y = df['Price']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.4)
linear_regressor = LinearRegression()
linear_regressor.fit(X_train, y_train)
y_pred = linear_regressor.predict(X_test)
r2_score(y_test, y_pred)
```

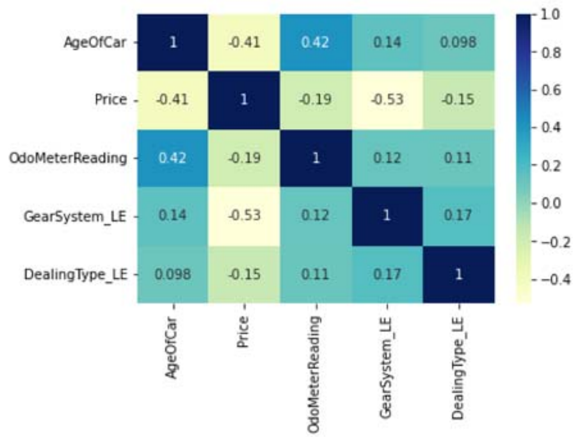
EXPLOARATORY DATA ANALYSIS

In [23]:

```
import pandas as pd
import pandas_profiling as pp
import seaborn as sns
import plotly.express as plt
```

In [24]:

```
#How can the above data be visualised alltogethr to give a gist of correlation between the elements
dataplot = sns.heatmap(df.corr(),cmap="YlGnBu",annot=True)
```



observatiions

1)We can observe that price and age are almost a perfect correlation
2)we can note that odometer reading and age of car are moderately related
3)we can see that there is almost moderate relationship between gearsystem and price of a car
4)we can see that there almost negliible relationship between DealingType and age of car

In [40]:

```
#Do people prefer owning pre-owned cars or new cars?
fig = plt.pie(df,'NoOfOwners')
fig.show()
```

OBSERVARTION

1)Majority of the cars are first hand and quater of the rest are second hand cars
2)A very small population of cars are 4th owner and abve
3)A negligble population have owned a test drive car
4)A vast majority of people like owning a new car over apre-owned one

In [26]:

```
#which fuel is the most used one?

fig =plt.bar(df,x='Unnamed: 4')
fig.show()
```

OBSERVATION
1)Majority of the cars are diesel based and very high majority which is almost equilvant to diesel baseed cars are petrol based as well
2)There is a negligble amount of cars running on renewable energy hence proving automobiles are not eco-friendly for the planet 3)There are no cars no running on Electrity

In [27]:
```
#What is The relationship between AGE of car and Number of OWNERS?
fig = plt.box(df,x='NoOfOwners',y='AgeOfCar')
fig.show()
```

OBSERVATION

1)We can observe that as number of owners increase so does the age of car implying that age of car and the number of owners are directly proportional

2)There is high quantity of outliers

3)the realtioship between age of car and test drive car is almost negligle and tending towards non-existent

In [28]:

```
#Q5)what is the relationship between age of car and dealing type?
fig = plt.scatter(df,y='AgeOfCar',x='DealingType')
fig.show()
```

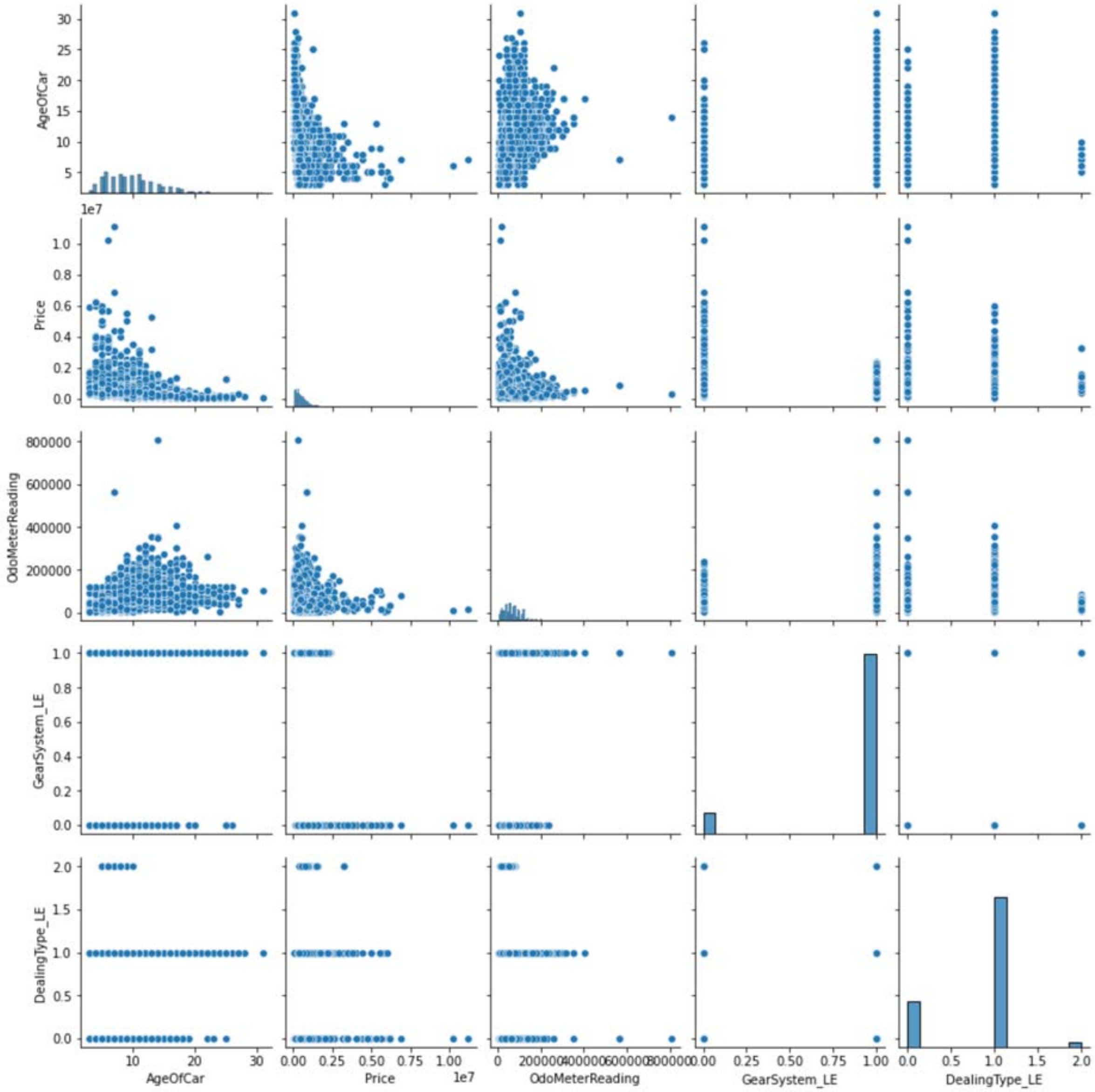
OBSERVATIONS

1)We can observe that trustmark brokership cars are very new and their age is less than decade
2)We can observe that the cars sold by Brokers have at least 2 decades and still runnning
3)We can observe that the cars which are directly owned by the owner have the maximum life

In [29]:

```
#visualise all of the above data in maps for comprehensible interpretation
a=sns.pairplot(df)

```



In [ ]:

```

```

In [31]:

```
df.to_csv("C:/Users/GULAFSHAN/Downloads/Lab01Final")
```

In [32]:

```
df.to_csv("C:/Users/GULAFSHAN/Downloads/Lab01Final")
```

In [39]:

```
df2= pd.read_csv("C:/Users/GULAFSHAN/Downloads/Lab01Final")
```

In [36]:

```
df
```

Out[36]:

	CarModel	AgeOfCar	Price	OdoMeterReading	Unnamed: 4	DealingType	GearSystem	NoOfOwners	GearSystem_LE	DealingType_LE
0	Ford Figo Aspire 1.5 TDCi Trend	8	574998.75	152620	Diesel	Broker	Manual	First Owner	1	0
1	Mahindra Scorpio SLE BSIV	11	656250.00	149000	Diesel	Direct Owner	Manual	First Owner	1	1
2	Tata Manza Club Class Quadrajet90 LS	9	250000.00	104000	Diesel	Direct Owner	Manual	First Owner	1	1
3	Toyota Corolla Altis 1.8 VL AT	13	437500.00	84000	Petrol	Direct Owner	Automatic	Third Owner	0	1
4	Tata Indigo CS eLS BS IV	12	225000.00	124000	Diesel	Direct Owner	Manual	First Owner	1	1
...	...	...	...	...	...	...	...	...	...	...
4335	Hyundai EON Era	9	362500.00	16000	Petrol	Broker	Manual	First Owner	1	0
4336	Hyundai Grand i10 1.2 Kappa Asta	6	625000.00	54000	Petrol	Direct Owner	Manual	First Owner	1	1
4337	Maruti Ritz LXi	7	343750.00	164000	Petrol	Direct Owner	Manual	First Owner	1	1
4338	Honda Amaze VX Diesel BSIV	5	975000.00	36114	Diesel	Broker	Manual	First Owner	1	0
4339	Honda Brio VX	9	431250.00	62000	Petrol	Broker	Manual	First Owner	1	0

4340 rows × 10 columns

In [ ]:

```

```