In [80]:
```
#Activity 1:Collect the dataset
#Activity 1.1:Importing the libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier,GradientBoostingRegress
from sklearn.tree import DecisionTreeClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import f1_score
from sklearn.metrics import classification_report,confusion_matrix
import warnings
import pickle
from scipy import stats
warnings.filterwarnings('ignore')
```

In [81]:
```
#Activity 1.2:Reading the Dataset
import pandas as pd
df=pd.read_csv("E:\\NMDS\\FlightBooking.csv")
```

Out[81]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Duration
0	IndiGo	24/03/2019	Banglore	New Delhi	BLR ? DEL	22:20	01:10 22 Mar	2h 50m
1	Air India	1/05/2019	Kolkata	Banglore	CCU ? IXR ? BBI ? BLR	05:50	13:15	7h 25m
2	Jet Airways	9/06/2019	Delhi	Cochin	DEL ? LKO ? BOM ? COK	09:25	04:25 10 Jun	19h
3	IndiGo	12/05/2019	Kolkata	Banglore	CCU ? NAG ? BLR	18:05	23:30	5h 25m
4	IndiGo	01/03/2019	Banglore	New Delhi	BLR ? NAG ? DEL	16:50	21:35	4h 45m

In [82]:
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10683 entries, 0 to 10682
Data columns (total 11 columns):
 #   Column           Non-Null Count  Dtype 
---  ------           --------------  ----- 
 0   Airline          10683 non-null  object
 1   Date_of_Journey  10683 non-null  object
 2   Source           10683 non-null  object
 3   Destination      10683 non-null  object
 4   Route            10682 non-null  object
 5   Dep_Time         10683 non-null  object
 6   Arrival_Time     10683 non-null  object
 7   Duration         10683 non-null  object
 8   Total_Stops      10682 non-null  object
 9   Additional_Info  10683 non-null  object
 10  Price            10683 non-null  int64 
dtypes: int64(1), object(10)
memory usage: 918.2+ KB
```

In [83]:
```
#import prision
#from prision import Category
#for i in category:
```

In [84]:
```
#We now split the Date column to extract the 'Date','Month' and 'Year' valu
#new columns in our data frame
df.date_of_Journey=df.Date_of_Journey.str.split('/')
```

Out[84]:
```
0        24/03/2019
1         1/05/2019
2         9/06/2019
3        12/05/2019
4        01/03/2019
            ...
10678     9/04/2019
10679    27/04/2019
10680    27/04/2019
10681    01/03/2019
10682     9/05/2019
Name: Date_of_Journey, Length: 10683, dtype: object
```

In [85]:
```
#Traiting the data_column
df['Date']=df.Date_of_Journey.str[0]
df['Month']=df.Date_of_Journey.str[1]
```

In [86]:
```
#Split the Route column
```

Out[86]:
```
array(['non-stop', '2 stops', '1 stop', '3 stops', nan, '4 stops'],
      dtype=object)
```

In [87]:
```
#We split the data in route column
df.Route=df.Route.astype(str).str.split('->')
df.Route
```

Out[87]:
```
0                    [BLR ? DEL]
1          [CCU ? IXR ? BBI ? BLR]
2          [DEL ? LKO ? BOM ? COK]
3                [CCU ? NAG ? BLR]
4                [BLR ? NAG ? DEL]
                    ...
10678                [CCU ? BLR]
10679                [CCU ? BLR]
10680                [BLR ? DEL]
10681                [BLR ? DEL]
10682      [DEL ? GOI ? BOM ? COK]
Name: Route, Length: 10683, dtype: object
```

In [88]:
```
df['City1']=df.Route.str[0]
df['City2']=df.Route.str[1]
df['City3']=df.Route.str[2]
df['City4']=df.Route.str[3]
df['City5']=df.Route.str[4]
```

In [89]:
```
#In similar manner, we split the Dep_time column, and create separate for d
df.Dep_Time=df.Dep_Time.astype(str).str.split(':')
df['Dep_Time_Hour']=df.Dep_Time.str[0]
df['Dep_Time_Mins']=df.Dep_Time.str[1]
```

In [90]:
```
#We also split the Arrival_Time Column
df.Arrival_Time=df.Arrival_Time.astype(str).str.split('')
df['Arrival_date']=df.Arrival_Time.str[1]
```

In [91]:
```
df['Time_of_Arrival']=df.Time_of_Arrival.astype(str).str.split(':')
df['Arrival_Time_Hour']=df.Time_of_Arrival.str[0]
```

In [92]:
```
#we also treat the 'Total_stops', column, and replace non-stop flights with
#extract the integer part of the "Total_Stops"
df.Total_Stops.replace('npn_stop',0,inplace=True)
df.Total_Stops=df.Total_Stops.str.split('')
```

In [93]:
```
df.Additional_Info.unique()
```

Out[93]:
```
array(['No info', 'In-flight meal not included',
       'No check-in baggage included', '1 Short layover', 'No Info',
       '1 Long layover', 'Change airports', 'Business class',
       'Red-eye flight', '2 Long layover'], dtype=object)
```

In [94]:

In [95]:

Out[95]:
```
(10683, 26)
```

In [96]:

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10683 entries, 0 to 10682
Data columns (total 26 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Airline            10683 non-null  object 
 1   Date_of_Journey    10683 non-null  object 
 2   Source             10683 non-null  object 
 3   Destination        10683 non-null  object 
 4   Route              10683 non-null  object 
 5   Dep_Time           10683 non-null  object 
 6   Arrival_Time       10683 non-null  object 
 7   Duration           10683 non-null  object 
 8   Total_Stops        10682 non-null  object 
 9   Additional_Info    10683 non-null  object 
 10  Price              10683 non-null  int64  
 11  Date               10683 non-null  object 
 12  Month              10683 non-null  object 
 13  Year               10683 non-null  object 
 14  City1              10683 non-null  object 
 15  City2              0 non-null      float64
 16  City3              0 non-null      float64
 17  City4              0 non-null      float64
 18  City5              0 non-null      float64
 19  City6              0 non-null      float64
 20  Dep_Time_Hour      10683 non-null  object 
 21  Dep_Time_Mins      10683 non-null  object 
 22  Arrival_date       10683 non-null  object 
 23  Time_of_Arrival    10683 non-null  object 
 24  Arrival_Time_Hour  10683 non-null  object 
 25  Arrival_Time_Mins  0 non-null      float64
dtypes: float64(6), int64(1), object(19)
memory usage: 2.1+ MB
```

In [97]:

```
#we also drop some columns  like 'city6' an 'city5', since majority of the 
#df.drop(['City4','City5','City6'],axis=1,inplace=True)
#df.drop(['Date_of_Journey','Route','Dep_Time','Duration'],axis=1,inplace=T
```

In [98]:

Out[98]:
```
Airline                0
Date_of_Journey        0
Source                 0
Destination            0
Route                  0
Dep_Time               0
Arrival_Time           0
Duration               0
Total_Stops            1
Additional_Info        0
Price                  0
Date                   0
Month                  0
Year                   0
City1                  0
City2              10683
City3              10683
City4              10683
City5              10683
City6              10683
Dep_Time_Hour          0
Dep_Time_Mins          0
Arrival_date           0
Time_of_Arrival        0
Arrival_Time_Hour      0
Arrival_Time_Mins  10683
dtype: int64
```

In [99]:
```
#Activity 2.1:Replacing Missing Values
#filling City3 as None, the missing value are less
df['City3'].fillna('None,inplace=True')
```

Out[99]:
```
0        None,inplace=True
1        None,inplace=True
2        None,inplace=True
3        None,inplace=True
4        None,inplace=True
              ...
10678    None,inplace=True
10679    None,inplace=True
10680    None,inplace=True
10681    None,inplace=True
10682    None,inplace=True
Name: City3, Length: 10683, dtype: object
```

In [100]:
```
#filling Arrival_Date as Departure_Date
```

In [101]:
```
#filling Travel_Mins as Zero(0)
#df['Travel_Mins'].fillna(0,inplace=True)
```

In [102]:

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10683 entries, 0 to 10682
Data columns (total 26 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Airline            10683 non-null  object 
 1   Date_of_Journey    10683 non-null  object 
 2   Source             10683 non-null  object 
 3   Destination        10683 non-null  object 
 4   Route              10683 non-null  object 
 5   Dep_Time           10683 non-null  object 
 6   Arrival_Time       10683 non-null  object 
 7   Duration           10683 non-null  object 
 8   Total_Stops        10682 non-null  object 
 9   Additional_Info    10683 non-null  object 
 10  Price              10683 non-null  int64  
 11  Date               10683 non-null  object 
 12  Month              10683 non-null  object 
 13  Year               10683 non-null  object 
 14  City1              10683 non-null  object 
 15  City2              0 non-null      float64
 16  City3              0 non-null      float64
 17  City4              0 non-null      float64
 18  City5              0 non-null      float64
 19  City6              0 non-null      float64
 20  Dep_Time_Hour      10683 non-null  object 
 21  Dep_Time_Mins      10683 non-null  object 
 22  Arrival_date       10683 non-null  object 
 23  Time_of_Arrival    10683 non-null  object 
 24  Arrival_Time_Hour  10683 non-null  object 
 25  Arrival_Time_Mins  10683 non-null  float64
dtypes: float64(6), int64(1), object(19)
memory usage: 2.1+ MB
```

In [103]:

Out[103]:

```
Price               1.812552
Date                1.298651
City2                    NaN
City3                    NaN
City4                    NaN
City5                    NaN
City6                    NaN
Dep_Time_Hour       0.113073
Dep_Time_Mins       0.167029
Arrival_date        0.151783
Arrival_Time_Mins   0.000000
dtype: float64
```

In [104]:
```
#changing the numerical columns from object to int
#df.Total_Stops=df.Total_Stops.astype('int64')
df.Date=df.Date.astype('int64')
df.Month=df.Month.astype(str)
df.Year=df.Year.astype(str)
df.Dep_Time_Hour=df.Dep_Time_Hour.astype('int64')
df.Dep_Time_Hour=df.Dep_Time_Hour.astype('int64')
df.Dep_Time_Mins=df.Dep_Time_Mins.astype('int64')
```

In [105]:

Out[105]:
```
[0        False
 1        False
 2        False
 3        False
 4        False
          ...
 10678    False
 10679    False
 10680    False
 10681    False
 10682    False
 Name: Arrival_Time_Hour, Length: 10683, dtype: bool]
```

In [106]:

In [107]:
```
#df.Travel_Hours=df.Travel_Hours.astype('int64')
```

In [108]:
```
#Creating a list of Different types of Columns
Categorical=['Airline','Source','Destination','Additional_Info','City1']
Numerical=['Total_Stops','Date','Month','Year','Dep_Time_Hour','Dep_Time_Mi
```

In [109]:
```
#Activity 2.2: Label Encoding
from sklearn.preprocessing import LabelEncoder
le=LabelEncoder()
df.Airline=le.fit_transform(df.Airline)
df.Source=le.fit_transform(df.Source)
df.Destination=le.fit_transform(df.Destination)
df.Total_Stops=le.fit_transform(df.Total_Stops)
df.City1=le.fit_transform(df.City1)
df.City2=le.fit_transform(df.City2)
df.City3=le.fit_transform(df.City3)
df.Additional_info=le.fit_transform(df.Additional_Info)
```

Out[109]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Duration	T
0	3	24/03/2019	0	5	[BLR ? DEL]	[22, 20]	[, 0, 1, :, 1, 0, , 2, 2, , M, a, r,]	2h 50m	
1	1	1/05/2019	3	0	[CCU ? IXR ? BBI ? BLR]	[05, 50]	[, 1, 3, :, 1, 5,]	7h 25m	
2	4	9/06/2019	2	1	[DEL ? LKO ? BOM ? COK]	[09, 25]	[, 0, 4, :, 2, 5, , 1, 0, , J, u, n,]	19h	
3	3	12/05/2019	3	0	[CCU ? NAG ? BLR]	[18, 05]	[, 2, 3, :, 3, 0,]	5h 25m	
4	3	01/03/2019	0	5	[BLR ? NAG ? DEL]	[16, 50]	[, 2, 1, :, 3, 5,]	4h 45m	

5 rows × 26 columns

In [110]:
```
#Activity 2.3: Output Columns
df=df[['Airline','Source','Destination','Date','Month','Year','Dep_Time_Hou
       'Arrival_Time_Hour','Arrival_Time_Mins','Price']]
```

Out[110]:

	Airline	Source	Destination	Date	Month	Year	Dep_Time_Hour	Dep_Time_Mins	Arrival_
0	3	0	5	2	4	/	22	20	
1	1	3	0	1	/	0	5	50	
2	4	2	1	9	/	0	9	25	
3	3	3	0	1	2	/	18	5	
4	3	0	5	0	1	/	16	50	

In [111]:
```
#Activity 3:Exploratory Data Analyis
#Activity 3.1: Descriptive statistical
```

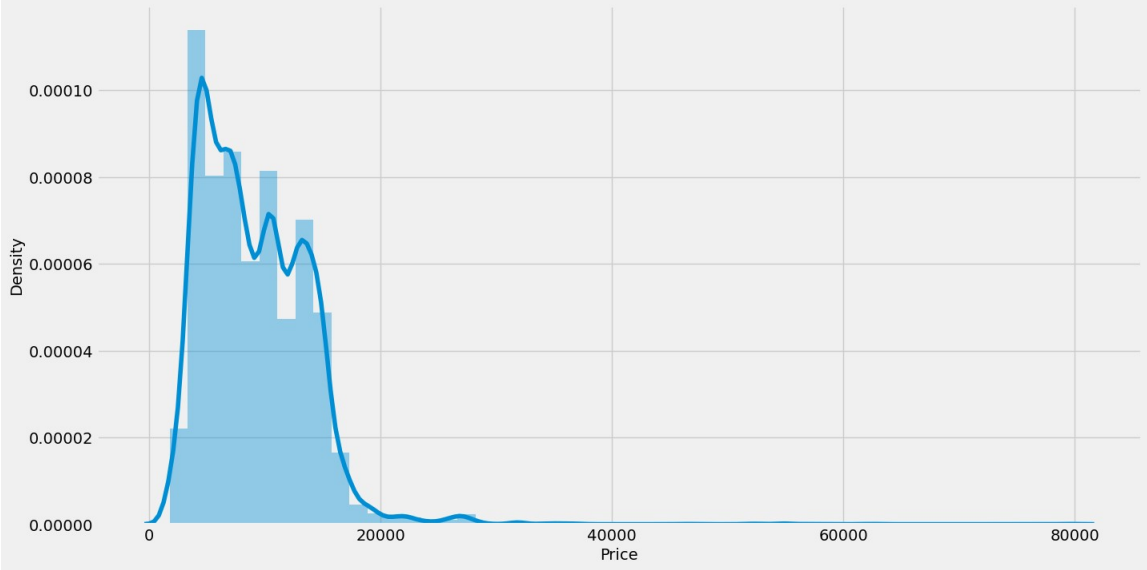
Out[111]:

	Airline	Source	Destination	Date	Dep_Time_Hour	Dep_Time_M
count	10682.000000	10682.000000	10682.000000	10682.000000	10682.000000	10682.000
mean	3.966205	1.952069	1.435967	2.941678	12.490358	24.408
std	2.352090	1.177110	1.474773	2.732095	5.748819	18.767
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000
25%	3.000000	2.000000	0.000000	1.000000	8.000000	5.000
50%	4.000000	2.000000	1.000000	2.000000	11.000000	25.000
75%	4.000000	3.000000	2.000000	3.000000	18.000000	40.000
max	11.000000	4.000000	5.000000	9.000000	23.000000	55.000

In [112]:
```
#Ploting Countplots for Categorical Data
import matplotlib.pyplot as plt
import seaborn as sns
c=1
plt.figure(figsize=(20,45))
for i in Categorical:
    plt.subplot(6,3,c)
    sns.countplot(df[i])
    plt.xticks(rotation=90)
    plt.tight_layout(pad=3.0)
    c=c+1
```

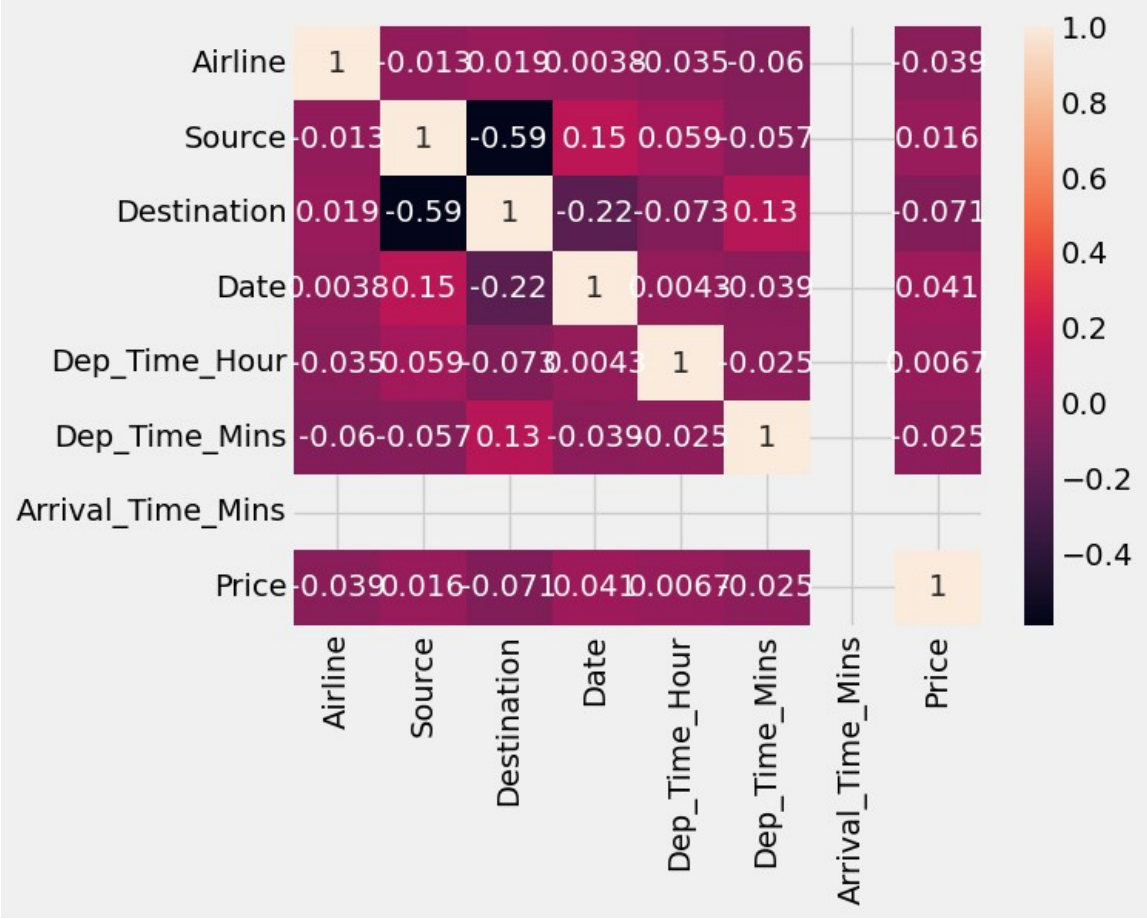
In [114]:
```
#Distribution of price column
plt.figure(figsize=(15,8))
```

Out[114]: <Axes: xlabel='Price', ylabel='Density'>



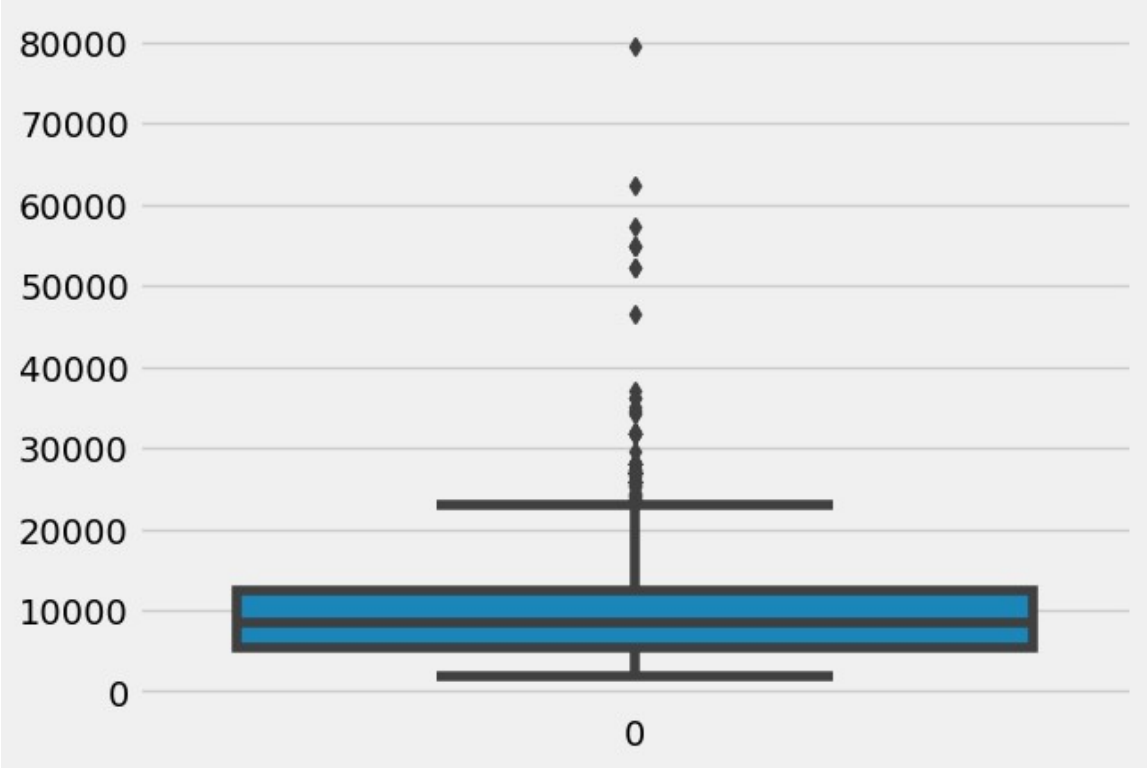
In [113]:

Out[113]: <Axes: >



In [115]:
```
#Detecting Outliers
import seaborn as sns
```

Out[115]: <Axes: >



In [ ]:
```
#Scaling the data
df=df[['Airline','Source','Destination','Date','Month','Year','Dep_Time_Hou
          'Arrival_Time_Hour','Arrival_Time_Mins','Price']]
y=df['Price']
x=df.drop(columns=['Price'],axis=1)
import pandas as pd
from sklearn.preprocessing import StandardScaler
ss=StandardScaler()
#x_scaled=ss.fit_transform(x)
#x_scaled=pd.DataFrame(x_scaled,columns=x.columns)
```

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

In [ ]:

In [ ]:
```
#Model Building
#model 1:RandomForestClassifier,GradientBoostingRegressor,AdaBoostRegressor
from sklearn.ensemble import RandomForestClassifier,GradientBoostingRegress
rfr=RandomForestClassifier()
gb=GradientBoostingRegressor()
```

In [ ]:
```
from sklearn.metrics import f1_score
from sklearn.metrics import classification_report,confusion_matrix
from sklearn.metrics import r2_score,mean_absoulte_error,mean_squared_error
for i in [rfr,gb,ad]:
    i.fit(x_train,y_train)
    y_pred=i.predict(x_test)
test_score=r2_score(y_test,y_pred)
train_score=r2_score(y_train,i.predict(x_train))
if abs(train_score-test_score)<0.2:
    print(i)
    print("R2 score is",r2_score(y_test,y_pred))
    print("R2 for train data",r2_score(y_train,i.predict(x_train)))
    print("Mean Absoult Error is",mean_absolute_error(y_pred,y_test))
    print("Mean Squared Error is",mean_squared_error(y_pred,y_test))
```

In [ ]:
```
#model 2:RandomForestClassifier,GradientBoostingRegressor,AdaBoostRegressor
from sklearn.neighbors import KNeighborsRegressor
from sklearn.svm import SVR
from.sklearn.tree import DecisionTreeRegressor
from sklearn.metrics import r2_score,mean_absoulte_error,mean_squared_error
knn=KNeighborsRegressor()
svr=SVR()
dt=DecisionTreeRegressor()
for i in [knn,svr,dt]:
    i.fit(x_train,y_train)
    y_pred=i.predict(x_test)
test_score=r2_score(y_test,y_pred)
train_score=r2_score(y_train,i.predict(x_train))
if abs(train_score-test_score)<0.1:
    print(i)
    print("R2 score is",r2_score(y_test,y_pred))
    print("R2 for train data",r2_score(y_train,i.predict(x_train)))
    print("Mean Absoult Error is",mean_absolute_error(y_pred,y_test))
    print("Mean Squared Error is",mean_squared_error(y_pred,y_test))
    print("Root Mean Squared Error is",(mean_squared_error(y_pred,y_test,sq
```

In [ ]:
```
#model 3: Checking Cross Validation for RandomForestRegressor
from sklearn.model_selection import cross_val_score
from sklearn.ensemble import RandomForestClassifier,GradientBoostingRegress
rfr=RandomForestClassifier()
gb=GradientBoostingRegressor()
ad=AdaBoostRegressor()
for i in [rfr,gb,ad]:
    i.fit(x_train,y_train)
    y_pred=i.predict(x_test)
for i in range(2,5):
    CV=cross_val_score(rfr,x,y,CV=i)
```