Problem Statement:To predict which model is best suitable for the given dataset

In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.simplefilter(action='ignore')
```

Data Collection

In [2]:

```
train_df=pd.read_csv(r"C:\Users\91955\Desktop\Data Analysis with Python\Data_Train 1
train_df
```

Out[2]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Dura
0	IndiGo	24/03/2019	Banglore	New Delhi	BLR ? DEL	22:20	01:10 22 Mar	2h
1	Air India	1/05/2019	Kolkata	Banglore	CCU ? IXR ? BBI ? BLR	05:50	13:15	7h
2	Jet Airways	9/06/2019	Delhi	Cochin	DEL ? LKO ? BOM ? COK	09:25	04:25 10 Jun	
3	IndiGo	12/05/2019	Kolkata	Banglore	CCU ? NAG ? BLR	18:05	23:30	5h
4	IndiGo	01/03/2019	Banglore	New Delhi	BLR ? NAG ? DEL	16:50	21:35	4h
...	...	...	...	...	...	...	...	
10678	Air Asia	9/04/2019	Kolkata	Banglore	CCU ? BLR	19:55	22:25	2h
10679	Air India	27/04/2019	Kolkata	Banglore	CCU ? BLR	20:45	23:20	2h
10680	Jet Airways	27/04/2019	Banglore	Delhi	BLR ? DEL	08:20	11:20	
10681	Vistara	01/03/2019	Banglore	New Delhi	BLR ? DEL	11:30	14:10	2h
10682	Air India	9/05/2019	Delhi	Cochin	DEL ? GOI ? BOM ? COK	10:55	19:15	8h

10683 rows × 11 columns

In [3]:

```
test_df=pd.read_csv(r"C:\Users\91955\Desktop\Data Analysis with Python\Test_set 1.cs
test_df
```

Out[3]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Durat
0	Jet Airways	06-06-2019	Delhi	Cochin	DEL ? BOM ? COK	17:30	07-06-2023 04:25	10h 5
1	IndiGo	12-05-2019	Kolkata	Banglore	CCU ? MAA ? BLR	6:20	10:20	
2	Jet Airways	21-05-2019	Delhi	Cochin	DEL ? BOM ? COK	19:15	22-05-2023 19:00	23h 4
3	Multiple carriers	21-05-2019	Delhi	Cochin	DEL ? BOM ? COK	8:00	21:00	'
4	Air Asia	24-06-2019	Banglore	Delhi	BLR ? DEL	23:55	25-06-2023 02:45	2h 5
...	...	...	...	...	...	...	...	
2666	Air India	06-06-2019	Kolkata	Banglore	CCU ? DEL ? BLR	20:30	07-06-2023 20:25	23h 5
2667	IndiGo	27-03-2019	Kolkata	Banglore	CCU ? BLR	14:20	16:55	2h 3
2668	Jet Airways	06-03-2019	Delhi	Cochin	DEL ? BOM ? COK	21:50	07-03-2023 04:25	6h 3
2669	Air India	06-03-2019	Delhi	Cochin	DEL ? BOM ? COK	4:00	19:15	15h 1
2670	Multiple carriers	15-06-2019	Delhi	Cochin	DEL ? BOM ? COK	4:55	19:15	14h 2

2671 rows × 10 columns

Data Cleaning and Pre processing

In [4]:

```
train_df.head()
```

Out[4]:

	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 [5]:

```
test_df.head()
```

Out[5]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Duration
0	Jet Airways	06-06-2019	Delhi	Cochin	DEL ? BOM ? COK	17:30	07-06-2023 04:25	10h 55m
1	IndiGo	12-05-2019	Kolkata	Banglore	CCU ? MAA ? BLR	6:20	10:20	4h
2	Jet Airways	21-05-2019	Delhi	Cochin	DEL ? BOM ? COK	19:15	22-05-2023 19:00	23h 45m
3	Multiple carriers	21-05-2019	Delhi	Cochin	DEL ? BOM ? COK	8:00	21:00	13h
4	Air Asia	24-06-2019	Banglore	Delhi	BLR ? DEL	23:55	25-06-2023 02:45	2h 50m

In [6]:

```
train_df.tail()
```

Out[6]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Dura
10678	Air Asia	9/04/2019	Kolkata	Banglore	CCU ? BLR	19:55	22:25	2h
10679	Air India	27/04/2019	Kolkata	Banglore	CCU ? BLR	20:45	23:20	2h
10680	Jet Airways	27/04/2019	Banglore	Delhi	BLR ? DEL	08:20	11:20	
10681	Vistara	01/03/2019	Banglore	New Delhi	BLR ? DEL	11:30	14:10	2h
10682	Air India	9/05/2019	Delhi	Cochin	DEL ? GOI ? BOM ? COK	10:55	19:15	8h

In [7]:

```
test_df.tail()
```

Out[7]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Duratic
2666	Air India	06-06-2019	Kolkata	Banglore	CCU ? DEL ? BLR	20:30	07-06-2023 20:25	23h 55
2667	IndiGo	27-03-2019	Kolkata	Banglore	CCU ? BLR	14:20	16:55	2h 35
2668	Jet Airways	06-03-2019	Delhi	Cochin	DEL ? BOM ? COK	21:50	07-03-2023 04:25	6h 35
2669	Air India	06-03-2019	Delhi	Cochin	DEL ? BOM ? COK	4:00	19:15	15h 15
2670	Multiple carriers	15-06-2019	Delhi	Cochin	DEL ? BOM ? COK	4:55	19:15	14h 20

In [8]:

```
train_df.describe()
```

Out[8]:

	Price
count	10683.000000
mean	9087.064121
std	4611.359167
min	1759.000000
25%	5277.000000
50%	8372.000000
75%	12373.000000
max	79512.000000

In [9]:

```
test_df.describe()
```

Out[9]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Dura
count	2671	2671	2671	2671	2671	2671	2671	2
unique	11	40	5	6	100	199	704	
top	Jet Airways	09-05-2019	Delhi	Cochin	DEL ? BOM ? COK	10:00	19:00	2h
freq	897	144	1145	1145	624	62	113	

In [10]:

```
train_df.shape
```

Out[10]:

```
(10683, 11)
```

In [11]:

```
test_df.shape
```

Out[11]:

```
(2671, 10)
```

In [12]:

```
train_df.info()
```

```
<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 [13]:

```
test_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2671 entries, 0 to 2670
Data columns (total 10 columns):
 #   Column           Non-Null Count  Dtype 
---  ------           --------------  ----- 
 0   Airline          2671 non-null   object
 1   Date_of_Journey  2671 non-null   object
 2   Source           2671 non-null   object
 3   Destination      2671 non-null   object
 4   Route            2671 non-null   object
 5   Dep_Time         2671 non-null   object
 6   Arrival_Time     2671 non-null   object
 7   Duration         2671 non-null   object
 8   Total_Stops      2671 non-null   object
 9   Additional_Info  2671 non-null   object
dtypes: object(10)
memory usage: 208.8+ KB
```

In [14]:

```
train_df.duplicated().sum()
```

Out[14]:

```
220
```

In [15]:

```
test_df.duplicated().sum()
```

Out[15]:

```
26
```

In [16]:

```
train_df.columns
```

Out[16]:

```
Index(['Airline', 'Date_of_Journey', 'Source', 'Destination', 'Route',
       'Dep_Time', 'Arrival_Time', 'Duration', 'Total_Stops',
       'Additional_Info', 'Price'],
      dtype='object')
```

In [17]:

```
test_df.columns
```

Out[17]:

```
Index(['Airline', 'Date_of_Journey', 'Source', 'Destination', 'Route',
       'Dep_Time', 'Arrival_Time', 'Duration', 'Total_Stops',
       'Additional_Info'],
      dtype='object')
```

In [18]:

```
train_df.isnull().sum()
```

Out[18]:

```
Airline            0
Date_of_Journey    0
Source             0
Destination        0
Route              1
Dep_Time           0
Arrival_Time       0
Duration           0
Total_Stops        1
Additional_Info    0
Price              0
dtype: int64
```

In [19]:

```
test_df.isnull().sum()
```

Out[19]:

```
Airline            0
Date_of_Journey    0
Source             0
Destination        0
Route              0
Dep_Time           0
Arrival_Time       0
Duration           0
Total_Stops        0
Additional_Info    0
dtype: int64
```

In [20]:

```
train_df.dropna(inplace=True)
```

In [21]:

```
train_df.isnull().sum()
```

Out[21]:

```
Airline            0
Date_of_Journey    0
Source             0
Destination        0
Route              0
Dep_Time           0
Arrival_Time       0
Duration           0
Total_Stops        0
Additional_Info    0
Price              0
dtype: int64
```

In [22]:

```
train_df['Airline'].value_counts()
```

Out[22]:

```
Airline
Jet Airways                          3849
IndiGo                               2053
Air India                            1751
Multiple carriers                    1196
SpiceJet                              818
Vistara                               479
Air Asia                              319
GoAir                                 194
Multiple carriers Premium economy      13
Jet Airways Business                    6
Vistara Premium economy                 3
Trujet                                  1
Name: count, dtype: int64
```

In [23]:

```
train_df['Source'].value_counts()
```

Out[23]:

```
Source
Delhi       4536
Kolkata     2871
Banglore    2197
Mumbai       697
Chennai      381
Name: count, dtype: int64
```

In [24]:

```
train_df['Destination'].value_counts()
```

Out[24]:

```
Destination
Cochin       4536
Banglore     2871
Delhi        1265
New Delhi     932
Hyderabad     697
Kolkata       381
Name: count, dtype: int64
```

In [25]:

```
train_df['Total_Stops'].value_counts()
```

Out[25]:

```
Total_Stops
1 stop      5625
non-stop    3491
2 stops     1520
3 stops       45
4 stops        1
Name: count, dtype: int64
```

In [26]:

```
convert={"Airline":{"Jet Airways":0,"IndiGo":1,"Air India":2,"Multiple carriers":3,
         "SpiceJet":4,"Vistara":5,"Air Asia":6,"GoAir":7,
         "Multiple carriers Premium economy":8,
         "Jet Airways Business":9,"Vistara Premium economy":10,"Trujet":11}}
train_df=train_df.replace(convert)
train_df
```

Out[26]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Durat
0	1	24/03/2019	Banglore	New Delhi	BLR ? DEL	22:20	01:10 22 Mar	2h 5
1	2	1/05/2019	Kolkata	Banglore	CCU ? IXR ? BBI ? BLR	05:50	13:15	7h 2
2	0	9/06/2019	Delhi	Cochin	DEL ? LKO ? BOM ? COK	09:25	04:25 10 Jun	
3	1	12/05/2019	Kolkata	Banglore	CCU ? NAG ? BLR	18:05	23:30	5h 2
4	1	01/03/2019	Banglore	New Delhi	BLR ? NAG ? DEL	16:50	21:35	4h 4
...	...	...	...	...	...	...	...	
10678	6	9/04/2019	Kolkata	Banglore	CCU ? BLR	19:55	22:25	2h 3
10679	2	27/04/2019	Kolkata	Banglore	CCU ? BLR	20:45	23:20	2h 3
10680	0	27/04/2019	Banglore	Delhi	BLR ? DEL	08:20	11:20	
10681	5	01/03/2019	Banglore	New Delhi	BLR ? DEL	11:30	14:10	2h 4
10682	2	9/05/2019	Delhi	Cochin	DEL ? GOI ? BOM ? COK	10:55	19:15	8h 2

10682 rows × 11 columns

In [27]:

```
convert={"Source":{"Delhi":0,"Kolkata":1,"Banglore":2,"Mumbai":3,"Chennai":4}}
train_df=train_df.replace(convert)
train_df
```

Out[27]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Durati
0	1	24/03/2019	2	New Delhi	BLR ? DEL	22:20	01:10 22 Mar	2h 50
1	2	1/05/2019	1	Banglore	CCU ? IXR ? BBI ? BLR	05:50	13:15	7h 25
2	0	9/06/2019	0	Cochin	DEL ? LKO ? BOM ? COK	09:25	04:25 10 Jun	1
3	1	12/05/2019	1	Banglore	CCU ? NAG ? BLR	18:05	23:30	5h 25
4	1	01/03/2019	2	New Delhi	BLR ? NAG ? DEL	16:50	21:35	4h 45
...	...	...	...	...	...	...	...	
10678	6	9/04/2019	1	Banglore	CCU ? BLR	19:55	22:25	2h 30
10679	2	27/04/2019	1	Banglore	CCU ? BLR	20:45	23:20	2h 35
10680	0	27/04/2019	2	Delhi	BLR ? DEL	08:20	11:20	:
10681	5	01/03/2019	2	New Delhi	BLR ? DEL	11:30	14:10	2h 40
10682	2	9/05/2019	0	Cochin	DEL ? GOI ? BOM ? COK	10:55	19:15	8h 20

10682 rows × 11 columns

In [28]:

```
convert={"Destination":{"Cochin":0,"Banglore":1,"Delhi":2,
                            "New Delhi":3,"Hyderabad":4,"Kolkata":5}}
train_df=train_df.replace(convert)
train_df
```

Out[28]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Durati
0	1	24/03/2019	2	3	BLR ? DEL	22:20	01:10 22 Mar	2h 5
1	2	1/05/2019	1	1	CCU ? IXR ? BBI ? BLR	05:50	13:15	7h 2
2	0	9/06/2019	0	0	DEL ? LKO ? BOM ? COK	09:25	04:25 10 Jun	1
3	1	12/05/2019	1	1	CCU ? NAG ? BLR	18:05	23:30	5h 2
4	1	01/03/2019	2	3	BLR ? NAG ? DEL	16:50	21:35	4h 4
...	...	...	...	...	...	...	...	
10678	6	9/04/2019	1	1	CCU ? BLR	19:55	22:25	2h 3
10679	2	27/04/2019	1	1	CCU ? BLR	20:45	23:20	2h 3
10680	0	27/04/2019	2	2	BLR ? DEL	08:20	11:20	
10681	5	01/03/2019	2	3	BLR ? DEL	11:30	14:10	2h 4
10682	2	9/05/2019	0	0	DEL ? GOI ? BOM ? COK	10:55	19:15	8h 2

10682 rows × 11 columns

In [29]:

```python
convert={"Total_Stops":{"non-stop":0,"1 stop":1,"2 stops":2,
"3 stops":3,"4 stops":4}}
train_df=train_df.replace(convert)
train_df
```

Out[29]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Durati
0	1	24/03/2019	2	3	BLR ? DEL	22:20	01:10 22 Mar	2h 5
1	2	1/05/2019	1	1	CCU ? IXR ? BBI ? BLR	05:50	13:15	7h 2
2	0	9/06/2019	0	0	DEL ? LKO ? BOM ? COK	09:25	04:25 10 Jun	1
3	1	12/05/2019	1	1	CCU ? NAG ? BLR	18:05	23:30	5h 2
4	1	01/03/2019	2	3	BLR ? NAG ? DEL	16:50	21:35	4h 4
...	...	...	...	...	...	...	...	
10678	6	9/04/2019	1	1	CCU ? BLR	19:55	22:25	2h 3
10679	2	27/04/2019	1	1	CCU ? BLR	20:45	23:20	2h 3
10680	0	27/04/2019	2	2	BLR ? DEL	08:20	11:20	
10681	5	01/03/2019	2	3	BLR ? DEL	11:30	14:10	2h 4
10682	2	9/05/2019	0	0	DEL ? GOI ? BOM ? COK	10:55	19:15	8h 2

10682 rows × 11 columns

In [30]:

```
train_df
```

Out[30]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Durati
0	1	24/03/2019	2	3	BLR ? DEL	22:20	01:10 22 Mar	2h 5
1	2	1/05/2019	1	1	CCU ? IXR ? BBI ? BLR	05:50	13:15	7h 2
2	0	9/06/2019	0	0	DEL ? LKO ? BOM ? COK	09:25	04:25 10 Jun	1
3	1	12/05/2019	1	1	CCU ? NAG ? BLR	18:05	23:30	5h 2
4	1	01/03/2019	2	3	BLR ? NAG ? DEL	16:50	21:35	4h 4
...	...	...	...	...	...	...	...	
10678	6	9/04/2019	1	1	CCU ? BLR	19:55	22:25	2h 3
10679	2	27/04/2019	1	1	CCU ? BLR	20:45	23:20	2h 3
10680	0	27/04/2019	2	2	BLR ? DEL	08:20	11:20	
10681	5	01/03/2019	2	3	BLR ? DEL	11:30	14:10	2h 4
10682	2	9/05/2019	0	0	DEL ? GOI ? BOM ? COK	10:55	19:15	8h 2

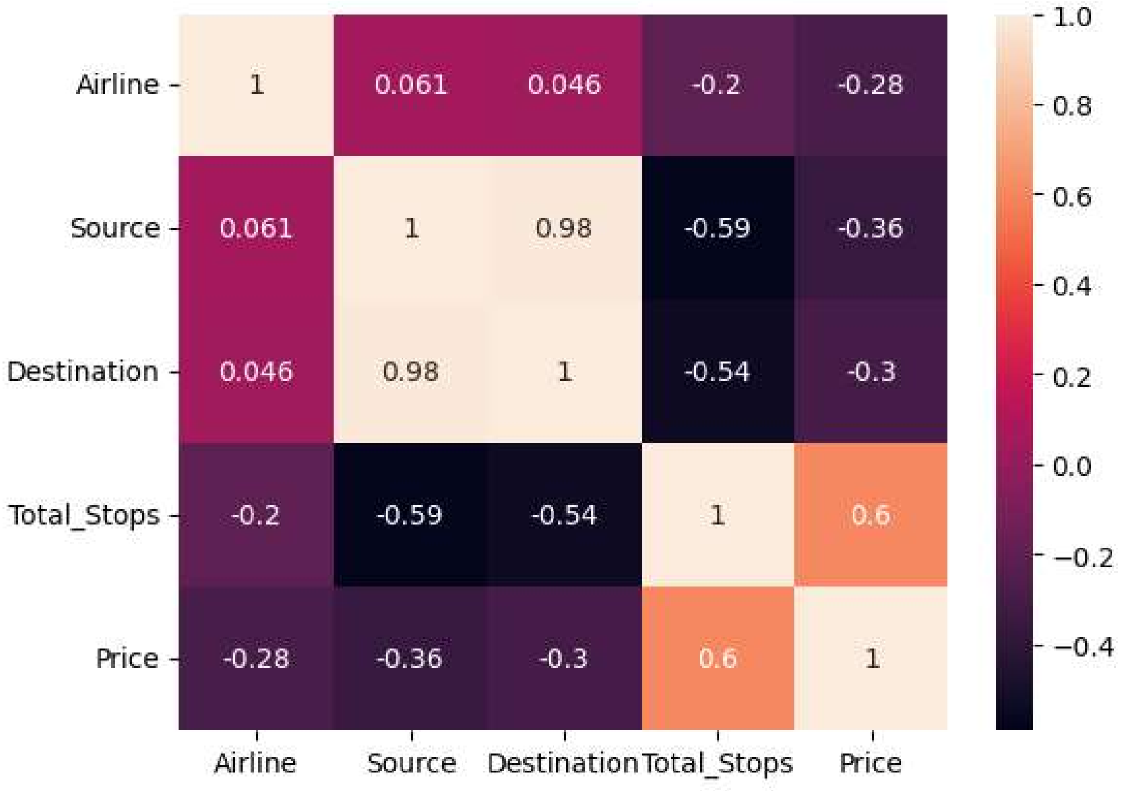
10682 rows × 11 columns

In [31]:

```
#EDA
dt=train_df[['Airline','Source','Destination','Total_Stops','Price']]
sns.heatmap(dt.corr(),annot=True)
```

Out[31]:

```
<Axes: >
```



In [32]:

```
x=dt[['Airline','Source','Destination','Total_Stops']]
y=dt['Price']
```

Linear Regression

In [33]:

```
#Linear Regression
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test=train_test_split(x,y,test_size=0.3,random_state=100)
```

In [34]:

```
from sklearn.linear_model import LinearRegression
regr=LinearRegression()
regr.fit(X_train,y_train)
print(regr.intercept_)
coeff_df=pd.DataFrame(regr.coef_,x.columns,columns=['coefficient'])
coeff_df
```

```
7211.098088897488
```

Out[34]:

	coefficient
Airline	-418.483922
Source	-3275.073380
Destination	2505.480291
Total_Stops	3541.798053

In [35]:

```
#Linear Rgeression
score=regr.score(X_test,y_test)
print(score)
```

```
0.4108304890928348
```

In [36]:

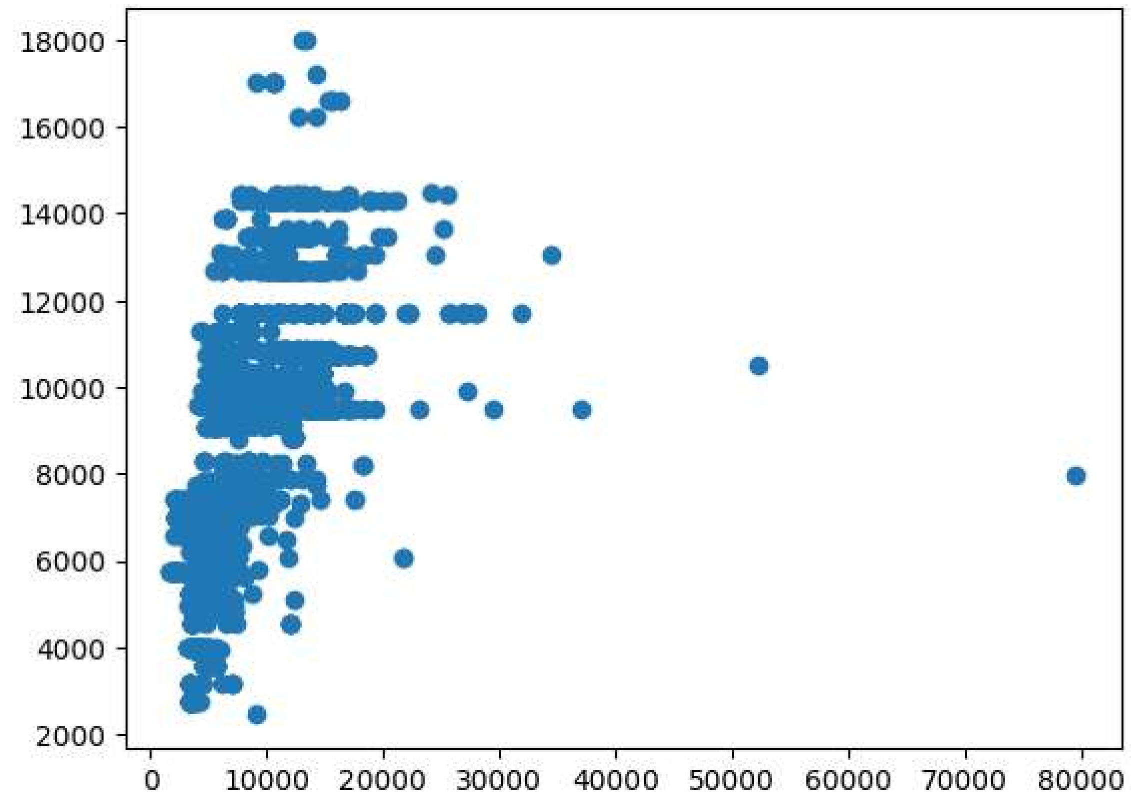
```
predictions=regr.predict(X_test)
```

In [37]:

```
plt.scatter(y_test,predictions)
```

Out[37]:

```
<matplotlib.collections.PathCollection at 0x243757db940>
```



In [38]:

```
x=np.array(dt['Price']).reshape(-1,1)
y=np.array(dt['Total_Stops']).reshape(-1,1)
dt.dropna(inplace=True)
```

In [39]:

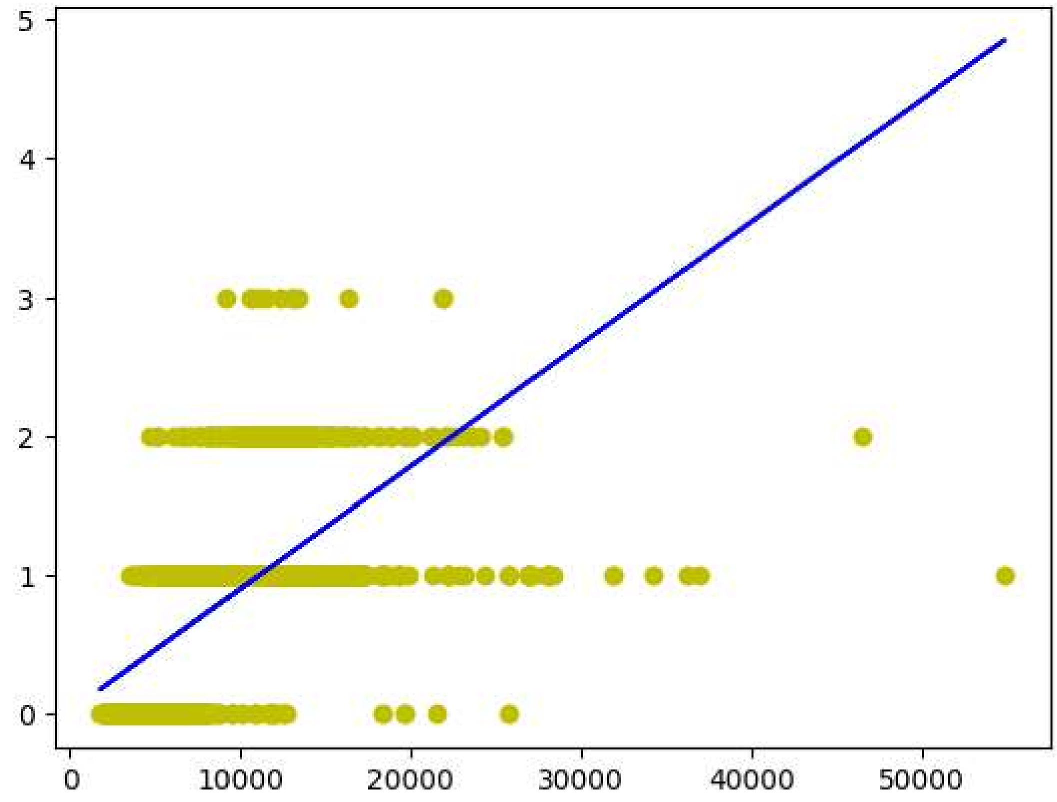
```
X_train,X_test,y_train,y_test=train_test_split(x,y,test_size=0.3)
regr.fit(X_train,y_train)
regr.fit(X_train,y_train)
```

Out[39]:

```
▾ LinearRegression
LinearRegression()
```

In [40]:

```
y_pred=regr.predict(X_test)
plt.scatter(X_test,y_test,color='y')
plt.plot(X_test,y_pred,color='b')
plt.show()
```



Logistic Regression

In [41]:

```
#Logistic Regression
x=np.array(dt['Price']).reshape(-1,1)
y=np.array(dt['Total_Stops']).reshape(-1,1)
dt.dropna(inplace=True)
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3,random_state=1)
from sklearn.linear_model import LogisticRegression
lr=LogisticRegression(max_iter=10000)
```

In [42]:

```
lr.fit(x_train,y_train)
```

Out[42]:

```
▾        LogisticRegression
LogisticRegression(max_iter=10000)
```

In [43]:

```python
score=lr.score(x_test,y_test)
print(score)
```

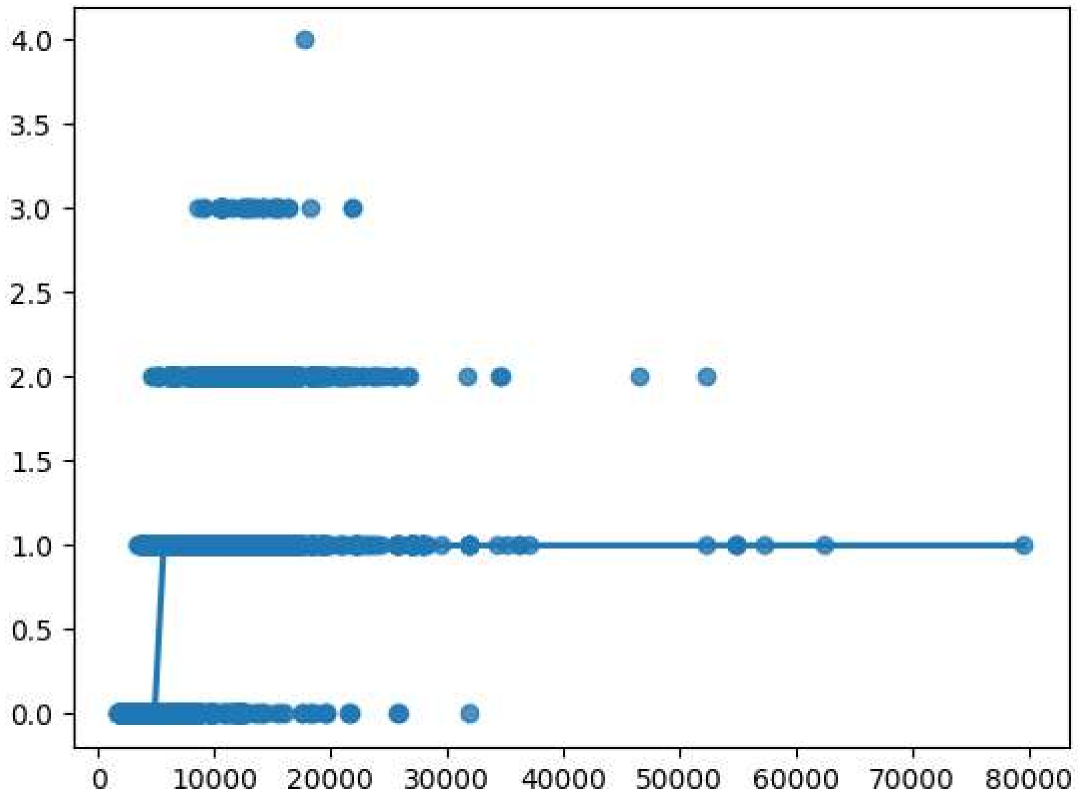
```
0.7160686427457098
```

In [44]:

```python
sns.regplot(x=x,y=y,data=dt,logistic=True,ci=None)
```

Out[44]:

```
<Axes: >
```



Decision Tree

In [45]:

```python
#Decision tree
from sklearn.tree import DecisionTreeClassifier
clf=DecisionTreeClassifier(random_state=0)
clf.fit(x_train,y_train)
```

Out[45]:

```
▾ DecisionTreeClassifier
DecisionTreeClassifier(random_state=0)
```

In [46]:

```
score=clf.score(x_test,y_test)
print(score)
```

```
0.9369734789391576
```

Random Forest

In [47]:

```
#Random forest classifier
from sklearn.ensemble import RandomForestClassifier
rfc=RandomForestClassifier()
rfc.fit(X_train,y_train)
```

Out[47]:

```
▾ RandomForestClassifier
RandomForestClassifier()
```

In [48]:

```
params={'max_depth':[2,3,5,10,20],
'min_samples_leaf':[5,10,20,50,100,200],
'n_estimators':[10,25,30,50,100,200]}
```

In [49]:

```
from sklearn.model_selection import GridSearchCV
grid_search=GridSearchCV(estimator=rfc,param_grid=params,cv=2,scoring="accuracy")
```

In [50]:

```
grid_search.fit(X_train,y_train)
```

Out[50]:

```
▸           GridSearchCV
▸ estimator: RandomForestClassifier
      ▸ RandomForestClassifier
```

In [51]:

```
grid_search.best_score_
```

Out[51]:

```
0.523605715699528
```

In [52]:

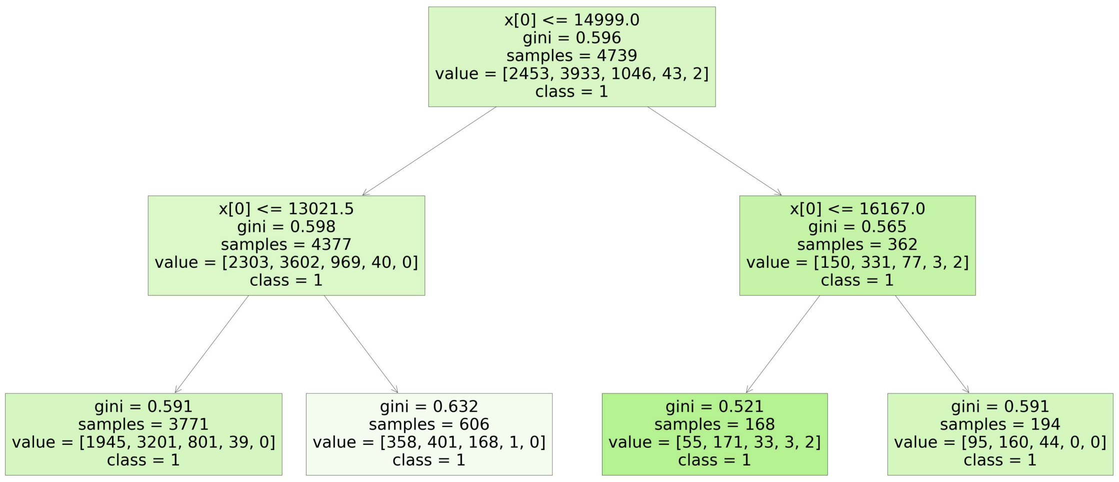
```
rf_best=grid_search.best_estimator_
rf_best
```

Out[52]:

```
▾                    RandomForestClassifier
RandomForestClassifier(max_depth=2, min_samples_leaf=10, n_estimators=10)
```

In [53]:

```
from sklearn.tree import plot_tree
plt.figure(figsize=(80,40))
plot_tree(rf_best.estimators_[4],class_names=['0','1','2','3','4'],filled=True);
```



In [54]:

```
score=rfc.score(x_test,y_test)
print(score)
```

```
0.46084243369734790
```

Conclusion:For the given dataset,we have performed linear regression,logistic regression,decision tree,random forest classification.Among all the models,we observed that ,in decision tree the accuracy is 0.93,and in the logistic regression we observed,the accuracy is 0.71 where as decision tree got the highest accuracy than the logistic regression.So, the best model that suits for the given dataset is decision tree and lasso regression.