Problem statement:

```
To predict the best model for the given dataset based on accuracy.
```

In [38]:

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

import warnings
warnings.filterwarnings("ignore")
```

Data collection

In [3]:

```
train_df=pd.read_csv(r"C:\Users\91949\Desktop\train_data.csv")
train_df
```

Out[3]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Dur
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 [4]:

```
test_df=pd.read_csv(r"C:\Users\91949\Desktop\test_data.csv")
test_df
```

Out[4]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Dura
0	Jet Airways	6/06/2019	Delhi	Cochin	DEL ? BOM ? COK	17:30	04:25 07 Jun	10h
1	IndiGo	12/05/2019	Kolkata	Banglore	CCU ? MAA ? BLR	06:20	10:20	
2	Jet Airways	21/05/2019	Delhi	Cochin	DEL ? BOM ? COK	19:15	19:00 22 May	23h
3	Multiple carriers	21/05/2019	Delhi	Cochin	DEL ? BOM ? COK	08:00	21:00	
4	Air Asia	24/06/2019	Banglore	Delhi	BLR ? DEL	23:55	02:45 25 Jun	2h
...	...	...	...	...	...	...	...	
2666	Air India	6/06/2019	Kolkata	Banglore	CCU ? DEL ? BLR	20:30	20:25 07 Jun	23h
2667	IndiGo	27/03/2019	Kolkata	Banglore	CCU ? BLR	14:20	16:55	2h
2668	Jet Airways	6/03/2019	Delhi	Cochin	DEL ? BOM ? COK	21:50	04:25 07 Mar	6h
2669	Air India	6/03/2019	Delhi	Cochin	DEL ? BOM ? COK	04:00	19:15	15h
2670	Multiple carriers	15/06/2019	Delhi	Cochin	DEL ? BOM ? COK	04:55	19:15	14h

2671 rows × 10 columns

Data Cleaning and Preprocessing

In [6]:

```
train_df.head()
```

Out[6]:

	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 [7]:

```
train_df.tail()
```

Out[7]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Dur
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 [8]:

```
test_df.head()
```

Out[8]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Duration
0	Jet Airways	6/06/2019	Delhi	Cochin	DEL ? BOM ? COK	17:30	04:25 07 Jun	10h 55m
1	IndiGo	12/05/2019	Kolkata	Banglore	CCU ? MAA ? BLR	06:20	10:20	4h
2	Jet Airways	21/05/2019	Delhi	Cochin	DEL ? BOM ? COK	19:15	19:00 22 May	23h 45m
3	Multiple carriers	21/05/2019	Delhi	Cochin	DEL ? BOM ? COK	08:00	21:00	13h
4	Air Asia	24/06/2019	Banglore	Delhi	BLR ? DEL	23:55	02:45 25 Jun	2h 50m

In [9]:

```
test_df.tail()
```

Out[9]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Durati
2666	Air India	6/06/2019	Kolkata	Banglore	CCU ? DEL ? BLR	20:30	20:25 07 Jun	23h 5
2667	IndiGo	27/03/2019	Kolkata	Banglore	CCU ? BLR	14:20	16:55	2h 3
2668	Jet Airways	6/03/2019	Delhi	Cochin	DEL ? BOM ? COK	21:50	04:25 07 Mar	6h 3
2669	Air India	6/03/2019	Delhi	Cochin	DEL ? BOM ? COK	04:00	19:15	15h 1
2670	Multiple carriers	15/06/2019	Delhi	Cochin	DEL ? BOM ? COK	04:55	19:15	14h 2

In [10]:

```
train_df.describe()
```

Out[10]:

	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 [11]:

```
test_df.describe()
```

Out[11]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Dur
count	2671	2671	2671	2671	2671	2671	2671	
unique	11	44	5	6	100	199	704	
top	Jet Airways	9/05/2019	Delhi	Cochin	DEL ? BOM ? COK	10:00	19:00	2h
freq	897	144	1145	1145	624	62	113	

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.size
```

Out[14]:

```
117513
```

In [15]:

```
test_df.size
```

Out[15]:

```
26710
```

In [16]:

```
train_df.shape
```

Out[16]:

```
(10683, 11)
```

In [17]:

```
test_df.shape
```

Out[17]:

```
(2671, 10)
```

Exploratory Data Analysis

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.duplicated().sum()
```

Out[20]:

```
220
```

In [21]:

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

Out[21]:

```
26
```

In [22]:

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

In [23]:

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

Out[23]:

```
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 [24]:

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

Out[24]:

```
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: Airline, dtype: int64
```

In [25]:

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

Out[25]:

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

In [26]:

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

Out[26]:

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

In [27]:

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

Out[27]:

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

In [28]:

```
airline={"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(airline)
train_df
```

Out[28]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Dura
0	1	24/03/2019	Banglore	New Delhi	BLR ? DEL	22:20	01:10 22 Mar	2h
1	2	1/05/2019	Kolkata	Banglore	CCU ? IXR ? BBI ? BLR	05:50	13:15	7h
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
4	1	01/03/2019	Banglore	New Delhi	BLR ? NAG ? DEL	16:50	21:35	4h
...	...	...	...	...	...	...	...	
10678	6	9/04/2019	Kolkata	Banglore	CCU ? BLR	19:55	22:25	2h
10679	2	27/04/2019	Kolkata	Banglore	CCU ? BLR	20:45	23:20	2h
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
10682	2	9/05/2019	Delhi	Cochin	DEL ? GOI ? BOM ? COK	10:55	19:15	8h

10682 rows × 11 columns

In [29]:

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

Out[29]:

	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 5
1	2	1/05/2019	1	Banglore	CCU ? IXR ? BBI ? BLR	05:50	13:15	7h 2
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 2
4	1	01/03/2019	2	New Delhi	BLR ? NAG ? DEL	16:50	21:35	4h 4
...	...	...	...	...	...	...	...	
10678	6	9/04/2019	1	Banglore	CCU ? BLR	19:55	22:25	2h 3
10679	2	27/04/2019	1	Banglore	CCU ? BLR	20:45	23:20	2h 3
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 4
10682	2	9/05/2019	0	Cochin	DEL ? GOI ? BOM ? COK	10:55	19:15	8h 2

10682 rows × 11 columns

In [30]:

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

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

Out[31]:

	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

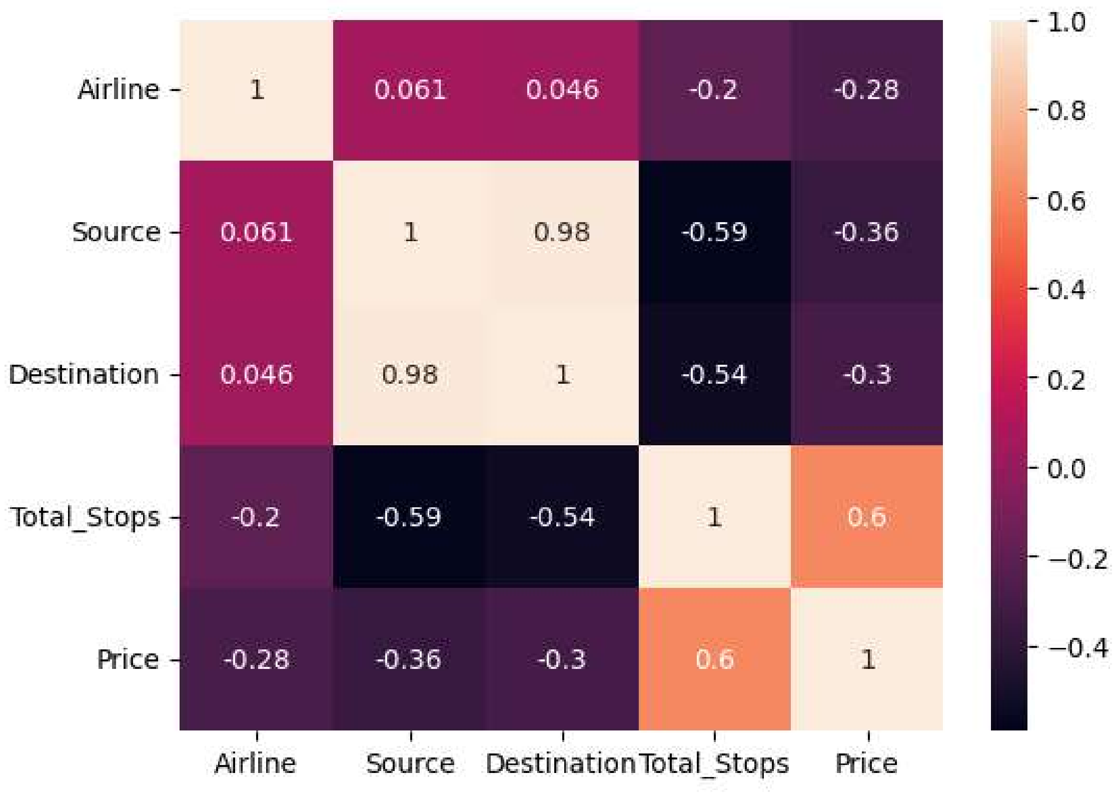
Data visualization

In [32]:

```
import seaborn as sns
df=train_df[['Airline','Source','Destination','Total_Stops','Price']]
sns.heatmap(df.corr(),annot=True)
```

Out[32]:

```
<Axes: >
```



In [33]:

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

```
#Data prediction and Evaluation
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]:

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

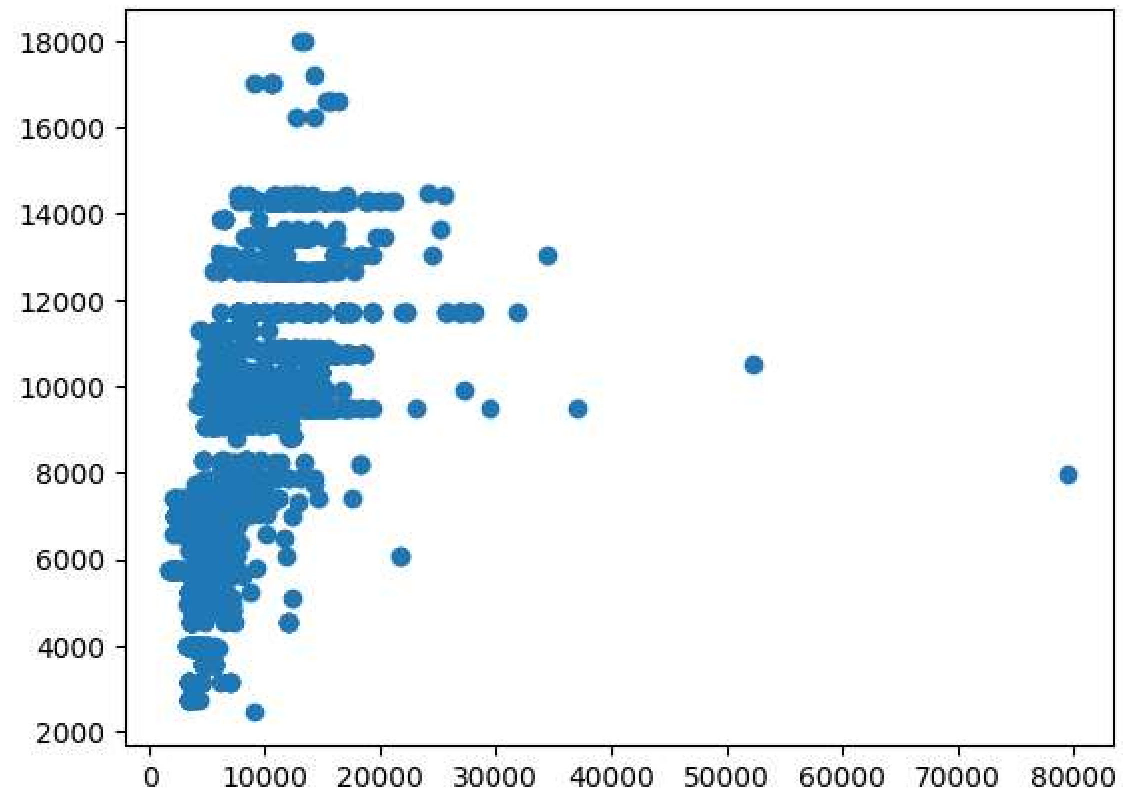
```
0.4108304890928348
```

In [36]:

```
predictions=regr.predict(x_test)
plt.scatter(y_test,predictions)
```

Out[36]:

```
<matplotlib.collections.PathCollection at 0x23f24a67710>
```



In [39]:

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

In [40]:

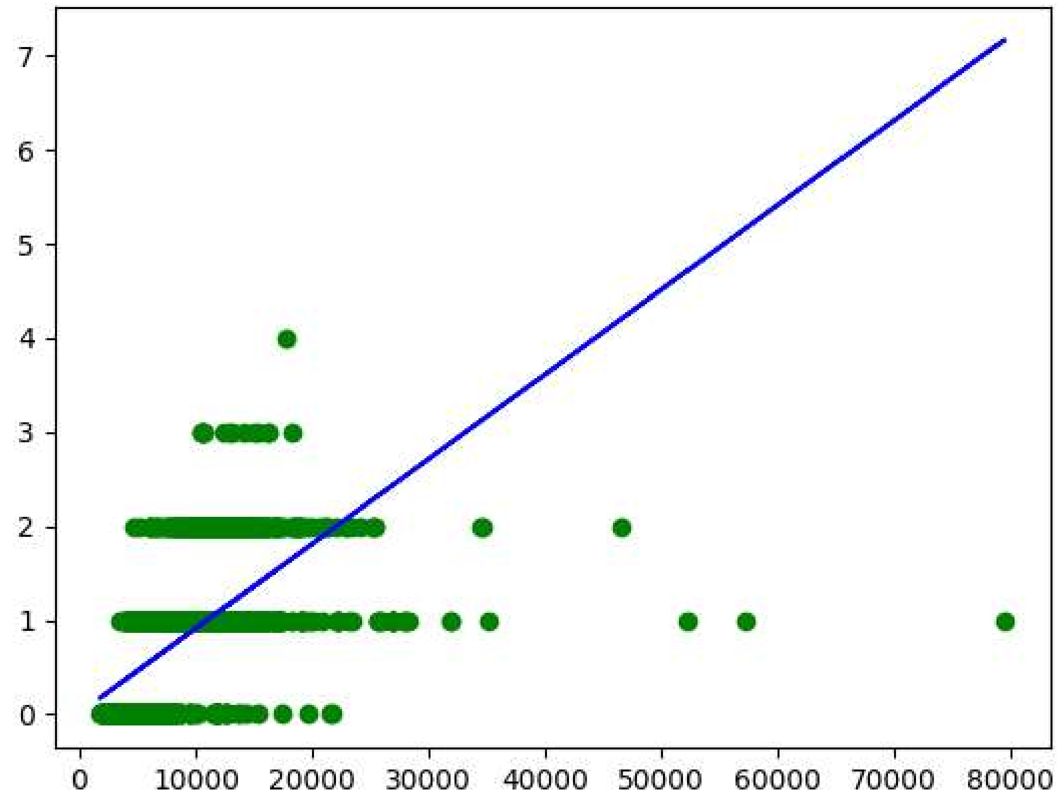
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3)
regr.fit(x_train,y_train)
regr.fit(x_train,y_train)
```

Out[40]:

```
▾ LinearRegression
LinearRegression()
```

In [41]:

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



Logistic Regression

In [42]:

```
x=np.array(df['Price']).reshape(-1,1)
y=np.array(df['Total_Stops']).reshape(-1,1)
df.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)
import warnings
warnings.simplefilter(action='ignore')
```

In [43]:

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

Out[43]:

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

In [44]:

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

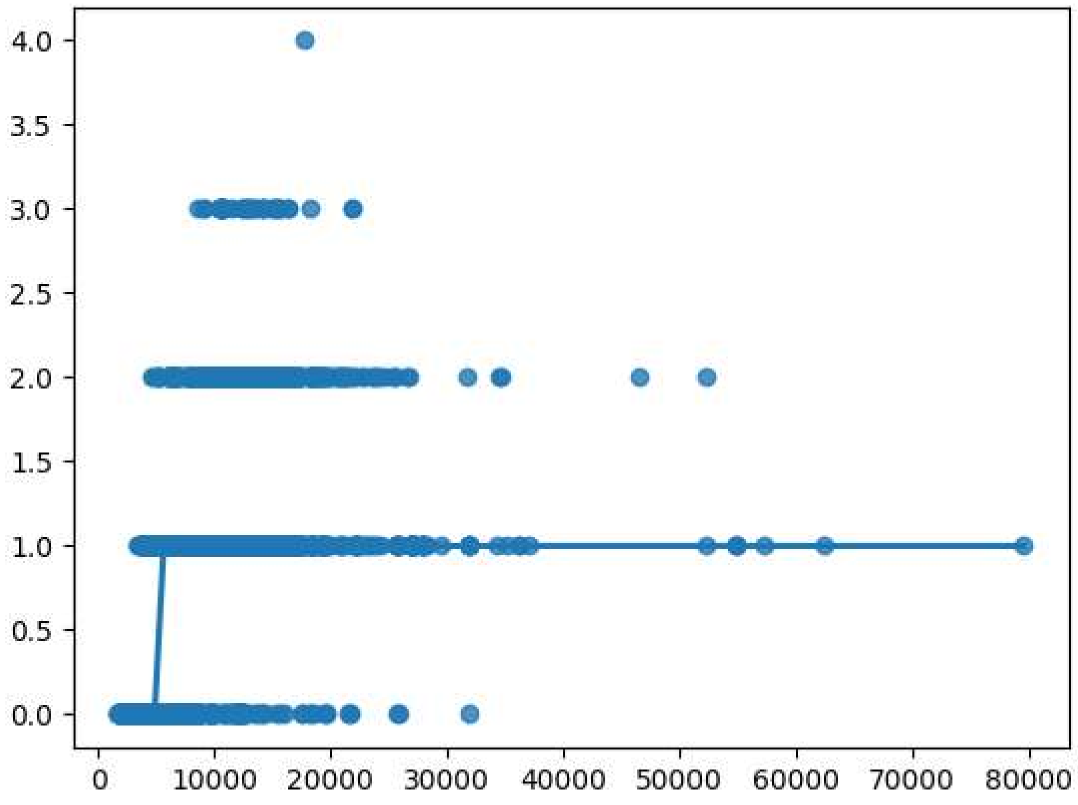
```
0.7160686427457098
```

In [45]:

```
sns.regplot(x=x,y=y,data=df,logistic=True,ci=None)
plt.show
```

Out[45]:

```
<function matplotlib.pyplot.show(close=None, block=None)>
```



Decision Tree

In [46]:

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

Out[46]:

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

In [47]:

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

```
0.9369734789391576
```

Random Forest

In [48]:

```
from sklearn.ensemble import RandomForestClassifier
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
```

Out[48]:

```
▾ RandomForestClassifier
RandomForestClassifier()
```

In [49]:

```
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 [50]:

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

Out[50]:

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

In [51]:

```
grid_search.best_score_
```

Out[51]:

```
0.873745472898494
```

In [52]:

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

Out[52]:

```
▾                      RandomForestClassifier
RandomForestClassifier(max_depth=20, min_samples_leaf=5, n_estimators=5
0)
```

Conclusion:

```
 we conclude that "Decision Tree" is the best model for Flight Price Prediction
dataset,because it got highest accuracy compared to other models.
```