In [ ]:

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

In [ ]:

```
df = pd.read_excel('Data_Train.xlsx', parse_dates=True)
```

In [ ]:

```
df.head(5)
```

Out[ ]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Duration	Total_Stops	Additional_Info	Pr
0	IndiGo	24/03/2019	Banglore	New Delhi	BLR → DEL	22:20	01:10 22 Mar	2h 50m	non-stop	No info	3
1	Air India	1/05/2019	Kolkata	Banglore	CCU → IXR → BBI → BLR	05:50	13:15	7h 25m	2 stops	No info	7
2	Jet Airways	9/06/2019	Delhi	Cochin	DEL → LKO → BOM → COK	09:25	04:25 10 Jun	19h	2 stops	No info	13
3	IndiGo	12/05/2019	Kolkata	Banglore	CCU → NAG → BLR	18:05	23:30	5h 25m	1 stop	No info	6
4	IndiGo	01/03/2019	Banglore	New Delhi	BLR → NAG → DEL	16:50	21:35	4h 45m	1 stop	No info	13

In [ ]:

```
df.shape
```

Out[ ]:

```
(10683, 11)
```

The dataset contains the data for prediction of flight price for various airlines based on various parameters. The dataset is having 11 variables with 10683 records.

In [ ]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10683 entries, 0 to 10682
Data columns (total 11 columns):
 #   Column           Non-Null Count  Dtype
```

```
 #   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
```

Description, null values, duplicated values of the dataset

In [ ]:

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

Out[ ]:

```
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
```

Since only one value of null is present for Route and Total_Stops variable, we remove those.

In [ ]:

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

In [ ]:

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

Out[ ]:

```
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
```

To check for duplicates in the dataset.

In [ ]:

```
df[df.duplicated()]
```

Out[ ]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Duration	Total_Stops	Additional_Info
683	Jet Airways	1/06/2019	Delhi	Cochin	DEL → NAG → BOM → COK	14:35	04:25 02 Jun	13h 50m	2 stops	No info
1061	Air India	21/05/2019	Delhi	Cochin	DEL → GOI → BOM → COK	22:00	19:15 22 May	21h 15m	2 stops	No info
1348	Air India	18/05/2019	Delhi	Cochin	DEL → HYD → BOM → COK	17:15	19:15 19 May	26h	2 stops	No info
1418	Jet Airways	6/06/2019	Delhi	Cochin	DEL → JAI → BOM → COK	05:30	04:25 07 Jun	22h 55m	2 stops	In-flight mea not included
1674	IndiGo	24/03/2019	Banglore	New Delhi	BLR → DEL	18:25	21:20	2h 55m	non-stop	No info
...	...	...	...	...	...	...	...	...	...	..
10594	Jet Airways	27/06/2019	Delhi	Cochin	DEL → AMD → BOM → COK	23:05	12:35 28 Jun	13h 30m	2 stops	No info
10616	Jet Airways	1/06/2019	Delhi	Cochin	DEL → JAI → BOM → COK	09:40	12:35 02 Jun	26h 55m	2 stops	No info
10634	Jet Airways	6/06/2019	Delhi	Cochin	DEL → JAI → BOM → COK	09:40	12:35 07 Jun	26h 55m	2 stops	In-flight mea not included
10672	Jet Airways	27/06/2019	Delhi	Cochin	DEL → AMD → BOM → COK	23:05	19:00 28 Jun	19h 55m	2 stops	In-flight mea not included
10673	Jet Airways	27/05/2019	Delhi	Cochin	DEL → AMD → BOM → COK	13:25	04:25 28 May	15h	2 stops	No info

220 rows × 11 columns

The duplicates has to be removed. Since, the time and date cant be duplicated even though the source and destination are.

In [ ]:

```
df.drop_duplicates(keep = 'first', inplace = True)
# keep = first represents, it keeps first value in dataframe and the next duplicated valu
es will be deleted.
```

In [ ]:

```
df.shape
```

Out[ ]:

```
(10462, 11)
```

In [ ]:

```
df.head()
```

Out[ ]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Duration	Total_Stops	Additional_Info	Pr
0	IndiGo	24/03/2019	Banglore	New Delhi	BLR → DEL	22:20	01:10 22 Mar	2h 50m	non-stop	No info	3
1	Air India	1/05/2019	Kolkata	Banglore	CCU → IXR → BBI → BLR	05:50	13:15	7h 25m	2 stops	No info	7
2	Jet Airways	9/06/2019	Delhi	Cochin	DEL → LKO → BOM → COK	09:25	04:25 10 Jun	19h	2 stops	No info	13
3	IndiGo	12/05/2019	Kolkata	Banglore	CCU → NAG → BLR	18:05	23:30	5h 25m	1 stop	No info	6
4	IndiGo	01/03/2019	Banglore	New Delhi	BLR → NAG → DEL	16:50	21:35	4h 45m	1 stop	No info	13

In [ ]:

```
df.dtypes
```

Out[ ]:

```
Airline            object
Date_of_Journey    object
Source             object
Destination        object
Route              object
Dep_Time           object
Arrival_Time       object
Duration           object
Total_Stops        object
Additional_Info    object
Price               int64
```

```
dtype: object
```

Splitting the dataset

The current dataset contains data, month and time integrated. This is splitted to analyse more.

In [ ]:

```
# Date of Journey
df['Date_of_Journey'] = df['Date_of_Journey'].astype('datetime64[ns]')
```

In [ ]:

```
df['Journey_day'] = df['Date_of_Journey'].dt.day
df['Journey_month'] = df['Date_of_Journey'].dt.month
#df['Journey_year'] = df['Date_of_Journey'].dt.year
df.drop(['Date_of_Journey'], axis = 1, inplace=True)
```

In [ ]:

```
df.head(2)
```

Out[ ]:

	Airline	Source	Destination	Route	Dep_Time	Arrival_Time	Duration	Total_Stops	Additional_Info	Price	Journey_day	J
0	IndiGo	Banglore	New Delhi	BLR → DEL	22:20	01:10 22 Mar	2h 50m	non-stop	No info	3897	24	
1	Air India	Kolkata	Banglore	CCU → IXR → BBI → BLR	05:50	13:15	7h 25m	2 stops	No info	7662	5	

In [ ]:

```
# Dep_time - Departure time splitting
df[['Dep_hr','Dep_m']] = df['Dep_Time'].astype(str).str.split(':', expand=True).astype(i
nt)
df.drop(['Dep_Time'], axis = 1, inplace = True)
```

In [ ]:

```
df.head()
```

Out[ ]:

	Airline	Source	Destination	Route	Arrival_Time	Duration	Total_Stops	Additional_Info	Price	Journey_day	Journey_m
0	IndiGo	Banglore	New Delhi	BLR → DEL	01:10 22 Mar	2h 50m	non-stop	No info	3897	24	
1	Air India	Kolkata	Banglore	CCU → IXR → BBI → BLR	13:15	7h 25m	2 stops	No info	7662	5	
2	Jet Airways	Delhi	Cochin	DEL → LKO → BOM → COK	04:25 10 Jun	19h	2 stops	No info	13882	6	
				CCU							

	Airline	Source	Destination	Route	Arrival_Time	Duration	Total_Stops	Additional_Info	Price	Journey_day	Journey_m
3	IndiGo	Kolkata	Banglore	NAG → BLR	23:30	5h 25m	1 stop	No info	6218	5	
4	IndiGo	Banglore	New Delhi	BLR → NAG → DEL	21:35	4h 45m	1 stop	No info	13302	3	

In [ ]:

```
# Arrival time split
df['Arrival_hour'] = pd.to_datetime(df.Arrival_Time).dt.hour
df['Arrival_min'] = pd.to_datetime(df.Arrival_Time).dt.minute
df.drop(['Arrival_Time'], axis = 1, inplace = True)
```

In [ ]:

```
df.head(3)
```

Out[ ]:

	Airline	Source	Destination	Route	Duration	Total_Stops	Additional_Info	Price	Journey_day	Journey_month	Dep_hr
0	IndiGo	Banglore	New Delhi	BLR → DEL	2h 50m	non-stop	No info	3897	24	3	22
1	Air India	Kolkata	Banglore	CCU → IXR → BBI → BLR	7h 25m	2 stops	No info	7662	5	1	5
2	Jet Airways	Delhi	Cochin	DEL → LKO → BOM → COK	19h	2 stops	No info	13882	6	9	9

In [ ]:

```
df.head(3)
```

Out[ ]:

	Airline	Source	Destination	Route	Duration	Total_Stops	Additional_Info	Price	Journey_day	Journey_month	Dep_hr
0	IndiGo	Banglore	New Delhi	BLR → DEL	2h 50m	non-stop	No info	3897	24	3	22
1	Air India	Kolkata	Banglore	CCU → IXR → BBI → BLR	7h 25m	2 stops	No info	7662	5	1	5
2	Jet Airways	Delhi	Cochin	DEL → LKO → BOM → COK	19h	2 stops	No info	13882	6	9	9

In [ ]:

```
df.dtypes
```

Out[ ]:

```
Airline            object
Source             object
Destination        object
Route              object
Duration           object
Total_Stops        object
Additional_Info    object
Price               int64
Journey_day         int64
Journey_month       int64
Dep_hr              int64
Dep_m               int64
Arrival_hour        int64
Arrival_min         int64
dtype: object
```

Data Analysis

In [ ]:

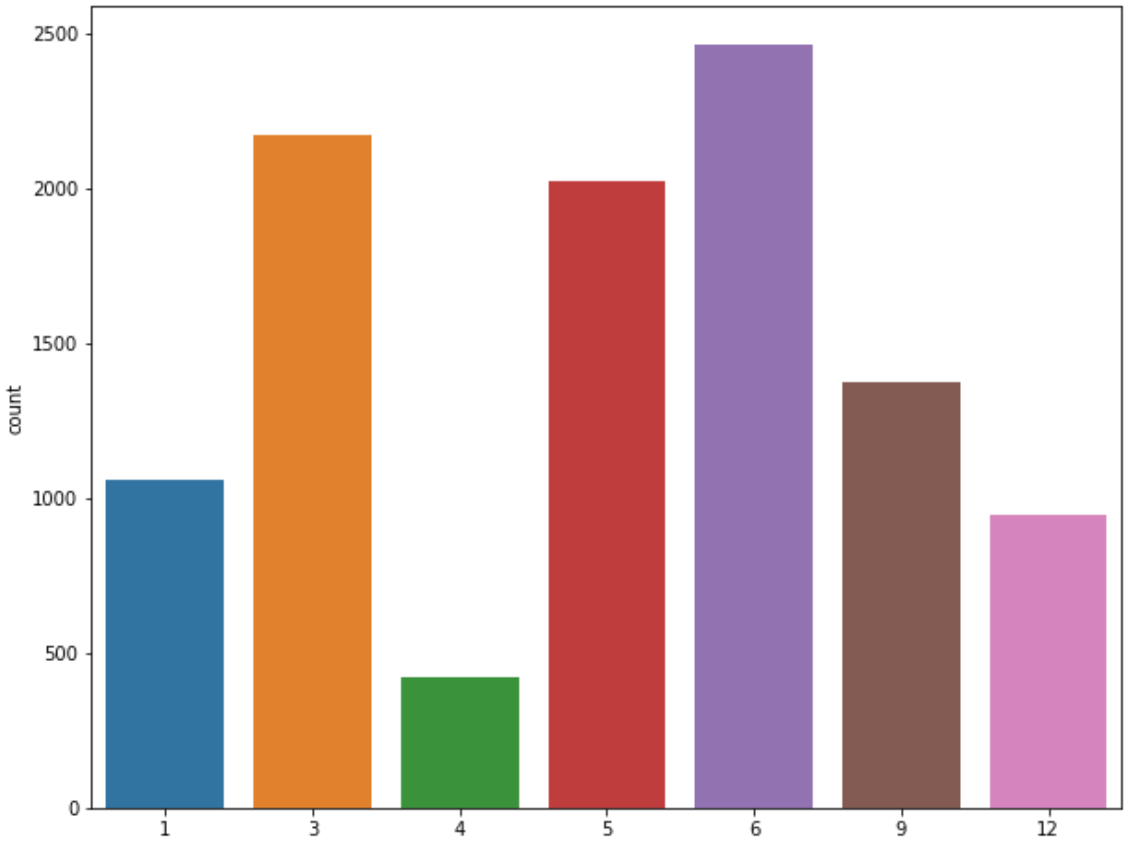
```
df['Journey_month'].value_counts()
```

Out[ ]:

```
6     2465
3     2169
5     2025
9     1375
1     1058
12     946
4      424
Name: Journey_month, dtype: int64
```

In [ ]:

```
plt.subplots(figsize = (10, 8))
sns.countplot(x = 'Journey_month', data = df)
plt.show()
```



Journey_month

The above bar plot represents the amount of flights ran during each month. We can see that for the month of June, 2465 flights have ran followed by 2169 flight in March. In April very less amount of flights have run. Lets analyse what flights ran in June month.

In [ ]:

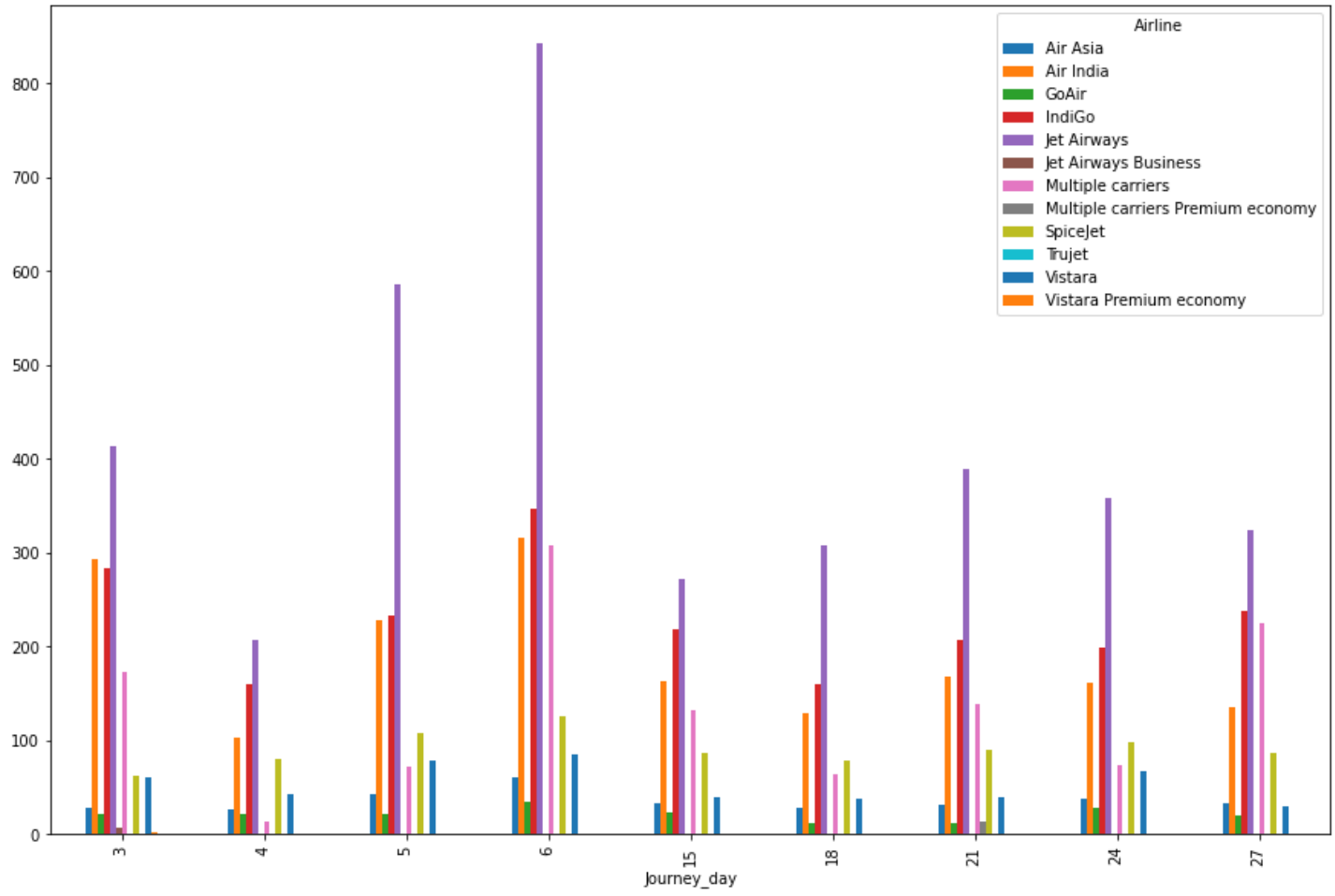
```
df_june = df[df['Journey_month'] == 6]
df_june.head(2)
```

Out[ ]:

	Airline	Source	Destination	Route	Duration	Total_Stops	Additional_Info	Price	Journey_day	Journey_month	Dep_hr
5	SpiceJet	Kolkata	Banglore	CCU → BLR	2h 25m	non-stop	No info	3873	24	6	9
12	Air India	Chennai	Kolkata	MAA → CCU	2h 15m	non-stop	No info	4667	24	6	11

In [ ]:

```
data = df.groupby(['Journey_day', 'Airline'])['Journey_day'].count()
data.unstack().plot.bar(figsize = (15, 10))
plt.show()
```



From the analysis in June month, we can observe following things:

1. **JetAirways ran through all the days with 800+ flights on 6th.**
2. **GoAir ran least no of flights on all days where TrueJet is not considered.**

Replace airline names

Replace airline names

I have found that New Delhi is present in Destination and Delhi is present in Source. Both these places are same. So, we replace New Delhi by Delhi.

In [ ]:

```
df.replace(to_replace ='New Delhi', value = 'Delhi', regex = True, inplace=True)
```

Count of each individual flights

In [ ]:

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

Out[ ]:

```
Jet Airways                          3700
IndiGo                               2043
Air India                            1694
Multiple carriers                    1196
SpiceJet                              815
Vistara                               478
Air Asia                              319
GoAir                                 194
Multiple carriers Premium economy      13
Jet Airways Business                    6
Vistara Premium economy                 3
Trujet                                  1
Name: Airline, dtype: int64
```

We can see that JetAirways has around 3700 flights. So for each month, it runs many flights.

In [ ]:

```
df.head()
```

Out[ ]:

	Airline	Source	Destination	Route	Duration	Total_Stops	Additional_Info	Price	Journey_day	Journey_month	Dep_hr
0	IndiGo	Banglore	Delhi	BLR → DEL	2h 50m	non-stop	No info	3897	24	3	22
1	Air India	Kolkata	Banglore	CCU → IXR → BBI → BLR	7h 25m	2 stops	No info	7662	5	1	5
2	Jet Airways	Delhi	Cochin	DEL → LKO → BOM → COK	19h	2 stops	No info	13882	6	9	9
3	IndiGo	Kolkata	Banglore	CCU → NAG → BLR	5h 25m	1 stop	No info	6218	5	12	18
4	IndiGo	Banglore	Delhi	BLR → NAG → DEL	4h 45m	1 stop	No info	13302	3	1	16

In [ ]:

```
df[(df.Source=='Banglore')&(df.Destination=='Delhi')].count()[0]
```

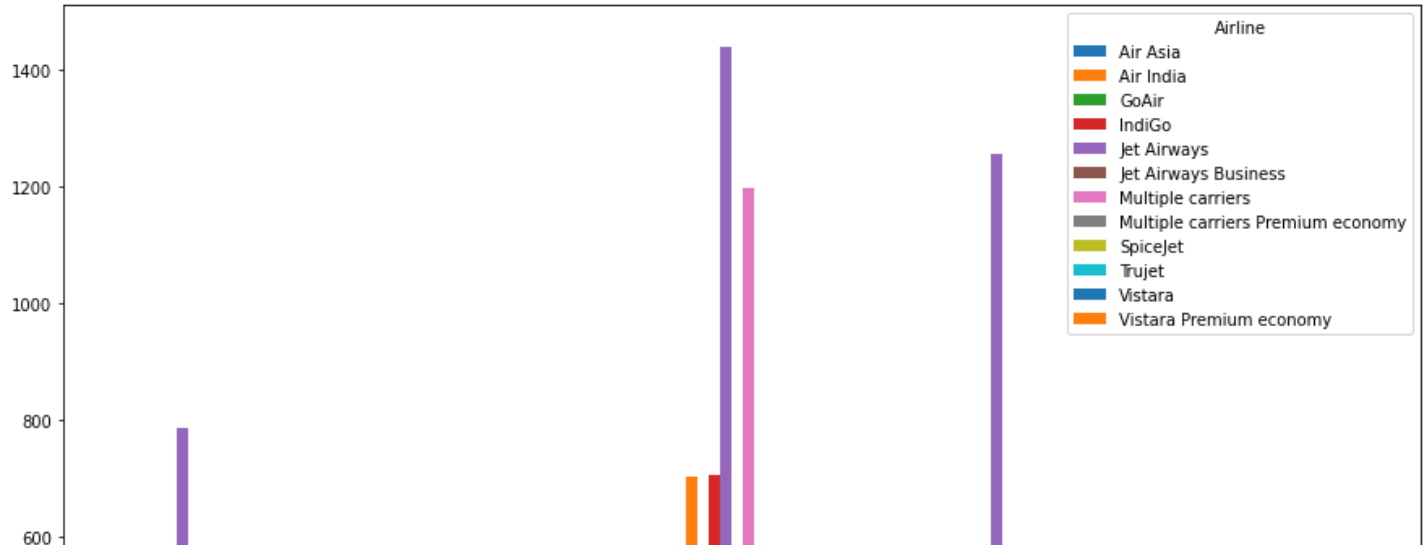
Out[ ]:

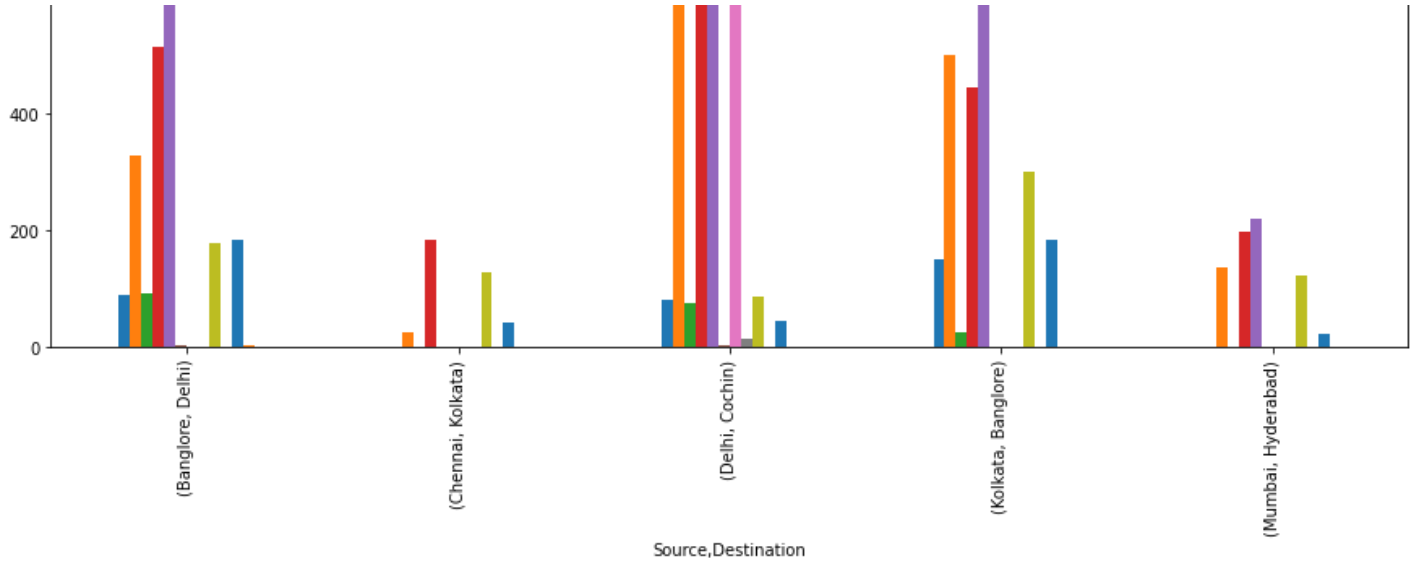
```
2179
```

In [ ]:

```
data2 = df.groupby(['Source', 'Destination', 'Airline'])['Destination'].count()
print(data2)
data2.unstack().plot.bar(figsize = (15, 10))
plt.show()
```

```
Source     Destination  Airline
Banglore   Delhi        Air Asia                          89
                        Air India                        329
                        GoAir                             93
                        IndiGo                           513
                        Jet Airways                      787
                        Jet Airways Business               4
                        SpiceJet                         178
                        Vistara                          184
                        Vistara Premium economy            2
Chennai    Kolkata      Air India                         25
                        IndiGo                           184
                        SpiceJet                         128
                        Vistara                           43
                        Vistara Premium economy            1
Delhi      Cochin       Air Asia                          80
                        Air India                        703
                        GoAir                             76
                        IndiGo                           705
                        Jet Airways                     1438
                        Jet Airways Business               2
                        Multiple carriers                1196
                        Multiple carriers Premium economy  13
                        SpiceJet                          87
                        Vistara                           45
Kolkata    Banglore     Air Asia                         150
                        Air India                        501
                        GoAir                             25
                        IndiGo                           445
                        Jet Airways                     1256
                        SpiceJet                         300
                        Vistara                          183
Mumbai     Hyderabad    Air India                        136
                        IndiGo                           196
                        Jet Airways                      219
                        SpiceJet                         122
                        Trujet                             1
                        Vistara                           23
Name: Destination, dtype: int64
```





The above bar plot represents the no of flights ran from Different source to destination. We can see that large amount of flights ran from Delhi to Cochin in which Jet Airways giving the major contribution.

In [ ]:

```
#data3 = df.groupby(['Source', 'Destination', 'Airline'])['Destination'].count()
#print(data3.index[1], data3.values[1])
"""
for i in range(len(data3)):
  print(data3.index[i], data3.values[i])
"""
```

Out[ ]:

```
'\nfor i in range(len(data3)):\n  print(data3.index[i], data3.values[i])\n'
```

Price analysis based on different variables

Price based on Additional info

In [ ]:

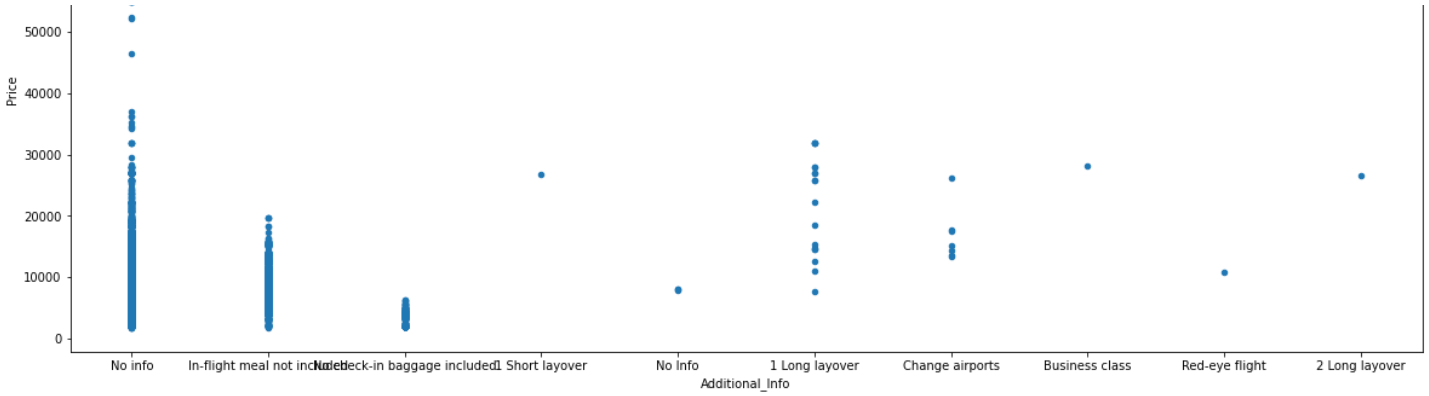
```
df.head(2)
```

Out[ ]:

	Airline	Source	Destination	Route	Duration	Total_Stops	Additional_Info	Price	Journey_day	Journey_month	Dep_hr	D
0	IndiGo	Banglore	Delhi	BLR → DEL	2h 50m	non-stop	No info	3897	24	3	22	
1	Air India	Kolkata	Banglore	CCU → IXR → BBI → BLR	7h 25m	2 stops	No info	7662	5	1	5	

In [ ]:

```
df.plot.scatter('Additional_Info', 'Price', figsize = (20, 8))
plt.show()
```

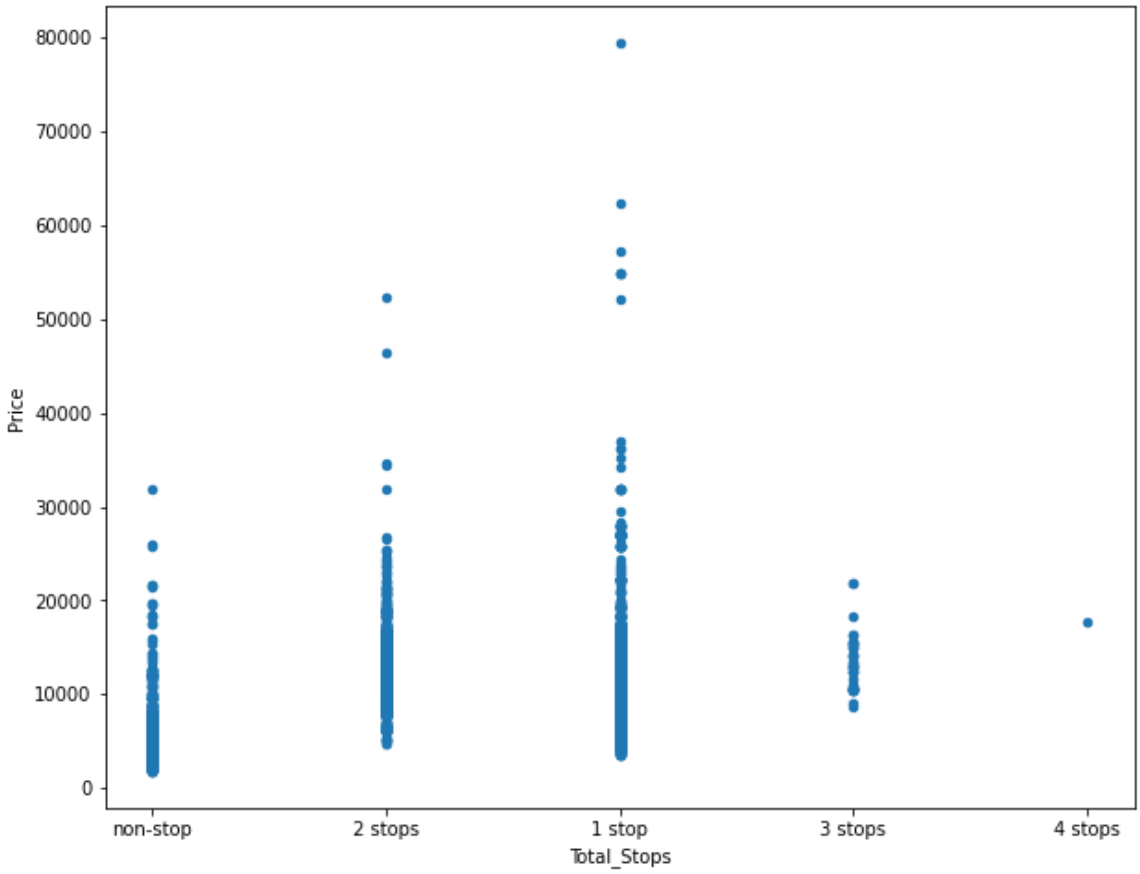


The price with Business Class has a max price with minimum starting from around 30k.

Price based on Total stops

In [ ]:

```
df.plot.scatter('Total_Stops', 'Price', figsize = (10,8))
plt.show()
```



In [ ]:

```
df.select_dtypes(include='object')
```

Out[ ]:

	Airline	Source	Destination	Route	Duration	Total_Stops	Additional_Info
0	IndiGo	Banglore	Delhi	BLR → DEL	2h 50m	non-stop	No info
1	Air India	Kolkata	Banglore	CCU → IXR → BBI → BLR	7h 25m	2 stops	No info
2	Jet Airways	Delhi	Cochin	DEL → LKO → BOM → COK	19h	2 stops	No info
3	IndiGo	Kolkata	Banglore	CCU → NAG → BLR	5h 25m	1 stop	No info
4	IndiGo	Banglore	Delhi	BLR → NAG → DEL	4h 45m	1 stop	No info
...	...	...	...	...	...	...	...
10673	Air Asia	Kolkata	Banglore	CCU → BLR	2h 30m	non-stop	No info

	Airline	Source	Destination	Route	Duration	Total_Stops	Additional_Info
10678	Air Asia	Kolkata	Banglore	CCU → BLR	2h 30m	non-stop	No info
10679	Air India	Kolkata	Banglore	CCU → BLR	2h 35m	non-stop	No info
10680	Jet Airways	Banglore	Delhi	BLR → DEL	3h	non-stop	No info
10681	Vistara	Banglore	Delhi	BLR → DEL	2h 40m	non-stop	No info
10682	Air India	Delhi	Cochin	DEL → GOI → BOM → COK	8h 20m	2 stops	No info

10462 rows × 7 columns

The above dataframe contains object data types.

1. Expect duration variable, other variables has to be converted to Categorical datatypes so that it will be useful for Machine learning model.
2. The Duration variable has to be convert to numerical or int values by converting 1hr = 60 min and adding to respective minutes.
3. After this, the remaining datasets are added and the dataset is ready for ML model.

Conclusion

1. The dataset represents the price of flights based on various parameters.
2. The conversion of date and time for respective variables has been done.
3. The duplicate values have been removed.
4. We observe that Jet Airways has the highest no of flights.
5. The flight distance from Delhi to Chennai are most.
6. The variation between additional_info and price have been found out.
7. The object datatypes needs to be converted to Categorical for ML model.