IMPORTING LIBERARIES

In [94]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split, RandomizedSearchCV
from sklearn.metrics import mean_absolute_error,mean_squared_error,explained_v
from sklearn.ensemble import RandomForestRegressor
from sklearn.preprocessing import StandardScaler, MinMaxScaler
```

IMPORTING FILE

In [93]:
```
train_data=pd.read_excel('Data_Train.xlsx')
train_data.head()
```

Out[93]:

	Airline	Date_of_Journey	Source	Destination	Route	Dep_Time	Arrival_Time	Duration	To
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	

Exploratory Data Analysis

In [4]:
```
train_data.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 [5]:
```
train_data.describe()
```

Out[5]:

	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

Checking Null Values

In [6]:
```
train_data.isnull().sum()
```

Out[6]:
```
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 [7]:
```
train_data.isnull().any()
```

Out[7]:
```
Airline            False
Date_of_Journey    False
Source             False
Destination        False
Route               True
Dep_Time           False
Arrival_Time       False
Duration           False
Total_Stops         True
Additional_Info    False
Price              False
dtype: bool
```

NULL VALUE TREATMENT

In [8]:
```
train_data.dropna(inplace=True)
```

RECHECKING NULL VALUE

In [9]:
```
train_data.isnull().sum()
```

Out[9]:
```
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
```

NULL VALUE HAS BEEN PROPERLY TREATED

FEATURE REMODELING

In [10]:
```
#converting Date_of_Journey to datetime format
train_data['Date_of_Journey']=pd.to_datetime(train_data['Date_of_Journey'])
```

```
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '24/03/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '24/06/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '27/05/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '18/04/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '24/04/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '15/04/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '21/03/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '15/05/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '18/06/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '15/06/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '18/05/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '27/06/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '21/05/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '15/03/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
```

```
ng: Parsing '24/05/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '21/04/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '21/06/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '27/03/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '18/03/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
D:\Anaconda3\lib\site-packages\pandas\core\tools\datetimes.py:1047: UserWarni
ng: Parsing '27/04/2019' in DD/MM/YYYY format. Provide format or specify infe
r_datetime_format=True for consistent parsing.
  cache_array = _maybe_cache(arg, format, cache, convert_listlike)
```

Checking converted Date_of_Journey to datetime format

In [11]:
```
train_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 10682 entries, 0 to 10682
Data columns (total 11 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   Airline          10682 non-null  object
 1   Date_of_Journey  10682 non-null  datetime64[ns]
 2   Source           10682 non-null  object
 3   Destination      10682 non-null  object
 4   Route            10682 non-null  object
 5   Dep_Time         10682 non-null  object
 6   Arrival_Time     10682 non-null  object
 7   Duration         10682 non-null  object
 8   Total_Stops      10682 non-null  object
 9   Additional_Info  10682 non-null  object
 10  Price            10682 non-null  int64
dtypes: datetime64[ns](1), int64(1), object(9)
memory usage: 1001.4+ KB
```

```python
In [12]: train_data.head()
```

Out[12]:

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

Extracting the month and day from the Date of Journey column

```python
In [13]: train_data['day_of_journey']=train_data['Date_of_Journey'].dt.day
train_data['month_of_journey']=train_data['Date_of_Journey'].dt.month
```

In [14]:
```
train_data.head()
```

Out[14]:

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

Dropping the date_of_journey column as it will not be further used anymore

In [15]:
```
train_data.drop('Date_of_Journey',axis=1,inplace=True)
```

In [16]:
```
train_data.head()
```

Out[16]:

	Airline	Source	Destination	Route	Dep_Time	Arrival_Time	Duration	Total_Stops	Additio
0	IndiGo	Banglore	New Delhi	BLR → DEL	22:20	01:10 22 Mar	2h 50m	non-stop	
1	Air India	Kolkata	Banglore	CCU → IXR → BBI → BLR	05:50	13:15	7h 25m	2 stops	
2	Jet Airways	Delhi	Cochin	DEL → LKO → BOM → COK	09:25	04:25 10 Jun	19h	2 stops	
3	IndiGo	Kolkata	Banglore	CCU → NAG → BLR	18:05	23:30	5h 25m	1 stop	
4	IndiGo	Banglore	New Delhi	BLR → NAG → DEL	16:50	21:35	4h 45m	1 stop	

Same as converting Dep_Time and Arrival_Time to datetime format

In [17]:
```
train_data['Dep_Time']=pd.to_datetime(train_data['Dep_Time'])
train_data['Arrival_Time']=pd.to_datetime(train_data['Arrival_Time'])
```

In [18]:
```
train_data.head()
```

Out[18]:

	Airline	Source	Destination	Route	Dep_Time	Arrival_Time	Duration	Total_Stops	Additio
0	IndiGo	Banglore	New Delhi	BLR → DEL	2023-05-11 22:20:00	2023-03-22 01:10:00	2h 50m	non-stop	
1	Air India	Kolkata	Banglore	CCU → IXR → BBI → BLR	2023-05-11 05:50:00	2023-05-11 13:15:00	7h 25m	2 stops	
2	Jet Airways	Delhi	Cochin	DEL → LKO → BOM → COK	2023-05-11 09:25:00	2023-06-10 04:25:00	19h	2 stops	
3	IndiGo	Kolkata	Banglore	CCU → NAG → BLR	2023-05-11 18:05:00	2023-05-11 23:30:00	5h 25m	1 stop	
4	IndiGo	Banglore	New Delhi	BLR → NAG → DEL	2023-05-11 16:50:00	2023-05-11 21:35:00	4h 45m	1 stop	

In [19]:
```
train_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 10682 entries, 0 to 10682
Data columns (total 12 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   Airline           10682 non-null  object
 1   Source            10682 non-null  object
 2   Destination       10682 non-null  object
 3   Route             10682 non-null  object
 4   Dep_Time          10682 non-null  datetime64[ns]
 5   Arrival_Time      10682 non-null  datetime64[ns]
 6   Duration          10682 non-null  object
 7   Total_Stops       10682 non-null  object
 8   Additional_Info   10682 non-null  object
 9   Price             10682 non-null  int64
 10  day_of_journey    10682 non-null  int64
 11  month_of_journey  10682 non-null  int64
dtypes: datetime64[ns](2), int64(3), object(7)
memory usage: 1.1+ MB
```

Extracting hours and minutes from the departure and arrival times

In [20]:
```
train_data['Dep_time_hr']=train_data['Dep_Time'].dt.hour
train_data['Dep_time_minute']=train_data['Dep_Time'].dt.minute
train_data['Arr_time_hr']=train_data['Arrival_Time'].dt.hour
train_data['Arr_time_minute']=train_data['Arrival_Time'].dt.minute
```

Dropping the dep_time and arrival_time columns

In [21]:
```
train_data.drop(['Dep_Time','Arrival_Time'],axis=1,inplace=True)
```

In [22]:
```
train_data.head()
```

Out[22]:

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

DURATION

In [23]:
```python
def duration_preprocess(value):
    lst=value.split()
    if len(lst)==2:     # if both the hours and minutes are present return it
        return value
    else:
        if 'h' in value:  # if only hour is present append 0m
            return value+' 0m'
        else:             # if only minute is present add 0h in the front
            return '0h '+value
```

Applying the function on the entire Duration column

In [24]:
```python
train_data['Duration']=train_data['Duration'].apply(duration_preprocess)
```

Checking Data

In [25]:
```python
train_data.head()
```

Out[25]:

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

Extracting the hours and minutes from duration

In [26]:
```
train_data['duration_hours']=train_data['Duration'].apply(lambda x:int(x.split
train_data['duration_minutes']=train_data['Duration'].apply(lambda x:int(x.spl
```

Dropping the duration column

In [27]:
```
train_data.drop('Duration',axis=1,inplace=True)
```

Remaining columns having object datatype

In [28]:
```

train_data.select_dtypes(['object']).columns
```

Out[28]:
```
Index(['Airline', 'Source', 'Destination', 'Route', 'Total_Stops',
       'Additional_Info'],
      dtype='object')
```

Value Count of Total Stop

In [29]:
```
train_data['Total_Stops'].value_counts()
```

Out[29]:
```
1 stop      5625
non-stop    3491
2 stops     1520
3 stops       45
4 stops        1
Name: Total_Stops, dtype: int64
```

Mapping non-stop to 0, 1 stop to 1, 2 stops to 2, 3 stops to 3, and 4 stops to 4

In [30]:
```
train_data['Total_Stops']=train_data['Total_Stops'].map({'non-stop':0,'1 stop'
```

In [31]:
```
train_data.head()
```

Out[31]:

	Airline	Source	Destination	Route	Total_Stops	Additional_Info	Price	day_of_journey	m
0	IndiGo	Banglore	New Delhi	BLR → DEL	0	No info	3897	24	
1	Air India	Kolkata	Banglore	CCU → IXR → BBI → BLR	2	No info	7662	5	
2	Jet Airways	Delhi	Cochin	DEL → LKO → BOM → COK	2	No info	13882	6	
3	IndiGo	Kolkata	Banglore	CCU → NAG → BLR	1	No info	6218	5	
4	IndiGo	Banglore	New Delhi	BLR → NAG → DEL	1	No info	13302	3	

Remaining columns having object datatype

In [32]:
```
train_data.select_dtypes(['object']).columns
```

Out[32]:
```
Index(['Airline', 'Source', 'Destination', 'Route', 'Additional_Info'], dtype
='object')
```

More Information

In [33]:
```
train_data['Additional_Info'].value_counts()
```

Out[33]:
```
No info                         8344
In-flight meal not included     1982
No check-in baggage included     320
1 Long layover                    19
Change airports                    7
Business class                     4
No Info                            3
1 Short layover                    1
Red-eye flight                     1
2 Long layover                     1
Name: Additional_Info, dtype: int64
```

Almost 80% of the values have no-info in the additional info column and hence does not provide any necessary insights

In [34]:
```
train_data.drop('Additional_Info',inplace=True,axis=1)
train_data.head()
```

Out[34]:

	Airline	Source	Destination	Route	Total_Stops	Price	day_of_journey	month_of_journey
0	IndiGo	Banglore	New Delhi	BLR → DEL	0	3897	24	3
1	Air India	Kolkata	Banglore	CCU → IXR → BBI → BLR	2	7662	5	1
2	Jet Airways	Delhi	Cochin	DEL → LKO → BOM → COK	2	13882	6	9
3	IndiGo	Kolkata	Banglore	CCU → NAG → BLR	1	6218	5	12
4	IndiGo	Banglore	New Delhi	BLR → NAG → DEL	1	13302	3	1

Remaining columns having object Datatype

In [35]:
```
train_data.select_dtypes(['object']).columns
```

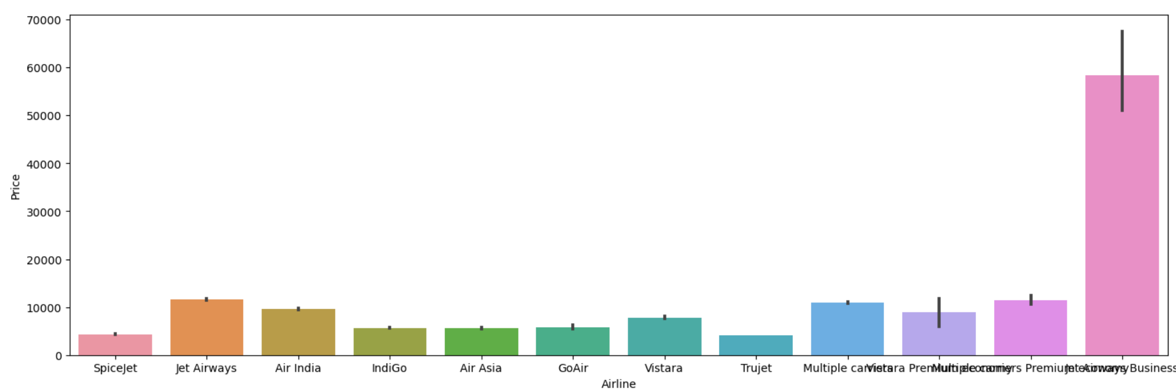
Out[35]:
```
Index(['Airline', 'Source', 'Destination', 'Route'], dtype='object')
```

AIRLINES DATA VALUE COUNT

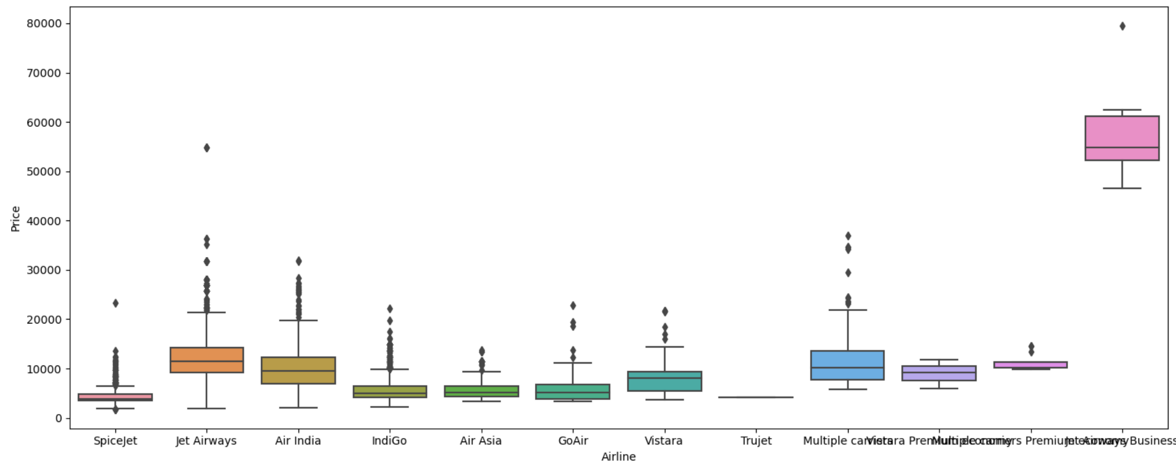
In [36]:
```
train_data['Airline'].value_counts()
```

Out[36]:
```
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 [37]:
```
plt.figure(figsize=(15,5))
sns.barplot(x='Airline',y='Price',data=train_data.sort_values('Price',ascendir
plt.tight_layout()
```



In [38]:
```
plt.figure(figsize=(15,6))
sns.boxplot(x='Airline',y='Price',data=train_data.sort_values('Price',ascendir
plt.tight_layout()
```



Descriptional Data For Various Airlines

In [39]:
```
train_data.groupby('Airline').describe()['Price'].sort_values('mean',ascending
```

Out[39]:

Airline	count	mean	std	min	25%	50%	75%	max
Trujet	1.0	4140.000000	NaN	4140.0	4140.0	4140.0	4140.00	4140.0
SpiceJet	818.0	4338.284841	1849.922514	1759.0	3574.5	3873.0	4760.00	23267.0
Air Asia	319.0	5590.260188	2027.362290	3383.0	4282.0	5162.0	6451.00	13774.0
IndiGo	2053.0	5673.682903	2264.142168	2227.0	4226.0	5000.0	6494.00	22153.0
GoAir	194.0	5861.056701	2703.585767	3398.0	3898.0	5135.0	6811.25	22794.0
Vistara	479.0	7796.348643	2914.298578	3687.0	5403.0	7980.0	9345.00	21730.0
Vistara Premium economy	3.0	8962.333333	2915.405518	5969.0	7547.0	9125.0	10459.00	11793.0
Air India	1751.0	9612.427756	3901.734561	2050.0	6891.0	9443.0	12219.00	31945.0
Multiple carriers	1196.0	10902.678094	3721.234997	5797.0	7723.0	10197.0	13587.00	36983.0
Multiple carriers Premium economy	13.0	11418.846154	1717.153936	9845.0	10161.0	11269.0	11269.00	14629.0
Jet Airways	3849.0	11643.923357	4258.940578	1840.0	9134.0	11467.0	14151.00	54826.0
Jet Airways Business	6.0	58358.666667	11667.596748	46490.0	52243.0	54747.0	61122.50	79512.0

Using One Hot Encoding

In [40]:
```python
Airline=pd.get_dummies(train_data['Airline'],drop_first=True)
Airline.head()
```

Out[40]:

	Air India	GoAir	IndiGo	Jet Airways	Jet Airways Business	Multiple carriers	Multiple carriers Premium economy	SpiceJet	Trujet	Vistara	Vist Premi econo
0	0	0	1	0	0	0	0	0	0	0	
1	1	0	0	0	0	0	0	0	0	0	
2	0	0	0	1	0	0	0	0	0	0	
3	0	0	1	0	0	0	0	0	0	0	
4	0	0	1	0	0	0	0	0	0	0	

Concatinating the Airline dataframe with the train_data dataframe

In [41]:
```
train_data=pd.concat([train_data,Airline],axis=1)
train_data.head()
```

Out[41]:

	Airline	Source	Destination	Route	Total_Stops	Price	day_of_journey	month_of_journey
0	IndiGo	Banglore	New Delhi	BLR → DEL	0	3897	24	3
1	Air India	Kolkata	Banglore	CCU → IXR → BBI → BLR	2	7662	5	1
2	Jet Airways	Delhi	Cochin	DEL → LKO → BOM → COK	2	13882	6	9
3	IndiGo	Kolkata	Banglore	CCU → NAG → BLR	1	6218	5	12
4	IndiGo	Banglore	New Delhi	BLR → NAG → DEL	1	13302	3	1

5 rows × 25 columns

Dropping the Airline column

In [42]:
```
train_data.drop('Airline',axis=1,inplace=True)
```

Source And Destination Related Value Count

In [43]:
```
train_data['Source'].value_counts()
```

Out[43]:
```
Delhi       4536
Kolkata     2871
Banglore    2197
Mumbai       697
Chennai      381
Name: Source, dtype: int64
```

In [44]:
```
train_data['Destination'].value_counts()
```

Out[44]:
```
Cochin        4536
Banglore      2871
Delhi         1265
New Delhi      932
Hyderabad      697
Kolkata        381
Name: Destination, dtype: int64
```

WE ARE USING ONE HOT ENCODING AS THERE ARE CATEGORICAL VALUES ONLY 5-6 VALUES ARE THERE AND THAT WOULD BE REPETATIVE ONLY

In [45]:
```
train_data=pd.get_dummies(data=train_data,columns=['Source','Destination'],drc
```

In [46]:
```
train_data.head()
```

Out[46]:

	Route	Total_Stops	Price	day_of_journey	month_of_journey	Dep_time_hr	Dep_time_minute
0	BLR → DEL	0	3897	24	3	22	20
1	CCU → IXR → BBI → BLR	2	7662	5	1	5	50
2	DEL → LKO → BOM → COK	2	13882	6	9	9	25
3	CCU → NAG → BLR	1	6218	5	12	18	5
4	BLR → NAG → DEL	1	13302	3	1	16	50

5 rows × 31 columns

Checking all the Features/Column Names

In [47]:
```
train_data.columns
```

Out[47]:
```
Index(['Route', 'Total_Stops', 'Price', 'day_of_journey', 'month_of_journey',
       'Dep_time_hr', 'Dep_time_minute', 'Arr_time_hr', 'Arr_time_minute',
       'duration_hours', 'duration_minutes', 'Air India', 'GoAir', 'IndiGo',
       'Jet Airways', 'Jet Airways Business', 'Multiple carriers',
       'Multiple carriers Premium economy', 'SpiceJet', 'Trujet', 'Vistara',
       'Vistara Premium economy', 'Source_Chennai', 'Source_Delhi',
       'Source_Kolkata', 'Source_Mumbai', 'Destination_Cochin',
       'Destination_Delhi', 'Destination_Hyderabad', 'Destination_Kolkata',
       'Destination_New Delhi'],
      dtype='object')
```

Remaining columns of object datatype

In [48]:
```
train_data.select_dtypes(['object']).columns
```

Out[48]:
```
Index(['Route'], dtype='object')
```

Route

In [49]:
```
route=train_data.select_dtypes(['object'])
route.head()
```

Out[49]:

	Route
0	BLR → DEL
1	CCU → IXR → BBI → BLR
2	DEL → LKO → BOM → COK
3	CCU → NAG → BLR
4	BLR → NAG → DEL

In [50]:
```
train_data['Total_Stops'].value_counts()
```

Out[50]:
```
1    5625
0    3491
2    1520
3      45
4       1
Name: Total_Stops, dtype: int64
```

There are maximum 4 stops for a flight and hence the number of routes would be 5 (a -> b -> c -> d -> e -> f)

In [51]:
```
route['Route_1']=route['Route'].str.split('→').str[0]
route['Route_2']=route['Route'].str.split('→').str[1]
route['Route_3']=route['Route'].str.split('→').str[2]
route['Route_4']=route['Route'].str.split('→').str[3]
route['Route_5']=route['Route'].str.split('→').str[4]
```

In [52]:
```
route.head()
```

Out[52]:

	Route	Route_1	Route_2	Route_3	Route_4	Route_5
0	BLR → DEL	BLR	DEL	NaN	NaN	NaN
1	CCU → IXR → BBI → BLR	CCU	IXR	BBI	BLR	NaN
2	DEL → LKO → BOM → COK	DEL	LKO	BOM	COK	NaN
3	CCU → NAG → BLR	CCU	NAG	BLR	NaN	NaN
4	BLR → NAG → DEL	BLR	NAG	DEL	NaN	NaN

In [53]:
```
# fill the NaN values with None
route.fillna('None',inplace=True)
route.head()
```

Out[53]:

	Route	Route_1	Route_2	Route_3	Route_4	Route_5
0	BLR → DEL	BLR	DEL	None	None	None
1	CCU → IXR → BBI → BLR	CCU	IXR	BBI	BLR	None
2	DEL → LKO → BOM → COK	DEL	LKO	BOM	COK	None
3	CCU → NAG → BLR	CCU	NAG	BLR	None	None
4	BLR → NAG → DEL	BLR	NAG	DEL	None	None

HENCE DATA HAS BEEN SEGREGATED PROPERLY

In [54]:
```
for i in range(1,6):
    col='Route_'+str(i)
    val=route[col].nunique()
    print(f'Number of categories in {col} is: {val}')
```

```
Number of categories in Route_1 is: 5
Number of categories in Route_2 is: 45
Number of categories in Route_3 is: 30
Number of categories in Route_4 is: 14
Number of categories in Route_5 is: 6
```

HERE IN ROUTE WE CAN SEE TOO MANY CATEGORIES SO WE CAN USE LABEL ENCODING NOT ONE HOT ENCODING

In [55]:
```python
from sklearn.preprocessing import LabelEncoder
```

In [56]:
```python
label_encoder=LabelEncoder()
```

In [57]:
```python
for i in range(1,6):
    col='Route_'+str(i)
    route[col]=label_encoder.fit_transform(route[col])
```

In [58]:
```python
route.head()
```

Out[58]:

	Route	Route_1	Route_2	Route_3	Route_4	Route_5
0	BLR → DEL	0	13	29	13	5
1	CCU → IXR → BBI → BLR	2	25	1	3	5
2	DEL → LKO → BOM → COK	3	32	4	5	5
3	CCU → NAG → BLR	2	34	3	13	5
4	BLR → NAG → DEL	0	34	8	13	5

Dropping the Route column

In [59]:
```python
route.drop('Route',inplace=True,axis=1)
route.head(2)
```

Out[59]:

	Route_1	Route_2	Route_3	Route_4	Route_5
0	0	13	29	13	5
1	2	25	1	3	5

Concatinating route and train_data

In [60]:
```
train_data=pd.concat([train_data,route],axis=1)
train_data.head(2)
```

Out[60]:

	Route	Total_Stops	Price	day_of_journey	month_of_journey	Dep_time_hr	Dep_time_minute
0	BLR → DEL	0	3897	24	3	22	20
1	CCU → IXR → BBI → BLR	2	7662	5	1	5	50

2 rows × 36 columns

Dropping the route column from train_data

In [61]:
```
train_data.drop('Route',inplace=True,axis=1)
train_data.head(2)
```

Out[61]:

	Total_Stops	Price	day_of_journey	month_of_journey	Dep_time_hr	Dep_time_minute	Arr_tim
0	0	3897	24	3	22	20	
1	2	7662	5	1	5	50	

2 rows × 35 columns

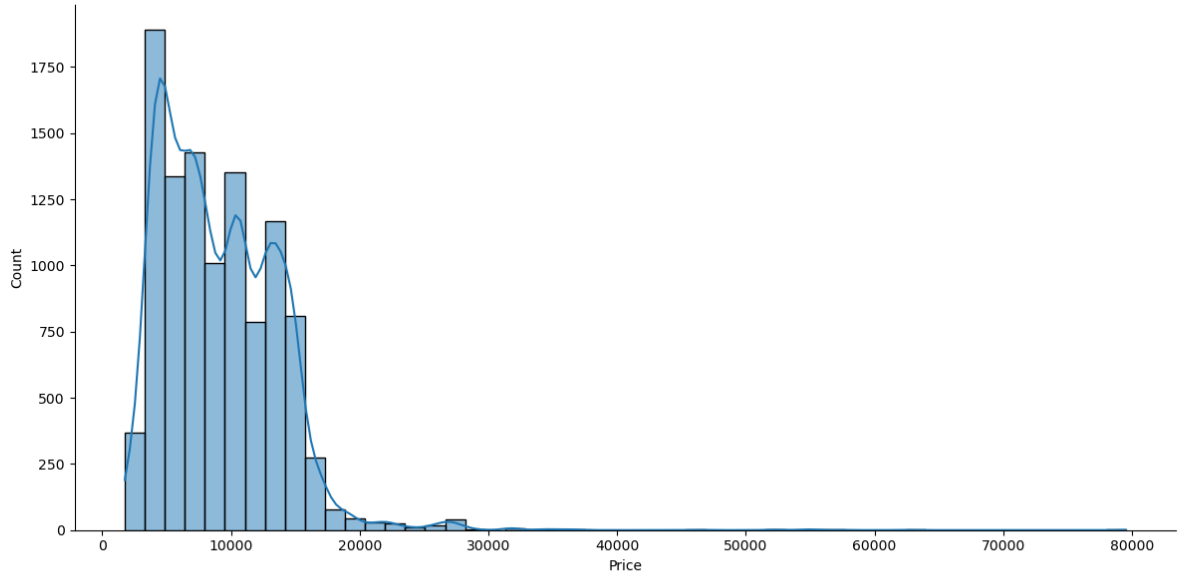
In [62]:
```
train_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 10682 entries, 0 to 10682
Data columns (total 35 columns):
 #   Column                              Non-Null Count  Dtype
---  ------                              --------------  -----
 0   Total_Stops                         10682 non-null  int64
 1   Price                               10682 non-null  int64
 2   day_of_journey                      10682 non-null  int64
 3   month_of_journey                    10682 non-null  int64
 4   Dep_time_hr                         10682 non-null  int64
 5   Dep_time_minute                     10682 non-null  int64
 6   Arr_time_hr                         10682 non-null  int64
 7   Arr_time_minute                     10682 non-null  int64
 8   duration_hours                      10682 non-null  int64
 9   duration_minutes                    10682 non-null  int64
 10  Air India                           10682 non-null  uint8
 11  GoAir                               10682 non-null  uint8
 12  IndiGo                              10682 non-null  uint8
 13  Jet Airways                         10682 non-null  uint8
 14  Jet Airways Business                10682 non-null  uint8
 15  Multiple carriers                   10682 non-null  uint8
 16  Multiple carriers Premium economy   10682 non-null  uint8
 17  SpiceJet                            10682 non-null  uint8
 18  Trujet                              10682 non-null  uint8
 19  Vistara                             10682 non-null  uint8
 20  Vistara Premium economy             10682 non-null  uint8
 21  Source_Chennai                      10682 non-null  uint8
 22  Source_Delhi                        10682 non-null  uint8
 23  Source_Kolkata                      10682 non-null  uint8
 24  Source_Mumbai                       10682 non-null  uint8
 25  Destination_Cochin                  10682 non-null  uint8
 26  Destination_Delhi                   10682 non-null  uint8
 27  Destination_Hyderabad               10682 non-null  uint8
 28  Destination_Kolkata                 10682 non-null  uint8
 29  Destination_New Delhi               10682 non-null  uint8
 30  Route_1                             10682 non-null  int32
 31  Route_2                             10682 non-null  int32
 32  Route_3                             10682 non-null  int32
 33  Route_4                             10682 non-null  int32
 34  Route_5                             10682 non-null  int32
dtypes: int32(5), int64(10), uint8(20)
memory usage: 1.3 MB
```

Outlier Detection

In [63]:
```
sns.displot(train_data['Price'],bins=50,aspect=2,height=6,kde=True)
```

Out[63]: <seaborn.axisgrid.FacetGrid at 0x1f890e899a0>



In [64]:
```
train_data[train_data['Price']>40000]
```

Out[64]:

	Total_Stops	Price	day_of_journey	month_of_journey	Dep_time_hr	Dep_time_minute	A
657	1	52229	3	1	5	45	
1478	1	54826	18	3	18	40	
2618	1	54826	18	3	22	50	
2924	1	79512	3	1	5	45	
5372	1	62427	3	1	5	45	
5439	1	54826	3	1	16	55	
7351	2	46490	3	3	20	5	
9715	2	52285	3	6	20	5	
10364	1	57209	3	1	9	45	

9 rows × 35 columns

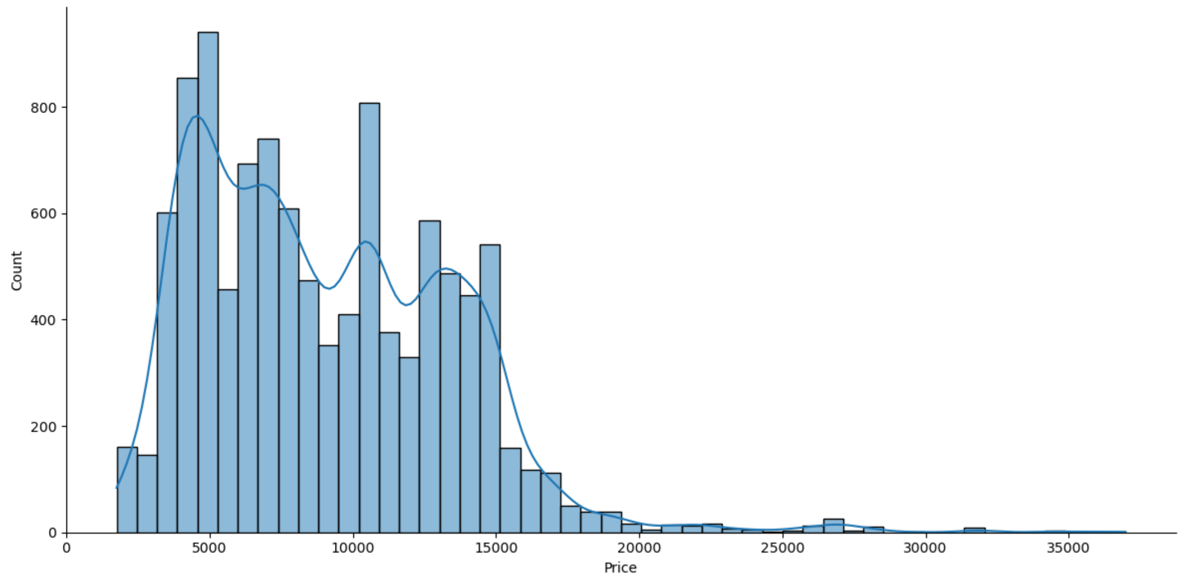
There are some outliers in the dataset where the airfare is over 40000, which could negatively impact the accuracy of machine learning models. To address this issue, it may be better to replace those outliers with the median price of the entire dataset.

Replacing airfare of more than 40000 with the median price

In [65]:
```python
train_data['Price']=np.where(train_data['Price']>40000,train_data['Price'].mec
```

In [66]:
```python
sns.displot(train_data['Price'],bins=50,aspect=2,height=6,kde=True)
```

Out[66]: <seaborn.axisgrid.FacetGrid at 0x1f89106db80>



MACHINE LEARNING PART

Spliting Data into Target and Feature

In [68]:
```python
X=train_data.drop('Price',axis=1)    # all columns except the price column
y=train_data['Price']                # the price column for which we are predic

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3)     #
```

DEFINING METRICS

In [75]:
```python
# Defining a function that prints out all the metrics
def metrics(y_true,y_pred):
    print(f'MAE: ',mean_absolute_error(y_true,y_pred))
    print(f'MSE: ',mean_squared_error(y_true,y_pred))
    print(f'RMSE: ',mean_squared_error(y_true,y_pred)**0.5)
    print(f'Explained Variance Score: ',explained_variance_score(y_true,y_pred

# function for calculating the accuracy
def accuracy(y_true,y_predictions):
    errors = abs(y_predictions - y_true)
    mape = 100 * np.mean(errors / y_true)
    accuracy_model = 100 - mape
    return accuracy_model
```

USING RANDOM FOREST

In [76]:
```
# creating an instance of the Random Forest model
model_random_forest=RandomForestRegressor(n_estimators=500,min_samples_split=3

# fitting the model
model_random_forest.fit(X_train,y_train)
```

Out[76]:
```
RandomForestRegressor(min_samples_split=3, n_estimators=500)
```

In [78]:
```
# making predictions on the test data
from sklearn.metrics import mean_absolute_error,mean_squared_error,explained_v
predictions_random_forest=model_random_forest.predict(X_test)

metrics(y_test,predictions_random_forest)
```

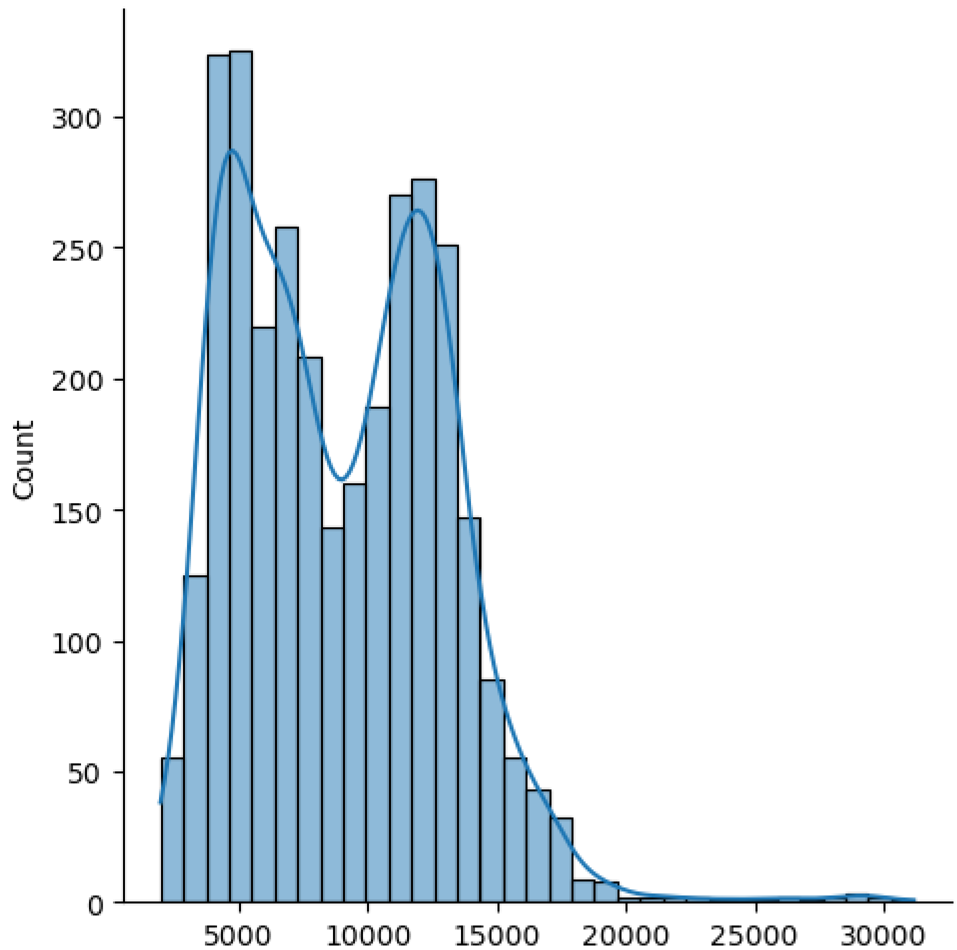
```
MAE:  1121.4502692460148
MSE:  3464535.372052645
RMSE:  1861.3262400913616
Explained Variance Score:  0.8223326516728537
```

In [79]:
```
accuracy(y_test,predictions_random_forest)
```

Out[79]:
```
87.61937955758866
```

```
In [86]: sns.displot(predictions_random_forest,kde=True)
```

```
Out[86]: <seaborn.axisgrid.FacetGrid at 0x1f895f9d820>
```




```
In [ ]:
```

```
In [ ]:
```