Linear Regression Model

Load the Dataset

```
import pandas as pd
df = pd.read_csv('/content/drive/MyDrive/ML Projects/Clean_Dataset.csv')
df
```

	Unnamed: 0	airline	flight	source_city	departure_time	stops	arrival_time	destination_city	class	duration	days_le
0	0	SpiceJet	SG-8709	Delhi	Evening	zero	Night	Mumbai	Economy	2.17	
1	1	SpiceJet	SG-8157	Delhi	Early_Morning	zero	Morning	Mumbai	Economy	2.33	
2	2	AirAsia	I5-764	Delhi	Early_Morning	zero	Early_Morning	Mumbai	Economy	2.17	
3	3	Vistara	UK-995	Delhi	Morning	zero	Afternoon	Mumbai	Economy	2.25	
4	4	Vistara	UK-963	Delhi	Morning	zero	Morning	Mumbai	Economy	2.33	
...	...	...	...	...	...	...	...	...	...	...	
300148	300148	Vistara	UK-822	Chennai	Morning	one	Evening	Hyderabad	Business	10.08	
300149	300149	Vistara	UK-826	Chennai	Afternoon	one	Night	Hyderabad	Business	10.42	
300150	300150	Vistara	UK-832	Chennai	Early_Morning	one	Night	Hyderabad	Business	13.83	
300151	300151	Vistara	UK-828	Chennai	Early_Morning	one	Evening	Hyderabad	Business	10.00	
300152	300152	Vistara	UK-822	Chennai	Morning	one	Evening	Hyderabad	Business	10.08	

300153 rows × 12 columns

Data Preprocessing

```
df.shape
```

```
(300153, 12)
```

```
df.describe()
```

	Unnamed: 0	duration	days_left	price
count	300153.000000	300153.000000	300153.000000	300153.000000
mean	150076.000000	12.221021	26.004751	20889.660523
std	86646.852011	7.191997	13.561004	22697.767366
min	0.000000	0.830000	1.000000	1105.000000
25%	75038.000000	6.830000	15.000000	4783.000000
50%	150076.000000	11.250000	26.000000	7425.000000
75%	225114.000000	16.170000	38.000000	42521.000000
max	300152.000000	49.830000	49.000000	123071.000000

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 300153 entries, 0 to 300152
Data columns (total 12 columns):
 #   Column            Non-Null Count   Dtype
---  ------            --------------   -----
 0   Unnamed: 0        300153 non-null  int64
 1   airline           300153 non-null  object
 2   flight            300153 non-null  object
 3   source_city       300153 non-null  object
 4   departure_time    300153 non-null  object
 5   stops             300153 non-null  object
 6   arrival_time      300153 non-null  object
 7   destination_city  300153 non-null  object
 8   class             300153 non-null  object
 9   duration          300153 non-null  float64
 10  days_left         300153 non-null  int64
 11  price             300153 non-null  int64
```

```
dtypes: float64(1), int64(3), object(8)
memory usage: 27.5+ MB
```

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

```
Unnamed: 0          0
airline             0
flight              0
source_city         0
departure_time      0
stops               0
arrival_time        0
destination_city    0
class               0
duration            0
days_left           0
price               0
dtype: int64
```

```
df.columns
```

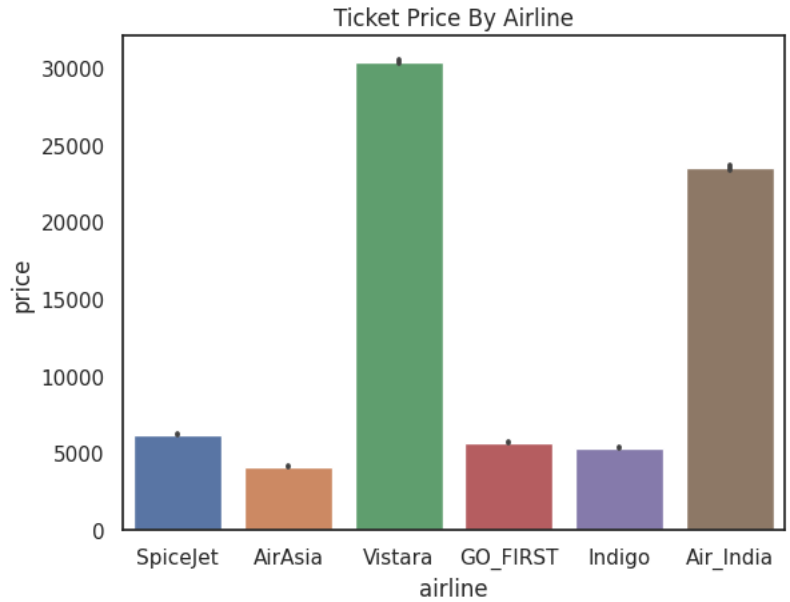
```
Index(['Unnamed: 0', 'airline', 'flight', 'source_city', 'departure_time',
       'stops', 'arrival_time', 'destination_city', 'class', 'duration',
       'days_left', 'price'],
      dtype='object')
```

```
df.nunique()
```

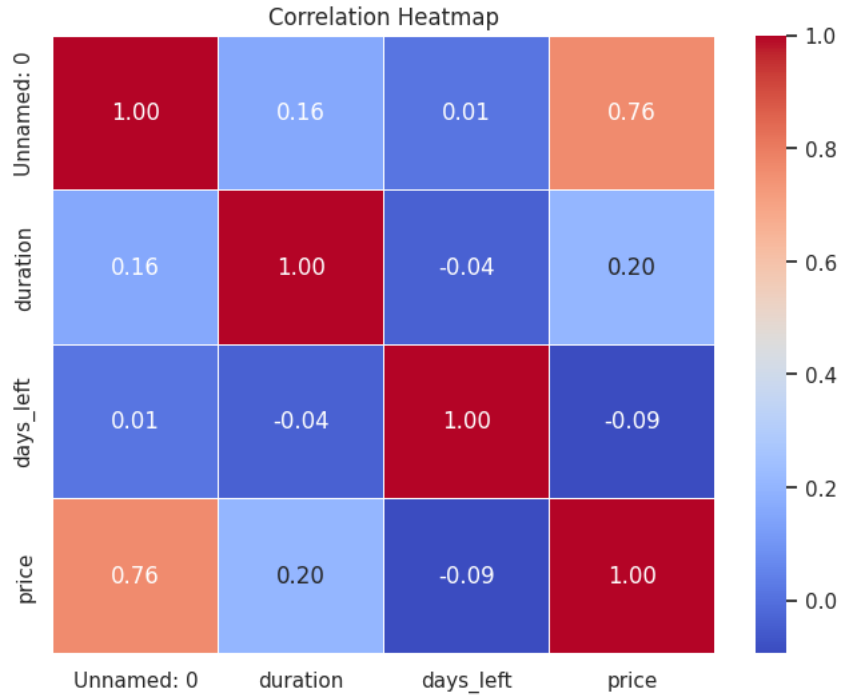
```
Unnamed: 0          300153
airline                  6
flight                1561
source_city              6
departure_time           6
stops                    3
arrival_time             6
destination_city         6
class                    2
duration               476
days_left               49
price                12157
dtype: int64
```

```
import seaborn as sns
import matplotlib.pyplot as plt

sns.barplot(x=df["airline"] , y=df["price"])
plt.title("Ticket Price By Airline")
plt.show()
```




```
import matplotlib.pyplot as plt
import seaborn as sns
sns.set(style = "white")
plt.figure(figsize=(8,6))
sns.heatmap(df.corr(numeric_only = True) , annot=True , cmap='coolwarm' , fmt='.2f' , linewidth=0.5)
plt.title('Correlation Heatmap')
plt.show()
```



Encoding Categorical Features

Converting the Categorical Columns (features with dtypes=object) into numerical features (dtypes = int64)

```
from sklearn.preprocessing import LabelEncoder
label_encoder = LabelEncoder()

df['class'] = label_encoder.fit_transform(df['class'])

df['destination_city'] = label_encoder.fit_transform(df['destination_city'])

df['arrival_time'] = label_encoder.fit_transform(df['arrival_time'])

df['stops'] = label_encoder.fit_transform(df['stops'])

df['departure_time'] = label_encoder.fit_transform(df['departure_time'])

df['source_city'] = label_encoder.fit_transform(df['source_city'])

df['flight'] = label_encoder.fit_transform(df['flight'])

df['airline'] = label_encoder.fit_transform(df['airline'])
```

Data Scaling

```
from sklearn.preprocessing import StandardScaler
standard_scaler = StandardScaler()
df = standard_scaler.fit_transform(df)
df
```

```
array([[-1.73204504,  0.48827006,  0.74916287, ..., -1.39753079,
        -1.84387477, -0.65806849],
       [-1.7320335 ,  0.48827006,  0.69994728, ..., -1.3752838 ,
        -1.84387477, -0.65806849],
       [-1.73202195, -1.69363332,  0.29216101, ..., -1.39753079,
        -1.84387477, -0.65793631],
       ...,
       [ 1.73202195,  1.0337459 ,  0.93196361, ...,  0.22371837,
         1.69569214,  2.56454459],
       [ 1.7320335 ,  1.0337459 ,  0.92493281, ..., -0.30881888,
         1.69569214,  2.67407096],
       [ 1.73204504,  1.0337459 ,  0.91087121, ..., -0.29769538,
         1.69569214,  2.67407096]])
```

Separation of X (features) and Y (Target)

```
y = df["price"]
x = df.drop(columns=["price"])
```

```
y
```

```
0          5953
1          5953
2          5956
3          5955
4          5955
          ...
300148    69265
300149    77105
300150    79099
300151    81585
300152    81585
Name: price, Length: 300153, dtype: int64
```

```
x
```

	Unnamed: 0	airline	flight	source_city	departure_time	stops	arrival_time	destination_city	class	duration	days_le
0	0	SpiceJet	SG-8709	Delhi	Evening	zero	Night	Mumbai	Economy	2.17	
1	1	SpiceJet	SG-8157	Delhi	Early_Morning	zero	Morning	Mumbai	Economy	2.33	
2	2	AirAsia	I5-764	Delhi	Early_Morning	zero	Early_Morning	Mumbai	Economy	2.17	
3	3	Vistara	UK-995	Delhi	Morning	zero	Afternoon	Mumbai	Economy	2.25	
4	4	Vistara	UK-963	Delhi	Morning	zero	Morning	Mumbai	Economy	2.33	
...	...	...	...	...	...	...	...	...	...	...	
300148	300148	Vistara	UK-822	Chennai	Morning	one	Evening	Hyderabad	Business	10.08	
300149	300149	Vistara	UK-826	Chennai	Afternoon	one	Night	Hyderabad	Business	10.42	
300150	300150	Vistara	UK-832	Chennai	Early_Morning	one	Night	Hyderabad	Business	13.83	
300151	300151	Vistara	UK-828	Chennai	Early_Morning	one	Evening	Hyderabad	Business	10.00	
300152	300152	Vistara	UK-822	Chennai	Morning	one	Evening	Hyderabad	Business	10.08	

300153 rows × 11 columns

Data Spliting into Training and Test sets

```
from sklearn.model_selection import train_test_split
x_train , x_test , y_train , y_test = train_test_split(x,y,test_size=0.2, random_state=100)
```

```
x_train.shape
```

```
(240122, 11)
```

```
x_test.shape
```

```
(60031, 11)
```

```
y_train.shape
```

```
(240122,)
```

```
y_test.shape
```

```
(60031,)
```

Encoding Categorical Features

```
from sklearn.preprocessing import LabelEncoder
label_encoder = LabelEncoder()

x_train['class'] = label_encoder.fit_transform(x_train['class'])
x_test['class'] = label_encoder.transform(x_test['class'])

x_train['destination_city'] = label_encoder.fit_transform(x_train['destination_city'])
x_test['destination_city'] = label_encoder.transform(x_test['destination_city'])
```

```
x_train['arrival_time'] = label_encoder.fit_transform(x_train['arrival_time'])
x_test['arrival_time'] = label_encoder.transform(x_test['arrival_time'])

x_train['stops'] = label_encoder.fit_transform(x_train['stops'])
x_test['stops'] = label_encoder.transform(x_test['stops'])

x_train['departure_time'] = label_encoder.fit_transform(x_train['departure_time'])
x_test['departure_time'] = label_encoder.transform(x_test['departure_time'])

x_train['source_city'] = label_encoder.fit_transform(x_train['source_city'])
x_test['source_city'] = label_encoder.transform(x_test['source_city'])

x_train['flight'] = label_encoder.fit_transform(x_train['flight'])
x_test['flight'] = label_encoder.fit_transform(x_test['flight'])

x_train['airline'] = label_encoder.fit_transform(x_train['airline'])
x_test['airline'] = label_encoder.transform(x_test['airline'])
```

Model Phase

Building the model

```
from sklearn.linear_model import LinearRegression

lr = LinearRegression()
```

Training the model

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

```
▾ LinearRegression
LinearRegression()
```

Apply the model to make predictions

```
y_lr_test_pred = lr.predict(x_test)
```

Evaluating the model

```
from sklearn.metrics import mean_squared_error, r2_score

lr_test_mse = mean_squared_error(y_test , y_lr_test_pred)
lr_test_r2 = r2_score(y_test , y_lr_test_pred)

lr_results = pd.DataFrame(['Linear Regression', lr_test_mse, lr_test_r2]).transpose()
lr_results.columns = ["Method","Test MSE", "Test R2"]
lr_results
```

	Method	Test MSE	Test R2
0	Linear Regression	49171067.385183	0.904829

RandomForest

```
from sklearn.ensemble import RandomForestRegressor
rf = RandomForestRegressor(random_state=100)
```

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

```
▾ RandomForestRegressor
RandomForestRegressor(random_state=100)
```

```
y_rf_test_pred = rf.predict(x_test)


from sklearn.metrics import mean_squared_error, r2_score

rf_test_mse = mean_squared_error(y_test , y_rf_test_pred)
rf_test_r2 = r2_score(y_test , y_rf_test_pred)


rf_results = pd.DataFrame(['Random Forest', rf_test_mse, rf_test_r2]).transpose()
rf_results.columns = ["Method","Test MSE", "Test R2"]
rf_results
```

	Method	Test MSE	Test R2
0	Random Forest	50426665.470066	0.902399

```
from sklearn.tree import DecisionTreeRegressor
dt = DecisionTreeRegressor()


dt.fit(x_train , y_train)
```

```
DecisionTreeRegressor
DecisionTreeRegressor()
```

```
y_dt_test_pred = dt.predict(x_test)


from sklearn.metrics import mean_squared_error, r2_score

dt_test_mse = mean_squared_error(y_test , y_dt_test_pred)
dt_test_r2 = r2_score(y_test , y_dt_test_pred)


dt_results = pd.DataFrame(['Decision Tree', dt_test_mse, dt_test_r2]).transpose()
dt_results.columns = ["Method" , "Test MSE", "Test R2"]
dt_results
```

	Method	Test MSE	Test R2
0	Decision Tree	72082945.487132	0.860484

Model Comparison

```
df_models = pd.concat([lr_results, rf_results , dt_results], axis=0)
df_models
```

	Method	Test MSE	Test R2
0	Linear Regression	49171067.385183	0.904829
0	Random Forest	50426665.470066	0.902399
0	Decision Tree	72082945.487132	0.860484

```
df_models.reset_index(drop=True)
```

	Method	Test MSE	Test R2
0	Linear Regression	49171067.385183	0.904829
1	Random Forest	50426665.470066	0.902399
2	Decision Tree	72082945.487132	0.860484

Conclusion

We can see that:

Linear Regression Model has the highest prediction accuracy with 90.48%

Random Forest Model is also great at prediciting the price of flight ticket with 90.23% accuracy.

Decision Tree Model is still efficient but has a prediction accuracy of 85% that is less accurate than "Linear regression" and "Random Forest" Models