In [1]:
```
#Importing libraries
import pandas as pd
import numpy as np
import random as rnd

# Data Visualization
import seaborn as sns
import matplotlib.pyplot as plt

# Machine Learning
from sklearn.linear_model import LogisticRegression
from sklearn.svm import LinearSVC, SVC
from sklearn import tree
from sklearn.svm import SVC
from sklearn.linear_model import Perceptron
from sklearn.linear_model import SGDClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import accuracy_score
```

```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\ensemble\weight_boosting.py:29: DeprecationWarning: numpy.core.umat
h_tests is an internal NumPy module and should not be imported. It will be removed in a future NumPy release.
  from numpy.core.umath_tests import inner1d
```

Reading .dat into pandas

In [2]:
```
data = pd.read_csv('http://users.stat.ufl.edu/~winner/data/airq402.dat',header = None, delim_whitespace=True, error_bad_li
```

In [3]:
```
data.head()
```

Out[3]:

	0	1	2	3	4	5	6	7	8	9	10
0	CAK	ATL	114.47	528	424.56	FL	70.19	111.03	FL	70.19	111.03
1	CAK	MCO	122.47	860	276.84	FL	75.10	123.09	DL	17.23	118.94
2	ALB	ATL	214.42	852	215.76	DL	78.89	223.98	CO	2.77	167.12
3	ALB	BWI	69.40	288	606.84	WN	96.97	68.86	WN	96.97	68.86
4	ALB	ORD	158.13	723	313.04	UA	39.79	161.36	WN	15.34	145.42

In [4]:
```
columnslst=["City1","City2","Average Fare","Distance","Average weekly passengers","market leading airline","market share1"
```

In [5]:
```
df=data.copy(deep=True)
```

Updating column names as per the data set description

In [6]:
```
df.columns=columnslst
```

In [7]:
```
#copying to the CSV file
df.to_csv(path_or_buf="airlinedata.csv",index=True)
```

In [8]:
```
df.head()
```

Out[8]:

	City1	City2	Average Fare	Distance	Average weekly passengers	market leading airline	market share1	Average fare	Low price airline	market share2	price
0	CAK	ATL	114.47	528	424.56	FL	70.19	111.03	FL	70.19	111.03
1	CAK	MCO	122.47	860	276.84	FL	75.10	123.09	DL	17.23	118.94
2	ALB	ATL	214.42	852	215.76	DL	78.89	223.98	CO	2.77	167.12
3	ALB	BWI	69.40	288	606.84	WN	96.97	68.86	WN	96.97	68.86
4	ALB	ORD	158.13	723	313.04	UA	39.79	161.36	WN	15.34	145.42

In [9]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 11 columns):
City1                       1000 non-null object
City2                       1000 non-null object
Average Fare                1000 non-null float64
Distance                    1000 non-null int64
Average weekly passengers   1000 non-null float64
market leading airline      1000 non-null object
market share1               1000 non-null float64
Average fare                1000 non-null float64
Low price airline           1000 non-null object
market share2               1000 non-null float64
price                       1000 non-null float64
dtypes: float64(6), int64(1), object(4)
memory usage: 86.0+ KB
```

In [10]:
```
""" we can see a lot of columns above are object. They shpuld eb categorical. Hence, I would capture all convert them into
char_cols = df.dtypes.pipe(lambda x: x[x == 'object']).index
#identifying the charecter / categorical columns
```

In [11]:
```
print(char_cols)
#got all categorical variables names in single list
```

```
Index(['City1', 'City2', 'market leading airline', 'Low price airline'], dtype='object')
```

In [12]:
```
for c in char_cols:
    df[c]= df[c].astype('category')
# converting into categorical variables
```

In [13]:
```
df.dtypes
#checking the conversion.
```

Out[13]:
```
City1                        category
City2                        category
Average Fare                  float64
Distance                        int64
Average weekly passengers     float64
market leading airline       category
market share1                 float64
Average fare                  float64
Low price airline            category
market share2                 float64
price                         float64
dtype: object
```

In [14]:
```
df['Average Fare']=df['Average Fare'].astype('int')
```

In [15]:
```
df.info()
```

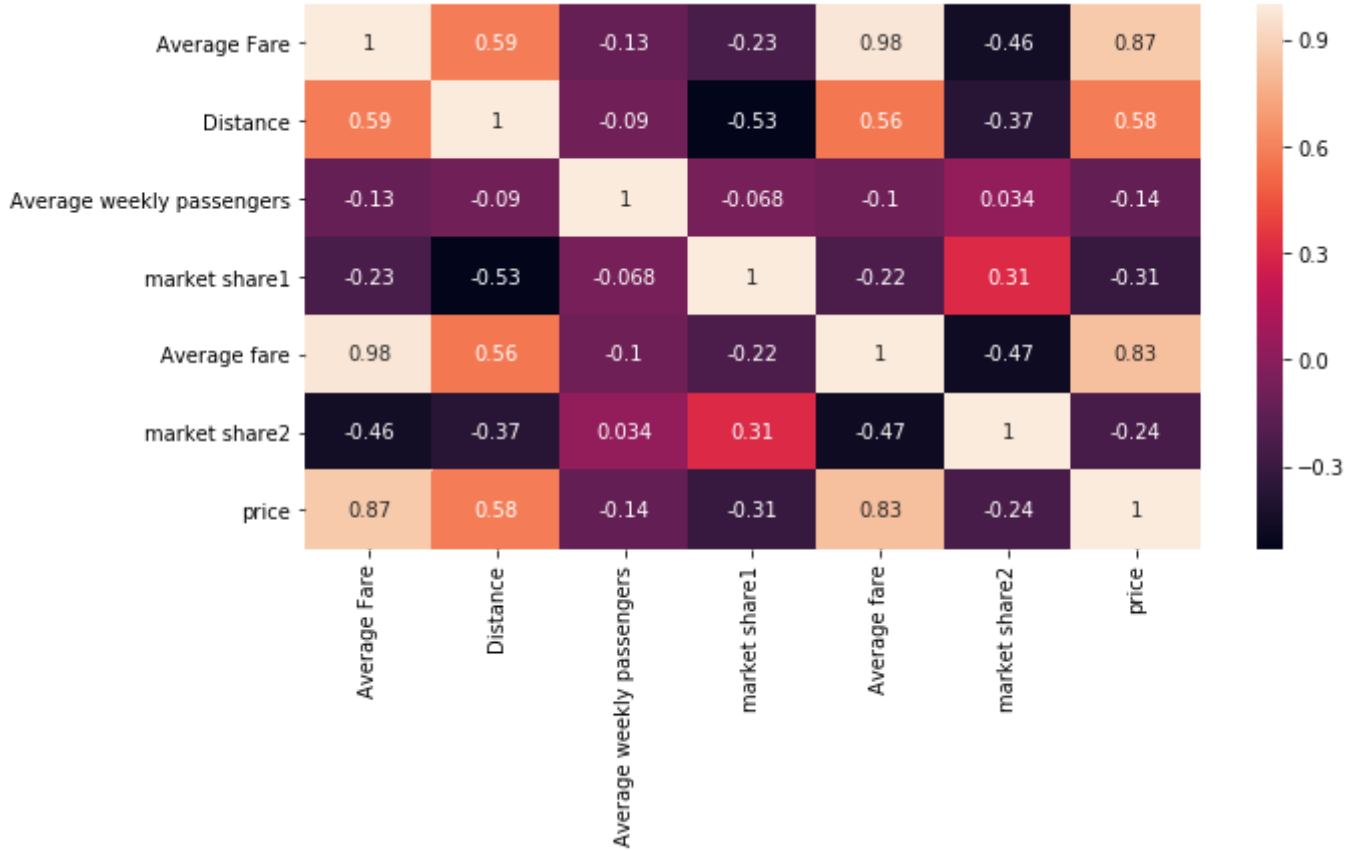
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 11 columns):
City1                         1000 non-null category
City2                         1000 non-null category
Average Fare                  1000 non-null int32
Distance                      1000 non-null int64
Average weekly passengers     1000 non-null float64
market leading airline        1000 non-null category
market share1                 1000 non-null float64
Average fare                  1000 non-null float64
Low price airline             1000 non-null category
market share2                 1000 non-null float64
price                         1000 non-null float64
dtypes: category(4), float64(5), int32(1), int64(1)
memory usage: 62.7 KB
```

In [16]:
```
#data.isnull().any()
df.isnull().sum()
# checking missing values
```

Out[16]:
```
City1                         0
City2                         0
Average Fare                  0
Distance                      0
Average weekly passengers     0
market leading airline        0
market share1                 0
Average fare                  0
Low price airline             0
market share2                 0
price                         0
dtype: int64
```

In [17]:
```
# Creating heat map for data visualization with correlation and coefficients
import seaborn as sns
f, ax = plt.subplots(figsize=(10, 5))
sns.heatmap(data=df.corr(), annot=True)
```

Out[17]: <matplotlib.axes._subplots.AxesSubplot at 0x2007a40cb70>



In [ ]:

In [ ]:

Part 2

In [18]:
```
df1=df.copy(deep=True)
```

In [19]:
```
df1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 11 columns):
City1                          1000 non-null category
City2                          1000 non-null category
Average Fare                   1000 non-null int32
Distance                       1000 non-null int64
Average weekly passengers      1000 non-null float64
market leading airline         1000 non-null category
market share1                  1000 non-null float64
Average fare                   1000 non-null float64
Low price airline              1000 non-null category
market share2                  1000 non-null float64
price                          1000 non-null float64
dtypes: category(4), float64(5), int32(1), int64(1)
memory usage: 62.7 KB
```

In [20]:
```
#Treat “Average Fare” – 3rd Column as your Dependent Variable and Rest of the columns as Independent Variable.
y=df1.pop('Average Fare')
X=df1
```

In [21]:
```
X1=pd.DataFrame()
for i, col in enumerate(['Distance','Average weekly passengers','market share1','Average fare','market share2','price']):
    X1[col]=df1[col]
```

In [22]:
```
X2=pd.DataFrame()
for i, col in enumerate(['Distance','market share1','Average fare','price']):
    X2[col]=df1[col]
```

In [23]:
```
X3=pd.DataFrame()
for i, col in enumerate(['Distance','market share1','market share2','price']):
    X3[col]=df1[col]
```

In [24]:
```
X1.shape
```

Out[24]:
```
(1000, 6)
```

In [25]:
```
X1.head()
```

Out[25]:

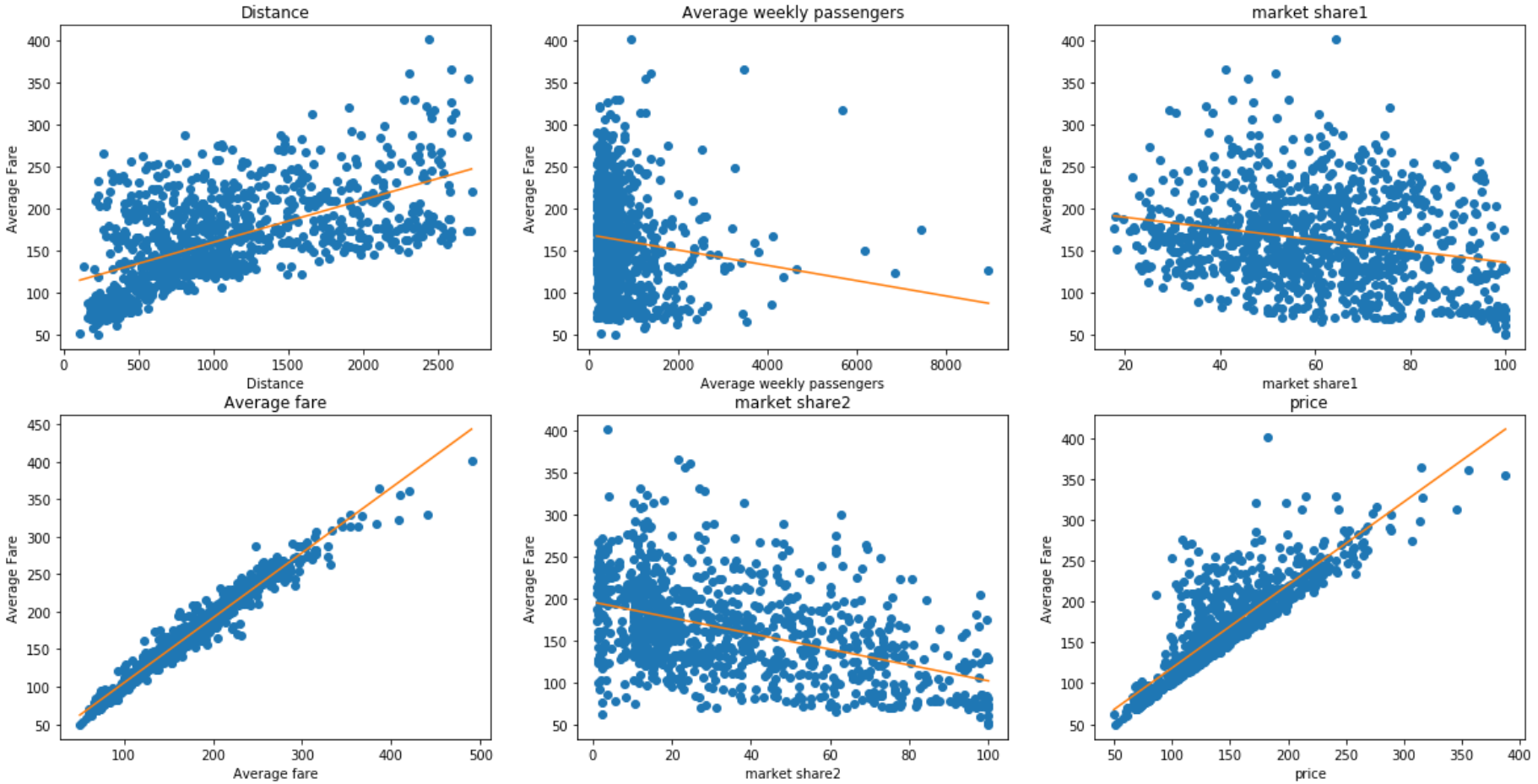
	Distance	Average weekly passengers	market share1	Average fare	market share2	price
0	528	424.56	70.19	111.03	70.19	111.03
1	860	276.84	75.10	123.09	17.23	118.94
2	852	215.76	78.89	223.98	2.77	167.12
3	288	606.84	96.97	68.86	96.97	68.86
4	723	313.04	39.79	161.36	15.34	145.42

In [ ]:
```

```

Create Scatter Plot of Independent Variable vs Dependent Variable.

In [26]:

```
# Plotting the 'Distance','Average weekly passengers','market share1','Average fare','market share2','price' against 'Aver
plt.figure(figsize=(20, 10))

# iterating for each column 'Distance','Average weekly passengers','market share1','Average fare','market share2','price'
for i, col in enumerate(['Distance','Average weekly passengers','market share1','Average fare','market share2','price']):
    plt.subplot(2, 3, i+1)
    x = X[col]
    plt.plot(x, y, 'o')
    # Create regression line
    plt.plot(np.unique(x), np.poly1d(np.polyfit(x, y, 1))(np.unique(x)))
    plt.title(col)
    plt.xlabel(col)
    plt.ylabel('Average Fare')
```



In [ ]:
```
#Based on Scatter Plot see if there is any transformation required for Independent Variable.
```

In [ ]:

In [ ]:

Build Multiple Linear Regression model.

In [27]:
```
#Splitting the data into Dependent and independent variables
X1=pd.DataFrame()
for i, col in enumerate(['Distance','Average weekly passengers','market share1','Average fare','market share2','price']):
    X1[col]=df1[col]
```

In [28]:
```
X2=pd.DataFrame()
for i, col in enumerate(['Distance','market share1','price']):
    X2[col]=df1[col]
```

In [29]:
```
X3=pd.DataFrame()
for i, col in enumerate(['Distance','market share1','market share2','price']):
    X3[col]=df1[col]
```

In [30]:
```
# follow the usual sklearn pattern: import, instantiate, fit
from sklearn.linear_model import LinearRegression
lm = LinearRegression()
lm.fit(X1, y)

# print intercept and coefficients
print(lm.intercept_)
print(lm.coef_)
```

```
10.31501765392943
[ 0.00216398 -0.00100061  0.06411164  0.70826319 -0.06558595  0.21874115]
```

In [31]:
```
# follow the usual sklearn pattern: import, instantiate, fit
from sklearn.linear_model import LinearRegression
lm = LinearRegression()
lm.fit(X2, y)

# print intercept and coefficients
print(lm.intercept_)
print(lm.coef_)
```

```
-5.024110846431483
[0.01554334 0.30288333 0.93059151]
```

In [32]:
```
# follow the usual sklearn pattern: import, instantiate, fit
from sklearn.linear_model import LinearRegression
lm = LinearRegression()
lm.fit(X3, y)

# print intercept and coefficients
print(lm.intercept_)
print(lm.coef_)
```

```
15.557213114620538
[ 0.00929572  0.425733   -0.56536016  0.91780805]
```

In [ ]:
```
```

Part 3

1. Find the most important features of this dataset to predict the average fair.

Price and Average fare are the most important features

2.Figure out what other model can be applied to improve the model performance.

In [34]:
```
#Splitting the data into Dependent and independent variables
x=pd.DataFrame()
for i, col in enumerate(['Average fare','price']):
    x[col]=df1[col]
```

In [35]:
```
# Functions created for all the models to verify which on eis best
def classifyWithLogisticRegression ( trainingData, results, testData ):
    clf_logreg = LogisticRegression()
    clf_logreg.fit(trainingData, results)
    return clf_logreg.predict(testData)

def classifyWithDecisionTree ( trainingData, results, testData ):
    clf_tree = tree.DecisionTreeClassifier()
    clf_tree.fit(trainingData, results)
    return clf_tree.predict(testData)

def classifyWithSVM ( trainingData, results, testData ):
    clf_svm = SVC()
    clf_svm.fit(trainingData,results)
    return clf_svm.predict(testData)

def classifyWithPerceptron ( trainingData, results, testData ):
    clf_perceptron = Perceptron()
    clf_perceptron.fit(trainingData,results)
    return clf_perceptron.predict(testData)

def classifyWithKNeighbors ( trainingData, results, testData ):
    clf_KNN = KNeighborsClassifier()
    clf_KNN.fit(trainingData,results)
    return clf_KNN.predict(testData)

def classifyWithGaussianNaiveBayes ( trainingData, results, testData ):
    clf_GaussianNB = GaussianNB()
    clf_GaussianNB.fit(trainingData,results)
    return clf_GaussianNB.predict(testData)

def classifyWithStochasticGradientDescent ( trainingData, results, testData ):
    sgd = SGDClassifier()
    sgd.fit(trainingData, results)
    return sgd.predict(testData)

def classifyWithLinearSVC ( trainingData, results, testData ):
    linear_svc = LinearSVC()
    linear_svc.fit(trainingData, results)
    return linear_svc.predict(testData)
```

```
def classifyWithRandomForest ( trainingData, results, testData ):
    random_forest = RandomForestClassifier(n_estimators=100)
    random_forest.fit(trainingData, results)
    return random_forest.predict(testData)
```

In [36]:
```
from sklearn.metrics import accuracy_score
from sklearn.model_selection import train_test_split
from sklearn import metrics
```

In [37]:
```
# Solitting the data into train and test
X_train,X_test,y_train,y_test = train_test_split(x,y,test_size = 0.3,random_state = 3)
```

Get the accuracy score on train and test data.

In [38]:
```
LR_prediction = classifyWithLogisticRegression(X_train, y_train, X_test)
DT_prediction = classifyWithDecisionTree(X_train, y_train, X_test)
SVM_prediction = classifyWithSVM(X_train, y_train, X_test)
KN_prediction = classifyWithKNeighbors(X_train, y_train, X_test)
LRSVC_prediction = classifyWithLinearSVC(X_train, y_train, X_test)
RF_prediction = classifyWithRandomForest(X_train, y_train, X_test)
NB_prediction = classifyWithGaussianNaiveBayes ( X_train, y_train, X_test )
print("Logistic regressor accuracy is",metrics.accuracy_score(y_test,LR_prediction))
print("Decision Tree regressor accuracy is",metrics.accuracy_score(y_test,DT_prediction))
print("SVM regressor accuracy is",metrics.accuracy_score(y_test,SVM_prediction))
print("KNeighbors regressor accuracy is",metrics.accuracy_score(y_test,KN_prediction))
print("LinearSVC regressor accuracy is",metrics.accuracy_score(y_test,LRSVC_prediction))
print("RandomForest regressor accuracy is",metrics.accuracy_score(y_test,RF_prediction))
print("Naive Base accuracy is",metrics.accuracy_score(y_test,NB_prediction))
```

```
Logistic regressor accuracy is 0.023333333333333334
Decision Tree regressor accuracy is 0.07
SVM regressor accuracy is 0.04666666666666667
KNeighbors regressor accuracy is 0.07666666666666666
LinearSVC regressor accuracy is 0.0
RandomForest regressor accuracy is 0.06666666666666667
Naive Base accuracy is 0.08666666666666667
```

In [ ]:

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