Task 5 Sales Predictions using Machine Learning

1.Importing Python's librarires Pandas, Numpy, matplotlib, seaborn, scikit-learn

In [1]:
```
import pandas as pd
import numpy as np

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

from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error, r2_score, mean_absolute_error
from sklearn.ensemble import RandomForestRegressor
from sklearn.tree import DecisionTreeRegressor
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import Lasso
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.svm import SVR
```

2. Reading 'Advertising.csv' file use pandas.

In [2]:
```
adv = pd.read_csv('Advertising.csv')
adv.head()
```

Out[2]:

	Unnamed: 0	TV	Radio	Newspaper	Sales
0	1	230.1	37.8	69.2	22.1
1	2	44.5	39.3	45.1	10.4
2	3	17.2	45.9	69.3	9.3
3	4	151.5	41.3	58.5	18.5
4	5	180.8	10.8	58.4	12.9

In [3]:
```
adv.shape
```

Out[3]:
```
(200, 5)
```

In [4]:
```
adv.drop('Unnamed: 0',inplace =True, axis =1)
```

In [5]:
```
adv.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 4 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   TV         200 non-null    float64
 1   Radio      200 non-null    float64
 2   Newspaper  200 non-null    float64
 3   Sales      200 non-null    float64
dtypes: float64(4)
memory usage: 6.4 KB
```

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

Out[6]:
```
TV           0
Radio        0
Newspaper    0
Sales        0
dtype: int64
```

In [7]:
```
adv.columns
```

Out[7]:
```
Index(['TV', 'Radio', 'Newspaper', 'Sales'], dtype='object')
```

Stastical discription of the dataset.

In [8]:
```
1 adv.describe().T
```

Out[8]:

	count	mean	std	min	25%	50%	75%	max
TV	200.0	147.0425	85.854236	0.7	74.375	149.75	218.825	296.4
Radio	200.0	23.2640	14.846809	0.0	9.975	22.90	36.525	49.6
Newspaper	200.0	30.5540	21.778621	0.3	12.750	25.75	45.100	114.0
Sales	200.0	14.0225	5.217457	1.6	10.375	12.90	17.400	27.0

Chcek for correlation in the columns of the data.

In [9]:
```
1 adv.corr()
```

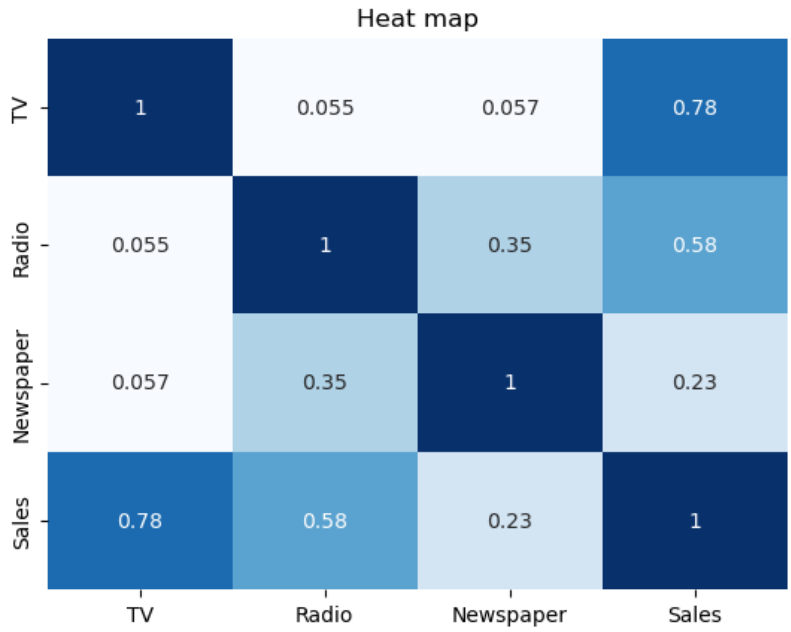
Out[9]:

	TV	Radio	Newspaper	Sales
TV	1.000000	0.054809	0.056648	0.782224
Radio	0.054809	1.000000	0.354104	0.576223
Newspaper	0.056648	0.354104	1.000000	0.228299
Sales	0.782224	0.576223	0.228299	1.000000

Heat Map which is used to visulazing the correaltion between columns of the dataset.

In [10]:
```
1 sns.heatmap(adv.corr(),annot =True,cbar= False,cmap ='Blues')
2 plt.title('Heat map')
```

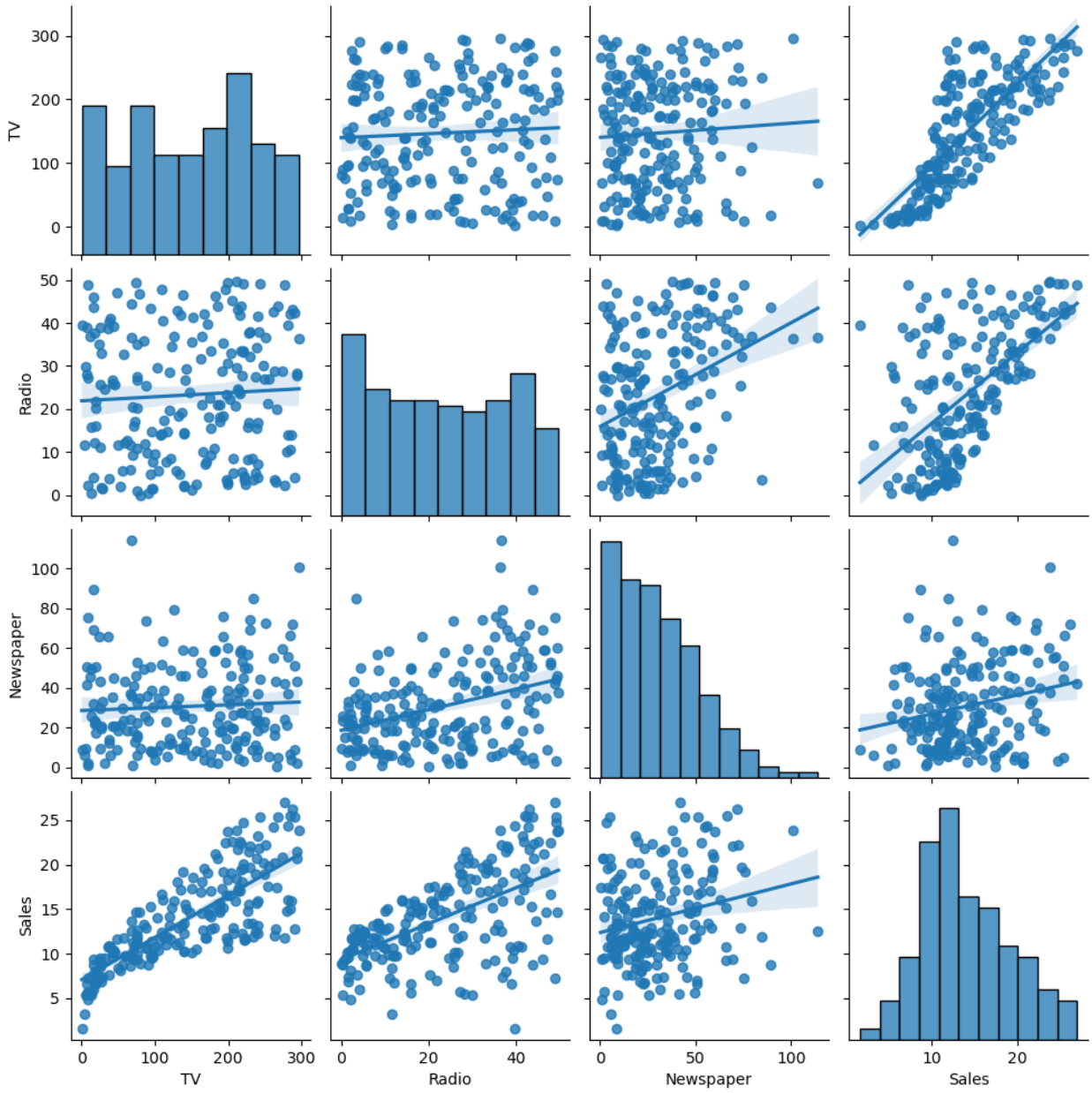
Out[10]:
```
Text(0.5, 1.0, 'Heat map')
```



Making pair plot.

In [11]:
```
1 sns.pairplot(adv,kind ='reg')
```

Out[11]: <seaborn.axisgrid.PairGrid at 0x1e60816b2e0>



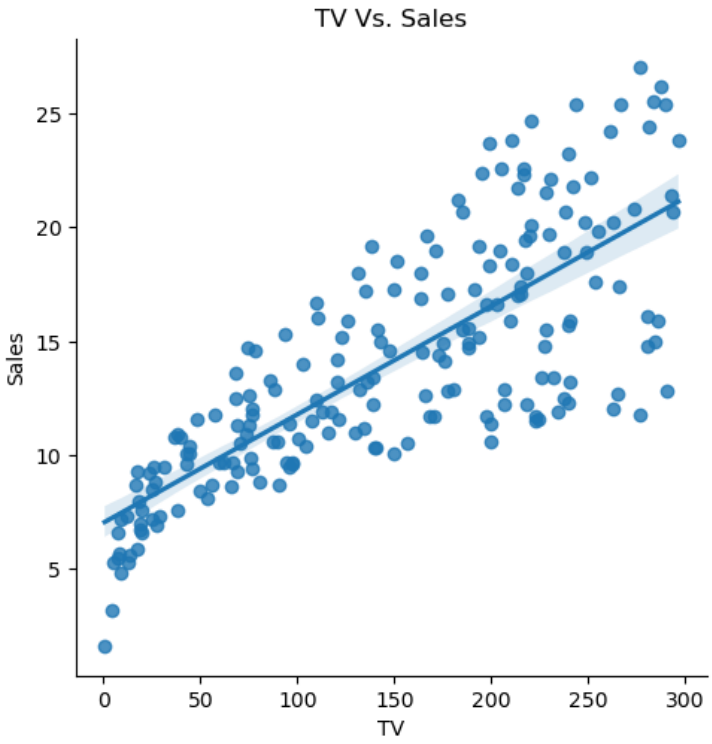
Making regression plot.

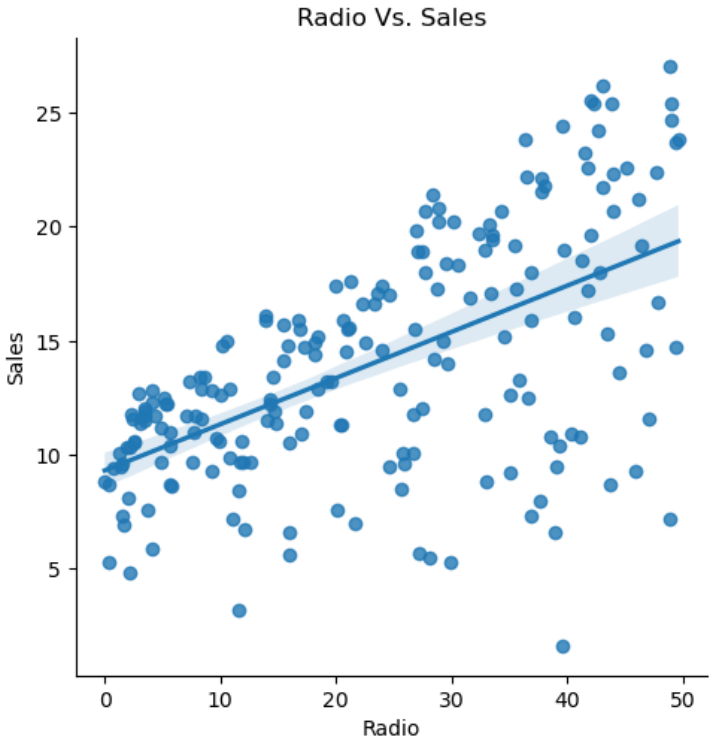
In [12]:

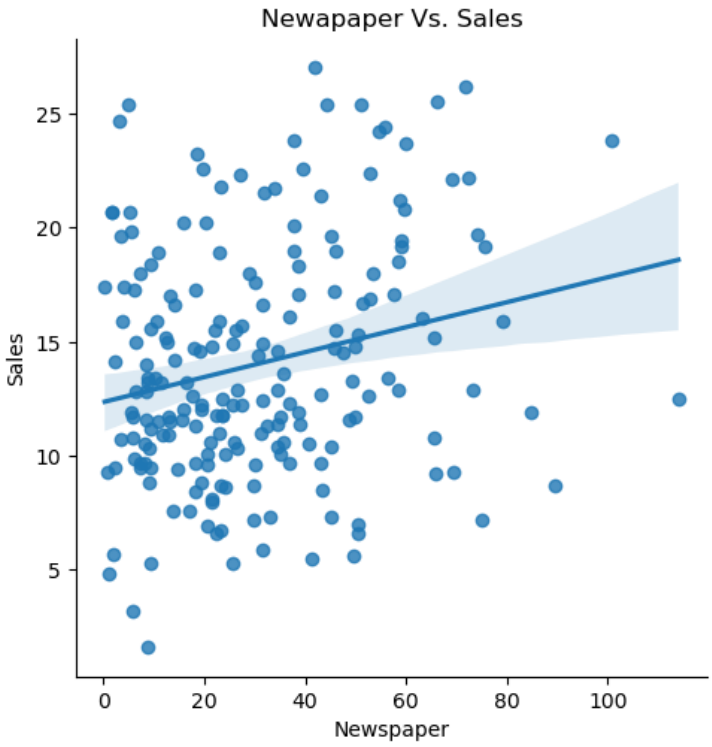
```
sns.lmplot(x='TV', y='Sales', data=adv)
plt.title("TV Vs. Sales")
sns.lmplot(x='Radio', y='Sales', data=adv)
plt.title("Radio Vs. Sales")
sns.lmplot(x='Newspaper', y='Sales', data=adv)
plt.title("Newapaper Vs. Sales")

```

Out[12]: Text(0.5, 1.0, 'Newapaper Vs. Sales')







3.Preparing the dataset for the training and testing the models.

In [13]:
```
1 X = adv.drop('Sales', axis = 1)
```

In [14]:
```
1 Y = adv['Sales']
```

In [15]:
```
1 x_train, x_test, y_train, y_test = train_test_split(X,Y, test_size =0.2, random_state =42)
```

In [16]:
```
1 print(x_train.shape , x_test.shape)
2 print(y_train.shape , y_test.shape)
```

```
(160, 3) (40, 3)
(160,) (40,)
```

3.1 Random Forest Regressor

In [17]:
```
1 forest = RandomForestRegressor()
```

In [18]:
```
1 forest.fit(x_train,y_train)
```

Out[18]:
```
▾ RandomForestRegressor
RandomForestRegressor()
```

In [19]:
```
1 y_for = forest.predict(x_test)
```

In [20]:
```
1 print("Accuracy of the Random Forest Regressor Model on train set: {:0.2f}.".format(forest.score(x_train,
2 print("Accuracy of the Random Forest Regressor Model on test set: {:0.2f}.".format(forest.score(x_test,y_
```

```
Accuracy of the Random Forest Regressor Model on train set: 99.62.
Accuracy of the Random Forest Regressor Model on test set: 98.05.
```

In [21]:
```
1 mse_for = mean_squared_error(y_test,y_for)
2 rmse_for = np.sqrt(mse_for)
3 print("Root Mean Squared Error of Random Forest Model: {:0.2f}".format(rmse_for))
4 print("R2 Score of Random Forest Model: {:0.2f}".format(r2_score(y_test,y_for)))
5 print("Mean Absolute Error of Random Forest Model: {:0.2f}".format(mean_absolute_error(y_test,y_for)))
```

```
Root Mean Squared Error of Random Forest Model: 0.78
R2 Score of Random Forest Model: 0.98
Mean Absolute Error of Random Forest Model: 0.64
```

3.2 Decision Tree Regressor

In [22]:
```
tree = DecisionTreeRegressor()
```

In [23]:
```
tree.fit(x_train,y_train)
```

Out[23]:
```
DecisionTreeRegressor
DecisionTreeRegressor()
```

In [24]:
```
y_tree = tree.predict(x_test)
```

In [25]:
```
print("Decision Tree Model Score on Trian Data:{:0.2f}".format(tree.score(x_train,y_train)*100))
print("Decision Tree Model Score on Test Data: {:0.2f}".format(tree.score(x_test,y_test)*100))
```

```
Decision Tree Model Score on Trian Data:100.00
Decision Tree Model Score on Test Data: 92.74
```

In [26]:
```
mse_tree = mean_squared_error(y_test,y_tree)
rmse_tree = np.sqrt(mse_tree)
print("Root Mean Squared Error of Decision Tree Model: {:0.2f}".format(rmse_tree))
print("R2 Score of Decision Tree Model: {:0.2f}".format(r2_score(y_test,y_tree)))
print("Mean Absolute Error of Decision Tree Model: {:0.2f}".format(mean_absolute_error(y_test,y_tree)))
```

```
Root Mean Squared Error of Decision Tree Model: 1.51
R2 Score of Decision Tree Model: 0.93
Mean Absolute Error of Decision Tree Model: 1.04
```

3.3 Linear Regression

In [27]:
```
lr= LinearRegression()
```

In [28]:
```
lr.fit(x_train,y_train)
```

Out[28]:
```
LinearRegression
LinearRegression()
```

In [29]:
```
y_lr =lr.predict(x_test)
```

In [30]:
```
print("Linear Regression Model Score on Trian Data:{:0.2f}".format(lr.score(x_train,y_train)*100))
print("Linear Regression Model Score on Test Data: {:0.2f}".format(lr.score(x_test,y_test)*100))
```

```
Linear Regression Model Score on Trian Data:89.57
Linear Regression Model Score on Test Data: 89.94
```

In [31]:
```
mse_lr = mean_squared_error(y_test,y_lr)
rmse_lr = np.sqrt(mse_lr)
print("Root Mean Squared Error of Linear Regression Model: {:0.2f}".format(rmse_lr))
print("R2 Score of Linear Regression Model: {:0.2f}".format(r2_score(y_test,y_lr)))
print("Mean Absolute Error of Linear Regression Model: {:0.2f}".format(mean_absolute_error(y_test,y_lr)))
```

```
Root Mean Squared Error of Linear Regression Model: 1.78
R2 Score of Linear Regression Model: 0.90
Mean Absolute Error of Linear Regression Model: 1.46
```

3.4 Lasso Model

In [32]:
```
las =Lasso()
```

In [33]:
```
las.fit(x_train,y_train)
```

Out[33]:
```
Lasso
Lasso()
```

In [34]:
```
y_las = las.predict(x_test)
```

In [35]:
```
print("Lasso Linear Model Score on Trian Data:{:0.2f}".format(lr.score(x_train,y_train)*100))
print("Lasso Linear Model Score on Test Data: {:0.2f}".format(lr.score(x_test,y_test)*100))
```

```
Lasso Linear Model Score on Trian Data:89.57
Lasso Linear Model Score on Test Data: 89.94
```

In [36]:
```
mse_las = mean_squared_error(y_test,y_las)
rmse_las = np.sqrt(mse_las)
print("Root Mean Squared Error of Lasso Linear Model: {:0.2f}".format(rmse_las))
print("R2 Score of Lasso Linear Model: {:0.2f}".format(r2_score(y_test,y_las)))
print("Mean Absolute Error of Lasso Linear Model: {:0.2f}".format(mean_absolute_error(y_test,y_las)))
```

```
Root Mean Squared Error of Lasso Linear Model: 1.77
R2 Score of Lasso Linear Model: 0.90
Mean Absolute Error of Lasso Linear Model: 1.45
```

3.5 Gradient Boosting Regressor

In [37]:
```
gbr = GradientBoostingRegressor()
```

In [38]:
```
gbr.fit(x_train,y_train)
```

Out[38]:
```
GradientBoostingRegressor
GradientBoostingRegressor()
```

In [39]:
```
y_gbr = gbr.predict(x_test)
```

In [40]:
```
print("Gradient Boosting Regressor Score on Trian Data:{:0.2f}".format(gbr.score(x_train,y_train)*100))
print("Gradient Boosting Regressor Score on Test Data: {:0.2f}".format(gbr.score(x_test,y_test)*100))
```

```
Gradient Boosting Regressor Score on Trian Data:99.87
Gradient Boosting Regressor Score on Test Data: 98.37
```

In [41]:
```
mse_gbr = mean_squared_error(y_test,y_gbr)
rmse_gbr = np.sqrt(mse_gbr)
print("Root Mean Squared Error of Gradient Boosting Regressor: {:0.2f}".format(rmse_gbr))
print("R2 Score of Gradient Boosting Regressor: {:0.2f}".format(r2_score(y_test,y_gbr)))
print("Mean Absolute Error of Gradient Boosting Regressor: {:0.2f}".format(mean_absolute_error(y_test,y_g
```

```
Root Mean Squared Error of Gradient Boosting Regressor: 0.72
R2 Score of Gradient Boosting Regressor: 0.98
Mean Absolute Error of Gradient Boosting Regressor: 0.61
```

3.6 Support Vector Regression

In [42]:
```
svr = SVR()
```

In [43]:
```
svr.fit(x_train,y_train)
```

Out[43]:
```
SVR
SVR()
```

In [44]:
```
y_svr = svr.predict(x_test)
```

In [45]:
```
print("SVR Score on Trian Data:{:0.2f}".format(svr.score(x_train,y_train)*100))
print("SVR Score on Test Data: {:0.2f}".format(svr.score(x_test,y_test)*100))
```

```
SVR Score on Trian Data:84.02
SVR Score on Test Data: 87.31
```

In [46]:

```
mse_svr = mean_squared_error(y_test,y_svr)
rmse_svr = np.sqrt(mse_svr)
print("Root Mean Squared Error of Gradient Boosting Regressor: {:0.2f}".format(rmse_svr))
print("R2 Score of Gradient Boosting Regressor: {:0.2f}".format(r2_score(y_test,y_svr)))
print("Mean Absolute Error of Gradient Boosting Regressor: {:0.2f}".format(mean_absolute_error(y_test,y_s
```

```
Root Mean Squared Error of Gradient Boosting Regressor: 2.00
R2 Score of Gradient Boosting Regressor: 0.87
Mean Absolute Error of Gradient Boosting Regressor: 1.51
```

From the above models two models gives best prediction:-

- Random Forest Model
- Gradient Booster Model

Thank You!!!