Assumptions:

```
i).There must be linear relationship btwn independent and dependent variables
ii). Mean of residual must be 0 or close to 0
iii). Variance around the regression line is the same for all values
         of X.
iv). There should be no multicollinearity
```

Multiple Linear Regression

In [1]:

```
import numpy as np
import pandas as pd
```

In [2]:

```
df=pd.read_csv("50_Startups.csv")
```

In [3]:

```
len(df)
```

Out[3]:

```
50
```

In [4]:

```
df.head()
```

Out[4]:

	R&D Spend	Administration	Marketing Spend	State	Profit
0	165349.20	136897.80	471784.10	New York	192261.83
1	162597.70	151377.59	443898.53	California	191792.06
2	153441.51	101145.55	407934.54	Florida	191050.39
3	144372.41	118671.85	383199.62	New York	182901.99
4	142107.34	91391.77	366168.42	Florida	166187.94

In [5]:

```
df.shape
```

Out[5]:

```
(50, 5)
```

Importing required Library

In [6]:

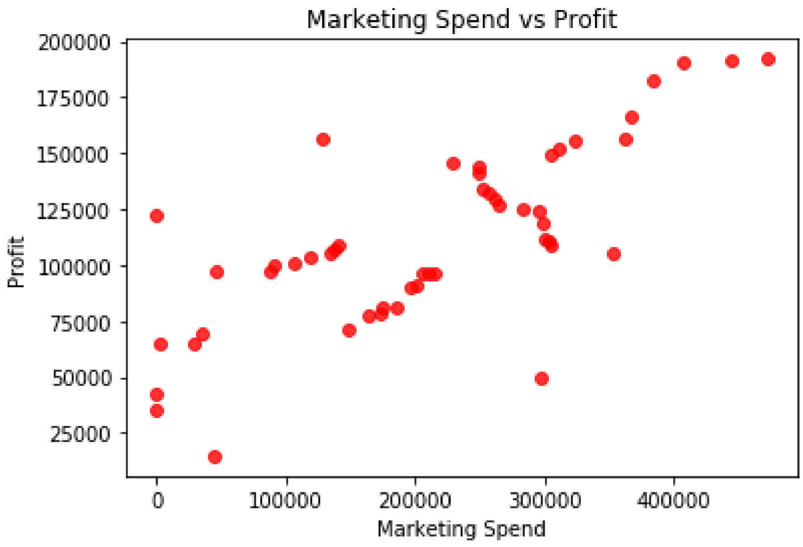
```
from sklearn.preprocessing import MinMaxScaler
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score
from sklearn.metrics import mean_squared_error

import matplotlib.pyplot as plt
```

Visualizing Data

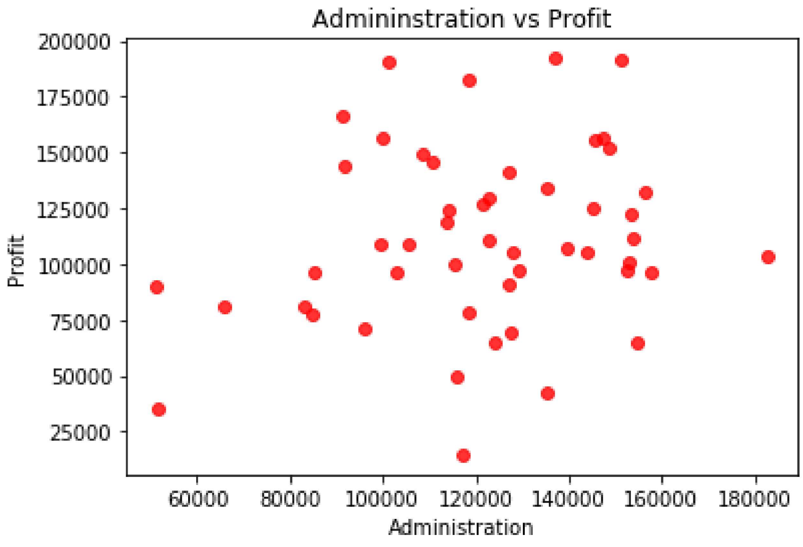
In [7]:

```
plt.scatter(df['Marketing Spend'],df['Profit'],alpha=0.8,color='red')
plt.title("Marketing Spend vs Profit")
plt.xlabel("Marketing Spend")
plt.ylabel("Profit")
plt.show()
```

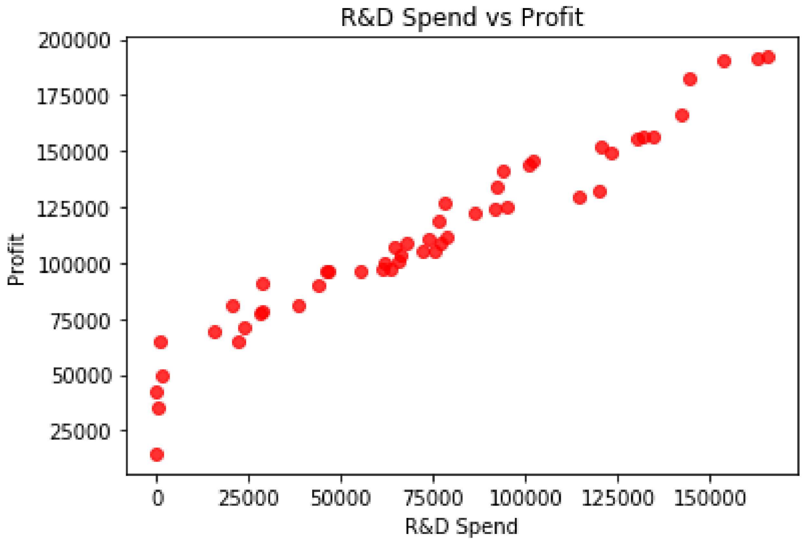


In [8]:

```
plt.scatter(df['Administration'],df['Profit'],alpha=0.8,color='red')
plt.title("Admininstration vs Profit")
plt.xlabel("Administration")
plt.ylabel("Profit")
plt.show()
```



In [9]:
```
plt.scatter(df['R&D Spend'],df['Profit'],alpha=0.8,color='red')
plt.title("R&D Spend vs Profit")
plt.xlabel("R&D Spend")
plt.ylabel("Profit")
plt.show()
```

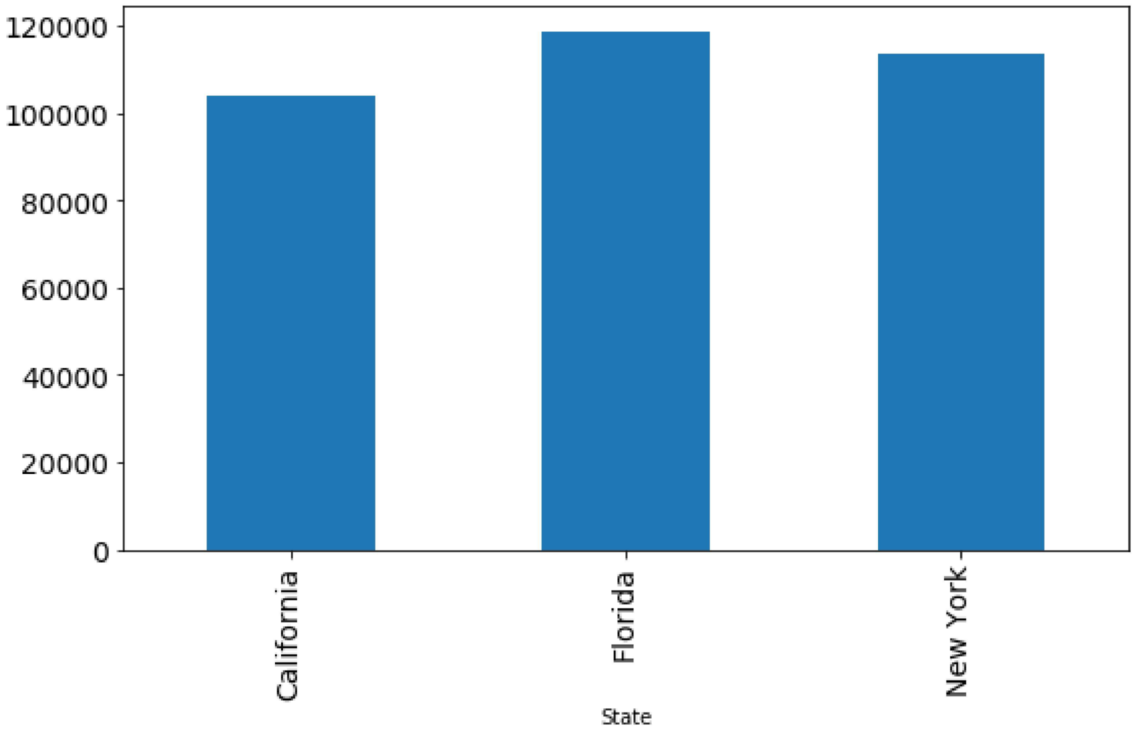


In [10]:

```
ax=df.groupby(['State'])['Profit'].mean()
ax.plot.bar(figsize=(9,5),fontsize=14)
```

Out[10]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2102b1d6b00>
```



In [11]:

```
df.State.value_counts()
```

Out[11]:

```
New York      17
California    17
Florida       16
Name: State, dtype: int64
```

In [12]:

```
#Creating Dummy Variable
df['NewYork']=np.where(df['State']=="New York",1,0)
df['California']=np.where(df['State']=="California",1,0)
df["Florida"]=np.where(df["State"]=="Florida",1,0)

#Drop State
df.drop(columns=["State"],inplace=True)
```

In [13]:

```
dep="Profit"
ind=df.columns.tolist()

#Removing Profit from independent variable
ind.remove(dep)
print(ind)
```

```
['R&D Spend', 'Administration', 'Marketing Spend', 'NewYork', 'California', 'Fl
orida']
```

Splitting the Data

In [14]:

```
x=df[ind]

y=df[dep]
```

In [15]:

```
xtrain,xtest,ytrain,ytest=train_test_split(x,y,test_size=0.2,random_state=0)
```

In [16]:

```
#Transforming Data   (helps to better fit the model)
scaler=MinMaxScaler()
xtrain=scaler.fit_transform(xtrain)
xtest=scaler.transform(xtest)
```

```
C:\Users\Gaurav\Anaconda3\lib\site-packages\sklearn\preprocessing\data.py:334:
DataConversionWarning: Data with input dtype int32, float64 were all converted
to float64 by MinMaxScaler.
  return self.partial_fit(X, y)
```

Building the Model

In [17]:

```
regressor=LinearRegression()
regressor.fit(xtrain,ytrain)
```

Out[17]:

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None,
         normalize=False)
```

Predicting on Test Data

In [18]:

```
pred=regressor.predict(xtest)
```

In [19]:

```
from sklearn.metrics import mean_squared_error
print("      Root Mean Squared Error")
print("---------------------------------")
np.sqrt(mean_squared_error(pred,ytest))
```

```
     Root Mean Squared Error
---------------------------------
```

Out[19]:

```
9137.990152794935
```

#On an average we will be off by 9k

In [20]:
```
print("         R2 Score")
print("---------------------------------")
np.sqrt(r2_score(pred,ytest))
```

```
         R2 Score
---------------------------------
```

Out[20]:
```
0.9640409332242128
```

R2 will be 1 for perfect model.It is close to 1.

```
Look for Gradient Descent Algorithm for knowing how the regressor is
calculated internally
```