In [77]:

```
# data preprocessing

# importing the libraries
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
import seaborn as sns
import sklearn
```

In [78]:

```
#importing the dataset
dataset = pd.read_csv ('50_Startups.csv')
```

In [79]:
```
dataset
```

Out[79]:

	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
5	131876.90	99814.71	362861.36	New York	156991.12
6	134615.46	147198.87	127716.82	California	156122.51
7	130298.13	145530.06	323876.68	Florida	155752.60
8	120542.52	148718.95	311613.29	New York	152211.77
9	123334.88	108679.17	304981.62	California	149759.96
10	101913.08	110594.11	229160.95	Florida	146121.95
11	100671.96	91790.61	249744.55	California	144259.40
12	93863.75	127320.38	249839.44	Florida	141585.52
13	91992.39	135495.07	252664.93	California	134307.35
14	119943.24	156547.42	256512.92	Florida	132602.65
15	114523.61	122616.84	261776.23	New York	129917.04
16	78013.11	121597.55	264346.06	California	126992.93
17	94657.16	145077.58	282574.31	New York	125370.37
18	91749.16	114175.79	294919.57	Florida	124266.90
19	86419.70	153514.11	0.00	New York	122776.86
20	76253.86	113867.30	298664.47	California	118474.03
21	78389.47	153773.43	299737.29	New York	111313.02
22	73994.56	122782.75	303319.26	Florida	110352.25
23	67532.53	105751.03	304768.73	Florida	108733.99

	R&D Spend	Administration	Marketing Spend	State	Profit
24	77044.01	99281.34	140574.81	New York	108552.04
25	64664.71	139553.16	137962.62	California	107404.34
26	75328.87	144135.98	134050.07	Florida	105733.54
27	72107.60	127864.55	353183.81	New York	105008.31
28	66051.52	182645.56	118148.20	Florida	103282.38
29	65605.48	153032.06	107138.38	New York	101004.64
30	61994.48	115641.28	91131.24	Florida	99937.59
31	61136.38	152701.92	88218.23	New York	97483.56
32	63408.86	129219.61	46085.25	California	97427.84
33	55493.95	103057.49	214634.81	Florida	96778.92
34	46426.07	157693.92	210797.67	California	96712.80
35	46014.02	85047.44	205517.64	New York	96479.51
36	28663.76	127056.21	201126.82	Florida	90708.19
37	44069.95	51283.14	197029.42	California	89949.14
38	20229.59	65947.93	185265.10	New York	81229.06
39	38558.51	82982.09	174999.30	California	81005.76
40	28754.33	118546.05	172795.67	California	78239.91
41	27892.92	84710.77	164470.71	Florida	77798.83
42	23640.93	96189.63	148001.11	California	71498.49
43	15505.73	127382.30	35534.17	New York	69758.98
44	22177.74	154806.14	28334.72	California	65200.33
45	1000.23	124153.04	1903.93	New York	64926.08
46	1315.46	115816.21	297114.46	Florida	49490.75
47	0.00	135426.92	0.00	California	42559.73
48	542.05	51743.15	0.00	New York	35673.41
49	0.00	116983.80	45173.06	California	14681.40

```
In [80]: dataset.head()
```

```
Out[80]:
     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 [81]: dataset.tail()
```

```
Out[81]:
      R&D Spend  Administration  Marketing Spend       State    Profit
45      1000.23       124153.04          1903.93    New York  64926.08
46      1315.46       115816.21        297114.46     Florida  49490.75
47         0.00       135426.92             0.00  California  42559.73
48       542.05        51743.15             0.00    New York  35673.41
49         0.00       116983.80         45173.06  California  14681.40
```

In [82]:

```
dataset.describe()
```

Out[82]:

	R&D Spend	Administration	Marketing Spend	Profit
count	50.000000	50.000000	50.000000	50.000000
mean	73721.615600	121344.639600	211025.097800	112012.639200
std	45902.256482	28017.802755	122290.310726	40306.180338
min	0.000000	51283.140000	0.000000	14681.400000
25%	39936.370000	103730.875000	129300.132500	90138.902500
50%	73051.080000	122699.795000	212716.240000	107978.190000
75%	101602.800000	144842.180000	299469.085000	139765.977500
max	165349.200000	182645.560000	471784.100000	192261.830000

In [83]:

```
print('there are',dataset.shape[0],'rows and',dataset.shape[1],'columns in the dataset.')
```

```
there are 50 rows and 5 columns in the dataset.
```

In [84]:

```
print('there are',dataset.duplicated().sum(),'duplicate values in the dataset.')
```

```
there are 0 duplicate values in the dataset.
```

In [85]:

```
dataset.isnull().sum()
```

Out[85]:

```
R&D Spend          0
Administration     0
Marketing Spend    0
State              0
Profit             0
dtype: int64
```

In [86]:
```
dataset.info()
```

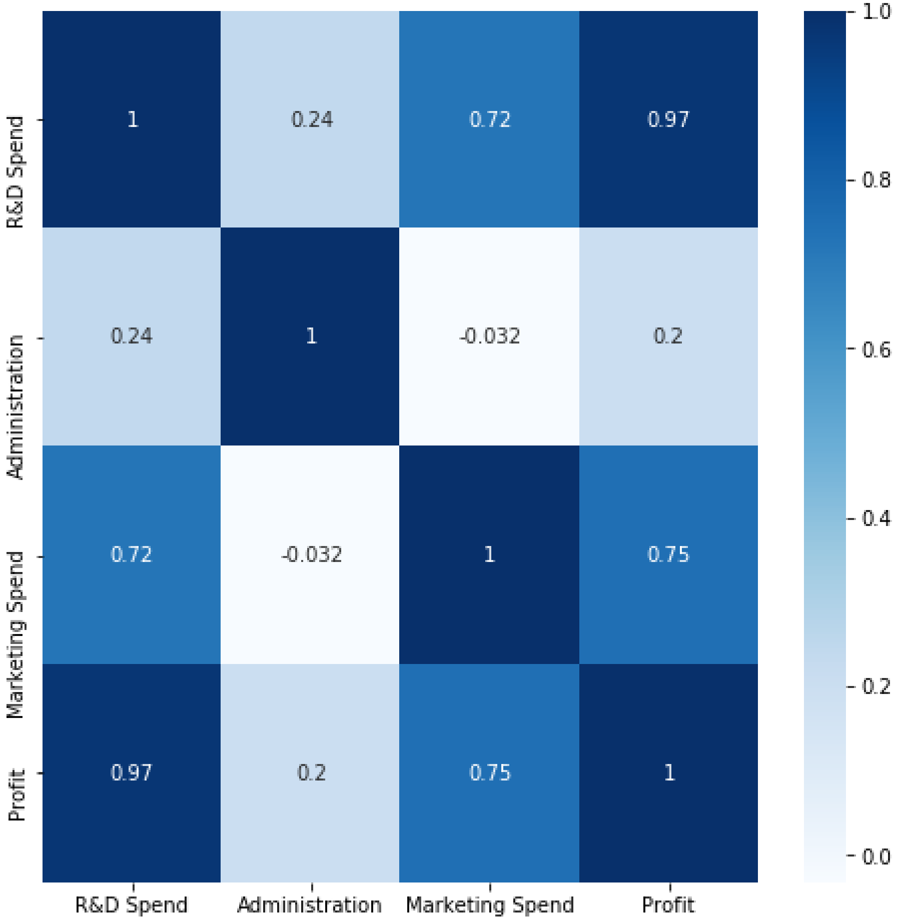
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 50 entries, 0 to 49
Data columns (total 5 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   R&D Spend        50 non-null     float64
 1   Administration   50 non-null     float64
 2   Marketing Spend  50 non-null     float64
 3   State            50 non-null     object 
 4   Profit           50 non-null     float64
dtypes: float64(4), object(1)
memory usage: 2.1+ KB
```

In [87]:
```
c=dataset.corr()
c
```

Out[87]:

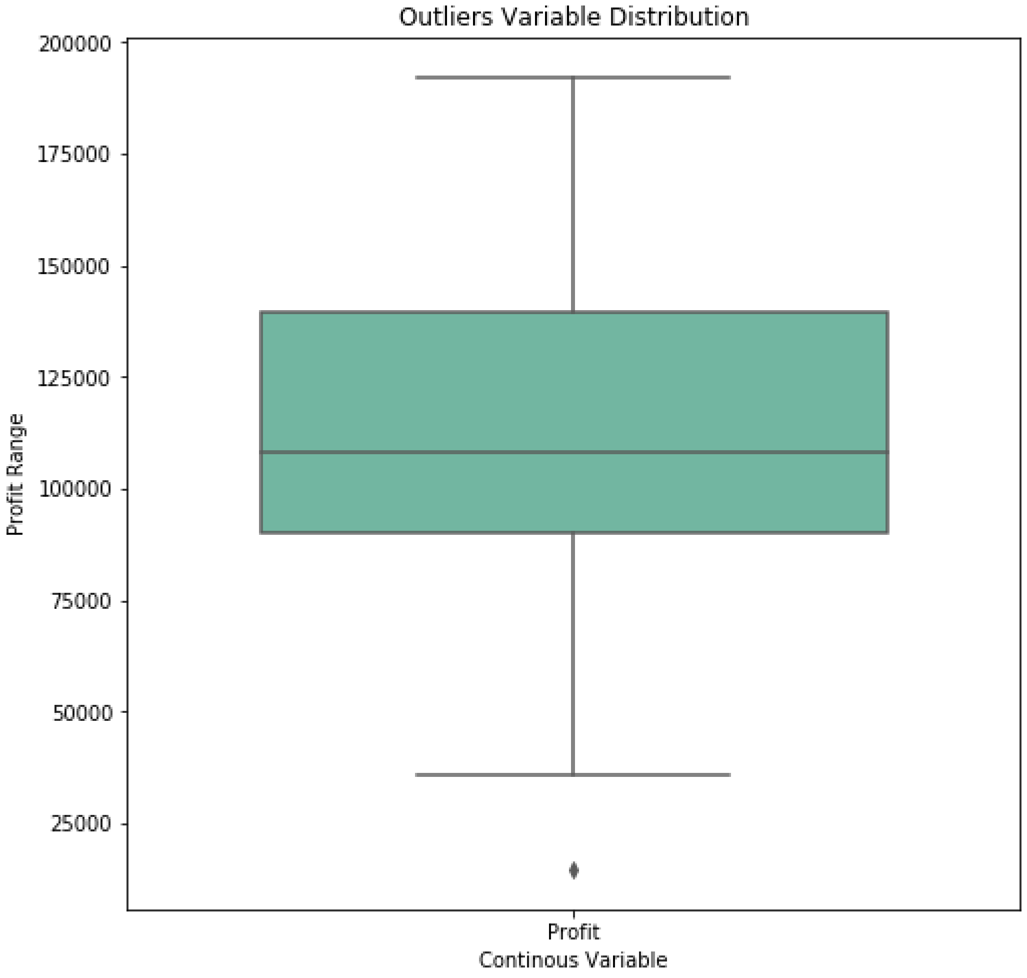
	R&D Spend	Administration	Marketing Spend	Profit
R&D Spend	1.000000	0.241955	0.724248	0.972900
Administration	0.241955	1.000000	-0.032154	0.200717
Marketing Spend	0.724248	-0.032154	1.000000	0.747766
Profit	0.972900	0.200717	0.747766	1.000000

```
In [88]: sns.heatmap(c,annot=True,cmap='Blues')
         plt.show()
```



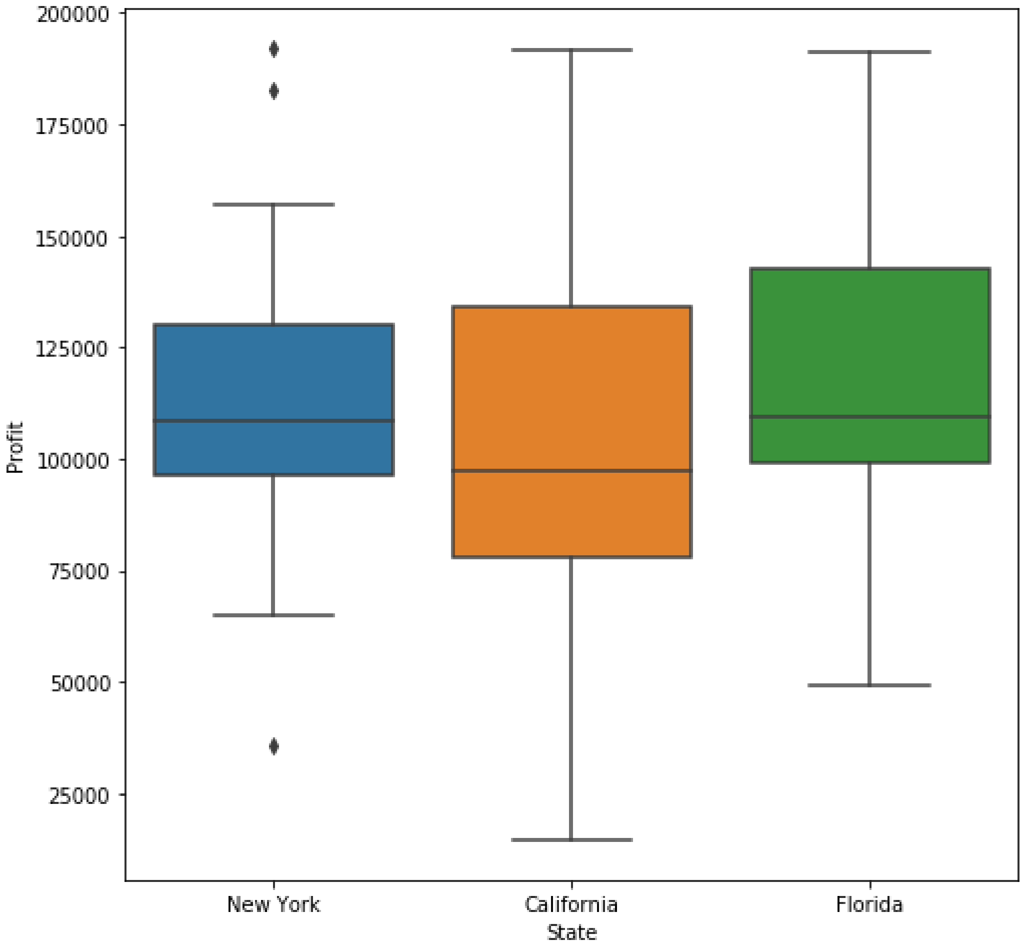
In [89]:

```
outliers = ['Profit']
plt.rcParams['figure.figsize']=[8,8]
sns.boxplot(data=dataset[outliers], orient="v",palette="Set2" , width=0.7)

plt.title("Outliers Variable Distribution")
plt.ylabel("Profit Range")
plt.xlabel("Continous Variable")

plt.show()
```



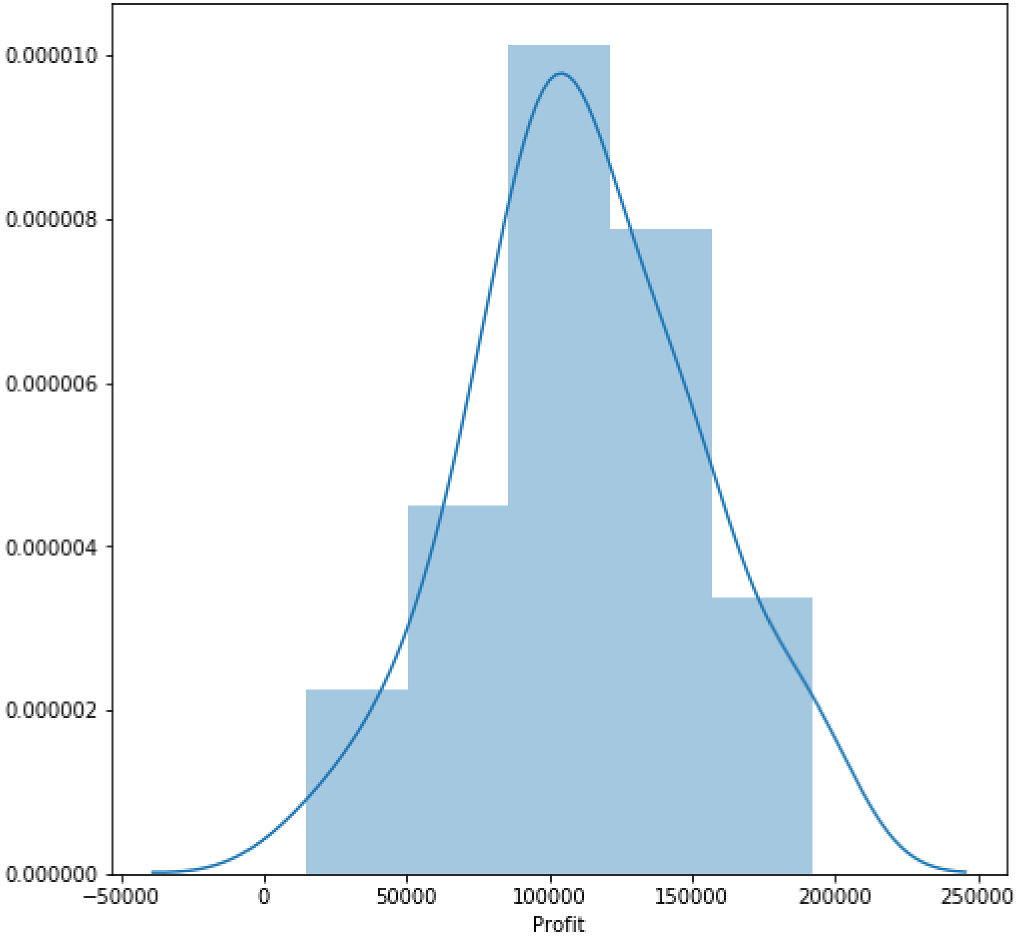
In [90]:

```
sns.boxplot(x='State',y='Profit',data=dataset)
plt.show()
```

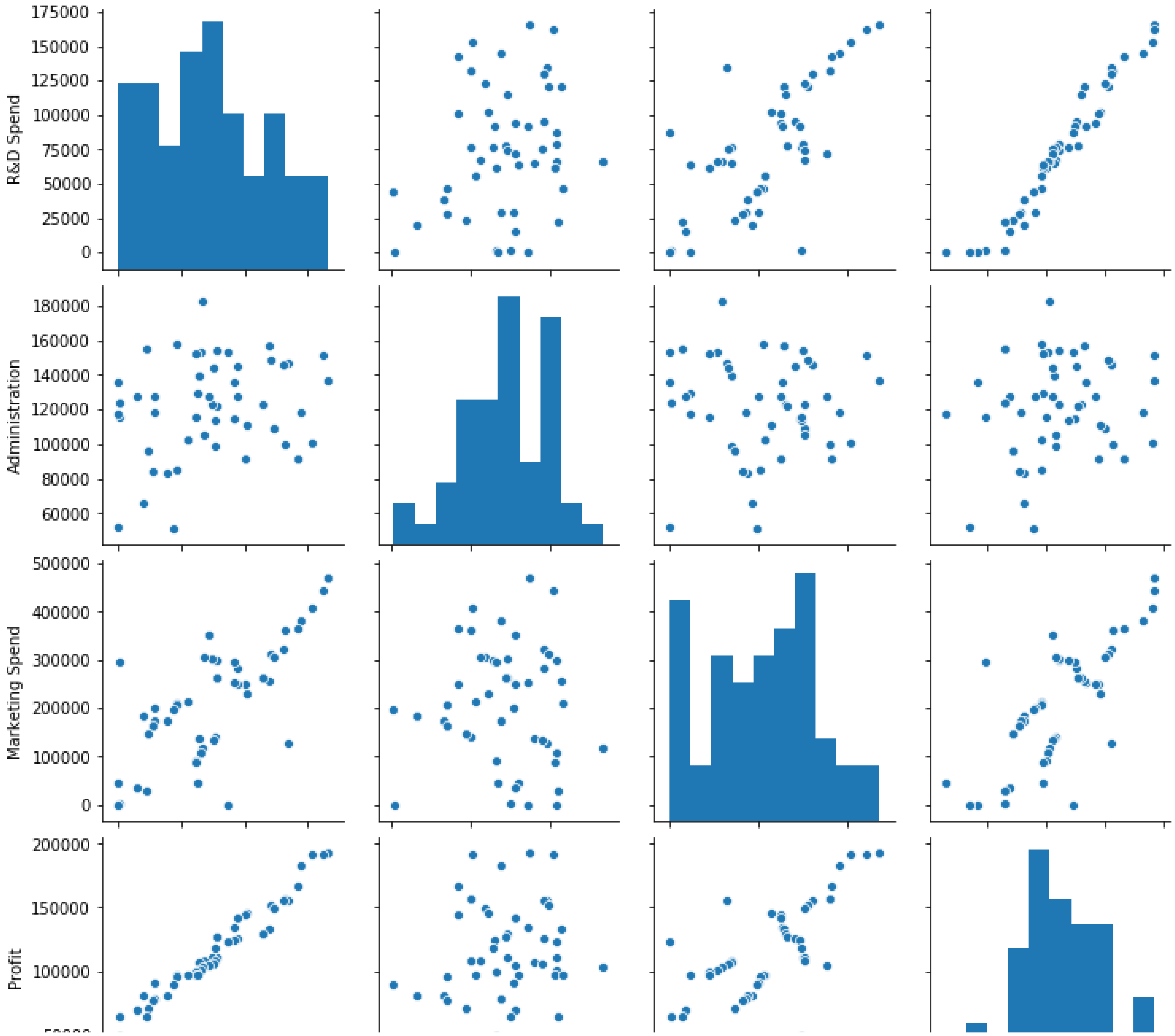


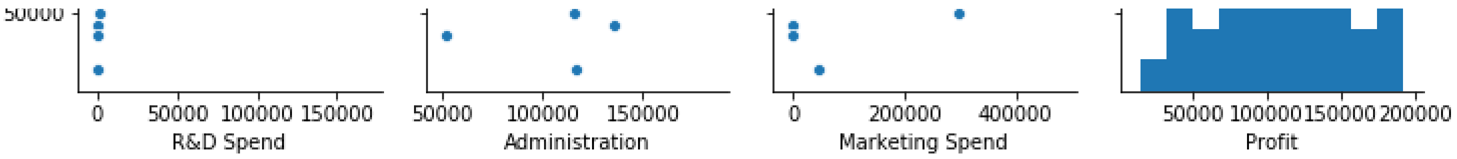
```
In [91]: sns.distplot(dataset['Profit'],bins=5,kde=True)
         plt.show
```

```
Out[91]: <function matplotlib.pyplot.show(*args, **kw)>
```



```
In [60]: sns.pairplot(dataset)
         plt.show()
```





In [92]:
```
# spliting Dataset in Dependent & Independent Varaibles
X= dataset.iloc[:, :-1].values
y=dataset.iloc[:, 4].values
```

In [93]:
```
from sklearn.preprocessing import LabelEncoder
```

In [94]:
```
labelencoder=LabelEncoder()
X[:, 3]=labelencoder.fit_transform(X[:, 3])
X1=pd.DataFrame(X)
X1.head()
```

Out[94]:
```
         0        1       2  3
0   165349   136898  471784  2
1   162598   151378  443899  0
2   153442   101146  407935  1
3   144372   118672  383200  2
4   142107  91391.8  366168  1
```

In [95]:

```
from sklearn.model_selection import train_test_split

x_train,x_test,y_train,y_test=train_test_split(X,y,train_size=0.7,random_state=0)
x_train
```

Out[95]:

```
array([[130298.13, 145530.06, 323876.68, 1],
       [119943.24, 156547.42, 256512.92, 1],
       [1000.23, 124153.04, 1903.93, 2],
       [542.05, 51743.15, 0.0, 2],
       [65605.48, 153032.06, 107138.38, 2],
       [114523.61, 122616.84, 261776.23, 2],
       [61994.48, 115641.28, 91131.24, 1],
       [63408.86, 129219.61, 46085.25, 0],
       [78013.11, 121597.55, 264346.06, 0],
       [23640.93, 96189.63, 148001.11, 0],
       [76253.86, 113867.3, 298664.47, 0],
       [15505.73, 127382.3, 35534.17, 2],
       [120542.52, 148718.95, 311613.29, 2],
       [91992.39, 135495.07, 252664.93, 0],
       [64664.71, 139553.16, 137962.62, 0],
       [131876.9, 99814.71, 362861.36, 2],
       [94657.16, 145077.58, 282574.31, 2],
       [28754.33, 118546.05, 172795.67, 0],
       [0.0, 116983.8, 45173.06, 0],
       [162597.7, 151377.59, 443898.53, 0],
       [93863.75, 127320.38, 249839.44, 1],
       [44069.95, 51283.14, 197029.42, 0],
       [77044.01, 99281.34, 140574.81, 2],
       [134615.46, 147198.87, 127716.82, 0],
       [67532.53, 105751.03, 304768.73, 1],
       [28663.76, 127056.21, 201126.82, 1],
       [78389.47, 153773.43, 299737.29, 2],
       [86419.7, 153514.11, 0.0, 2],
       [123334.88, 108679.17, 304981.62, 0],
       [38558.51, 82982.09, 174999.3, 0],
       [1315.46, 115816.21, 297114.46, 1],
       [144372.41, 118671.85, 383199.62, 2],
       [165349.2, 136897.8, 471784.1, 2],
       [0.0, 135426.92, 0.0, 0],
       [22177.74, 154806.14, 28334.72, 0]], dtype=object)
```

In [96]:

```
from sklearn.linear_model import LinearRegression

model=LinearRegression()
model.fit(x_train,y_train)
print('Model has been trained sucessfully')
```

```
Model has been trained sucessfully
```

In [97]:

```
y_pred= model.predict(x_test)
y_pred
```

Out[97]:

```
array([104055.1842384 , 132557.60289702, 133633.01284474,  72336.28081054,
       179658.27210893, 114689.63133397,  66514.82249033,  98461.69321326,
       114294.70487032, 169090.51127461,  96281.907934  ,  88108.30057881,
       110687.1172322 ,  90536.34203081, 127785.3793861 ])
```

In [98]:

```
testing_data_model_score = model.score(x_test, y_test)
print("Model Score/Performance on Testing data",testing_data_model_score)

training_data_model_score=model.score(x_train,y_train)
print("Model Score/Performance on Testing data",testing_data_model_score)
```

```
Model Score/Performance on Testing data 0.9355139722149947
Model Score/Performance on Testing data 0.9355139722149947
```

```
In [99]: df = pd.DataFrame(data={'Predicted value':y_pred.flatten(),'Actual Value':y_test.flatten()})
         df

Out[99]:
        Predicted value   Actual Value
     0    104055.184238      103282.38
     1    132557.602897      144259.40
     2    133633.012845      146121.95
     3     72336.280811       77798.83
     4    179658.272109      191050.39
     5    114689.631334      105008.31
     6     66514.822490       81229.06
     7     98461.693213       97483.56
     8    114294.704870      110352.25
     9    169090.511275      166187.94
    10     96281.907934       96778.92
    11     88108.300579       96479.51
    12    110687.117232      105733.54
    13     90536.342031       96712.80
    14    127785.379386      124266.90

In [ ]:
```