In [1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels
import statsmodels.api as sm
import sklearn
from sklearn.model_selection import train_test_split
```

In [2]:

```
adv=pd.read_csv("https://raw.githubusercontent.com/rkmishracs/dataset/main/advertising.csv")
```

In [3]:

```
adv.head()
```

Out[3]:

| | TV | Radio | Newspaper | Sales |
|---|---|---|---|---|
| **0** | 230.1 | 37.8 | 69.2 | 22.1 |
| **1** | 44.5 | 39.3 | 45.1 | 10.4 |
| **2** | 17.2 | 45.9 | 69.3 | 12.0 |
| **3** | 151.5 | 41.3 | 58.5 | 16.5 |
| **4** | 180.8 | 10.8 | 58.4 | 17.9 |

In [4]:

```
adv.shape
```

Out[4]:

```
(200, 4)
```

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.describe()
```

Out[6]:

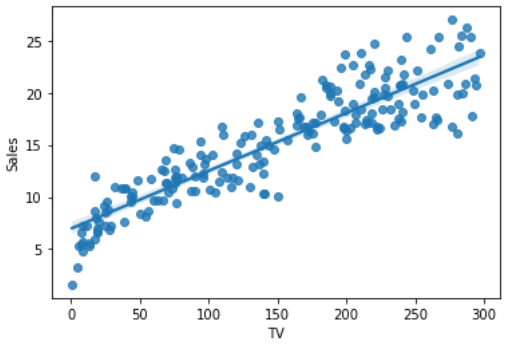
| | TV | Radio | Newspaper | Sales |
|---|---|---|---|---|
| **count** | 200.000000 | 200.000000 | 200.000000 | 200.000000 |
| **mean** | 147.042500 | 23.264000 | 30.554000 | 15.130500 |
| **std** | 85.854236 | 14.846809 | 21.778621 | 5.283892 |
| **min** | 0.700000 | 0.000000 | 0.300000 | 1.600000 |
| **25%** | 74.375000 | 9.975000 | 12.750000 | 11.000000 |
| **50%** | 149.750000 | 22.900000 | 25.750000 | 16.000000 |
| **75%** | 218.825000 | 36.525000 | 45.100000 | 19.050000 |
| **max** | 296.400000 | 49.600000 | 114.000000 | 27.000000 |

In [7]:

```
sns.regplot(x='TV', y='Sales', data=adv)
```

Out[7]:

```
<AxesSubplot:xlabel='TV', ylabel='Sales'>
```

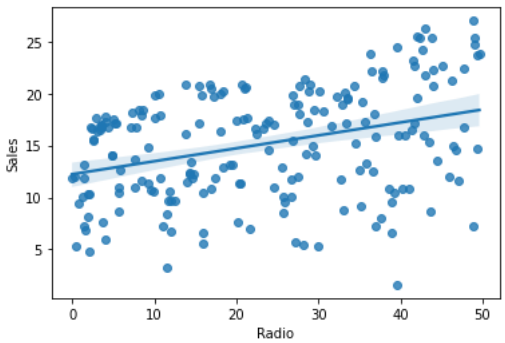



In [8]:

```
sns.regplot(x='Radio', y='Sales', data=adv)
```

Out[8]:

```
<AxesSubplot:xlabel='Radio', ylabel='Sales'>
```

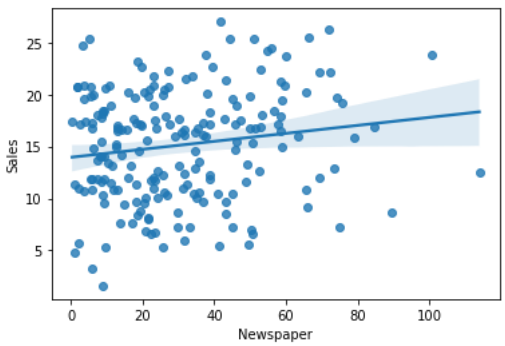



In [9]:

```
sns.regplot(x='Newspaper', y='Sales', data=adv)
```

Out[9]:

```
<AxesSubplot:xlabel='Newspaper', ylabel='Sales'>
```

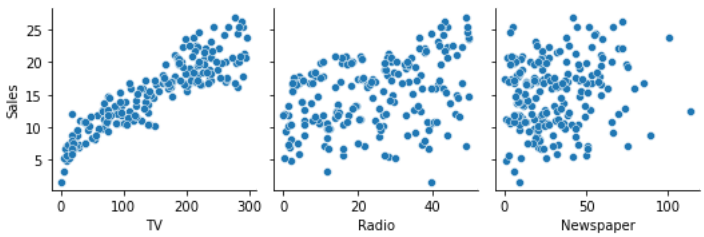



In [10]:

```
sns.pairplot(data=adv, x_vars=['TV', 'Radio', 'Newspaper'], y_vars='Sales')
```

Out[10]:

```
<seaborn.axisgrid.PairGrid at 0x7f8088206b80>
```



In [11]:

```
adv.corr()
```

Out[11]:

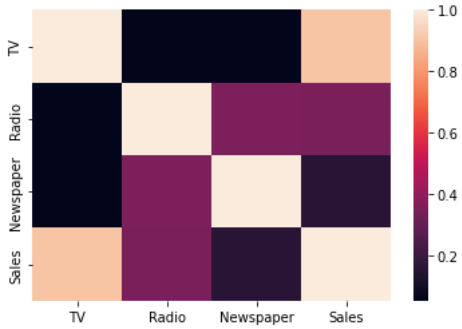
| | TV | Radio | Newspaper | Sales |
|---|---|---|---|---|
| **TV** | 1.000000 | 0.054809 | 0.056648 | 0.901208 |
| **Radio** | 0.054809 | 1.000000 | 0.354104 | 0.349631 |
| **Newspaper** | 0.056648 | 0.354104 | 1.000000 | 0.157960 |
| **Sales** | 0.901208 | 0.349631 | 0.157960 | 1.000000 |

In [12]:

```
sns.heatmap(adv.corr())
```

Out[12]:

```
<AxesSubplot:>
```

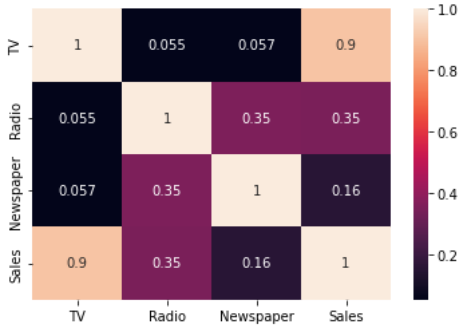



In [13]:

```
sns.heatmap(adv.corr(), annot=True)
```

Out[13]:

```
<AxesSubplot:>
```




In [14]:

```
X=adv['TV']
y=adv['Sales']
```

In [15]:

```
X_train, X_test, y_train, y_test= train_test_split(X,y, train_size=0.70, random_state=100)
```

In [16]:

```
X_train_sm=sm.add_constant(X_train)
X_train_sm.head()
```

```
/Users/admin/opt/anaconda3/lib/python3.9/site-packages/statsmodels/tsa/tsatools.py:142: FutureWarning: In a futur
e version of pandas all arguments of concat except for the argument 'objs' will be keyword-only
  x = pd.concat(x[::order], 1)
```

Out[16]:

| | const | TV |
|---|---|---|
| **74** | 1.0 | 213.4 |
| **3** | 1.0 | 151.5 |
| **185** | 1.0 | 205.0 |
| **26** | 1.0 | 142.9 |
| **90** | 1.0 | 134.3 |

In [18]:

```
lr=sm.OLS(y_train, X_train_sm)
lr_model=lr.fit()
lr_model.params
```

Out[18]:

```
const    6.948683
TV       0.054546
dtype: float64
```

In [19]:

```
lr_model.summary()
```

Out[19]:

OLS Regression Results

| | | | |
|---|---|---|---|
| **Dep. Variable:** | Sales | **R-squared:** | 0.816 |
| **Model:** | OLS | **Adj. R-squared:** | 0.814 |
| **Method:** | Least Squares | **F-statistic:** | 611.2 |
| **Date:** | Wed, 25 Jan 2023 | **Prob (F-statistic):** | 1.52e-52 |
| **Time:** | 14:11:22 | **Log-Likelihood:** | -321.12 |
| **No. Observations:** | 140 | **AIC:** | 646.2 |
| **Df Residuals:** | 138 | **BIC:** | 652.1 |
| **Df Model:** | 1 | | |
| **Covariance Type:** | nonrobust | | |

| | coef | std err | t | P>\|t\| | [0.025 | 0.975] |
|---|---|---|---|---|---|---|
| **const** | 6.9487 | 0.385 | 18.068 | 0.000 | 6.188 | 7.709 |
| **TV** | 0.0545 | 0.002 | 24.722 | 0.000 | 0.050 | 0.059 |

| | | | |
|---|---|---|---|
| **Omnibus:** | 0.027 | **Durbin-Watson:** | 2.196 |
| **Prob(Omnibus):** | 0.987 | **Jarque-Bera (JB):** | 0.150 |
| **Skew:** | -0.006 | **Prob(JB):** | 0.928 |
| **Kurtosis:** | 2.840 | **Cond. No.** | 328. |

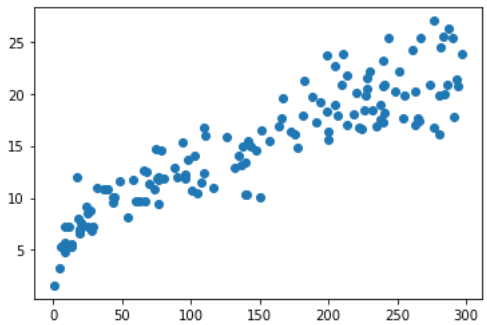
Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

In [20]:

```
plt.scatter(X_train, y_train)
```

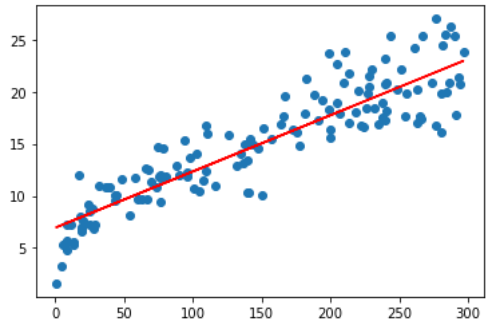
Out[20]:

```
<matplotlib.collections.PathCollection at 0x7f80a33aebb0>
```



In [29]:

```
plt.scatter(X_train, y_train)
plt.plot(X_train, 6.948+0.054*X_train,'r')
plt.show()
```




In [30]:

```
y_train_pred=lr_model.predict(X_train_sm)
y_train_pred
```

Out[30]:

```
74     18.588747
3      15.212365
185    18.130563
26     14.743271
90     14.274178
         ...
87     12.986898
103    17.197830
67     14.546907
24     10.346884
8       7.417777
Length: 140, dtype: float64
```

In [23]:

```
residual=y_train-y_train_pred
residual
```

Out[23]:

```
74    -1.588747
3      1.287635
185    4.469437
26     0.256729
90    -0.274178
         ...
87     3.013102
103    2.502170
67    -1.146907
24    -0.646884
8     -2.617777
Length: 140, dtype: float64
```

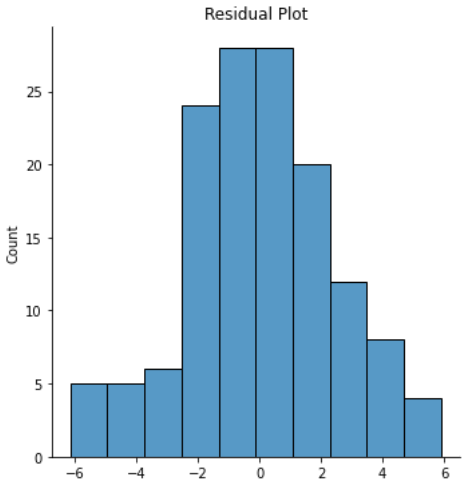
In [27]:

```
plt.figure()
sns.displot(residual)
plt.title("Residual Plot")
```

Out[27]:

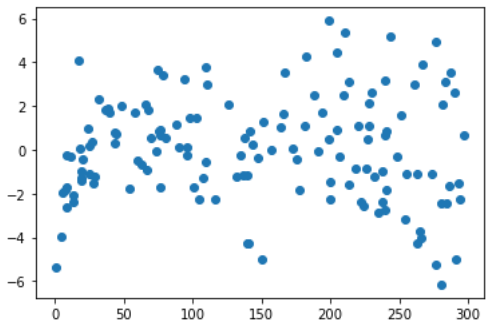
```
Text(0.5, 1.0, 'Residual Plot')
```

```
<Figure size 432x288 with 0 Axes>
```




In [26]:

```
plt.scatter(X_train, residual)
plt.show()
```




In [ ]: