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/advertis
```

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
```

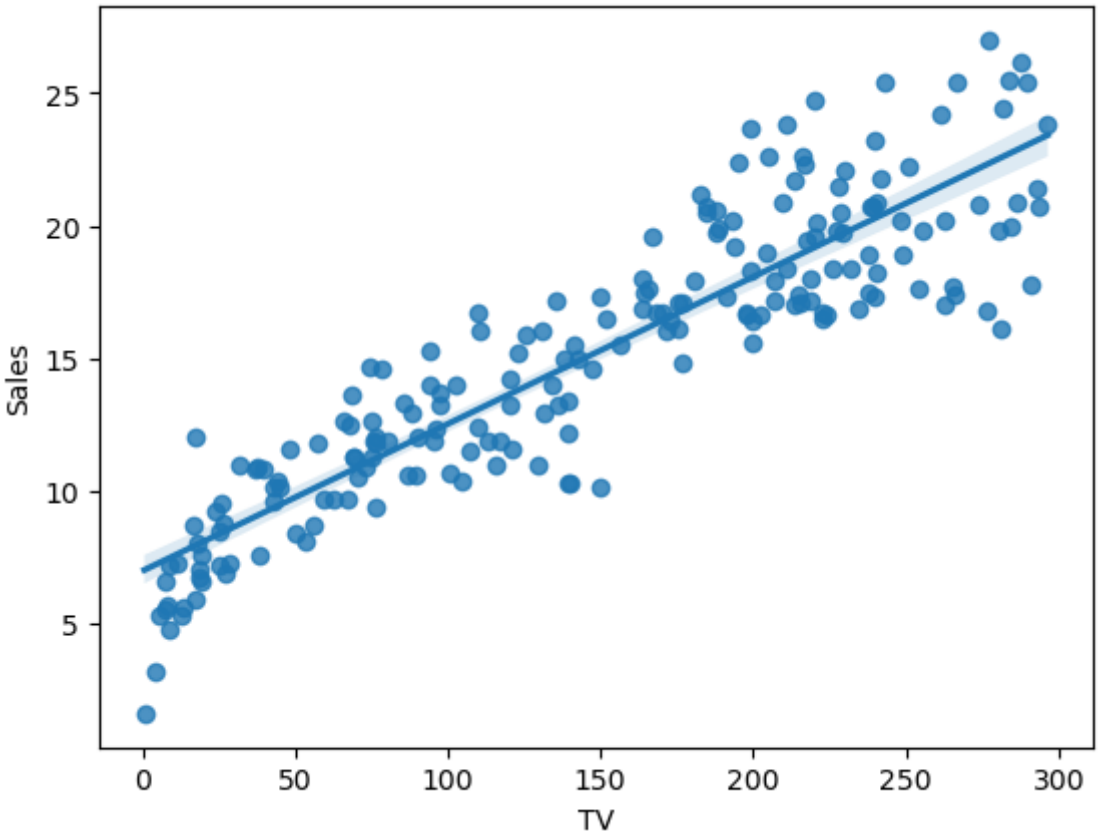
In [6]:
```
adv.describe()
```

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

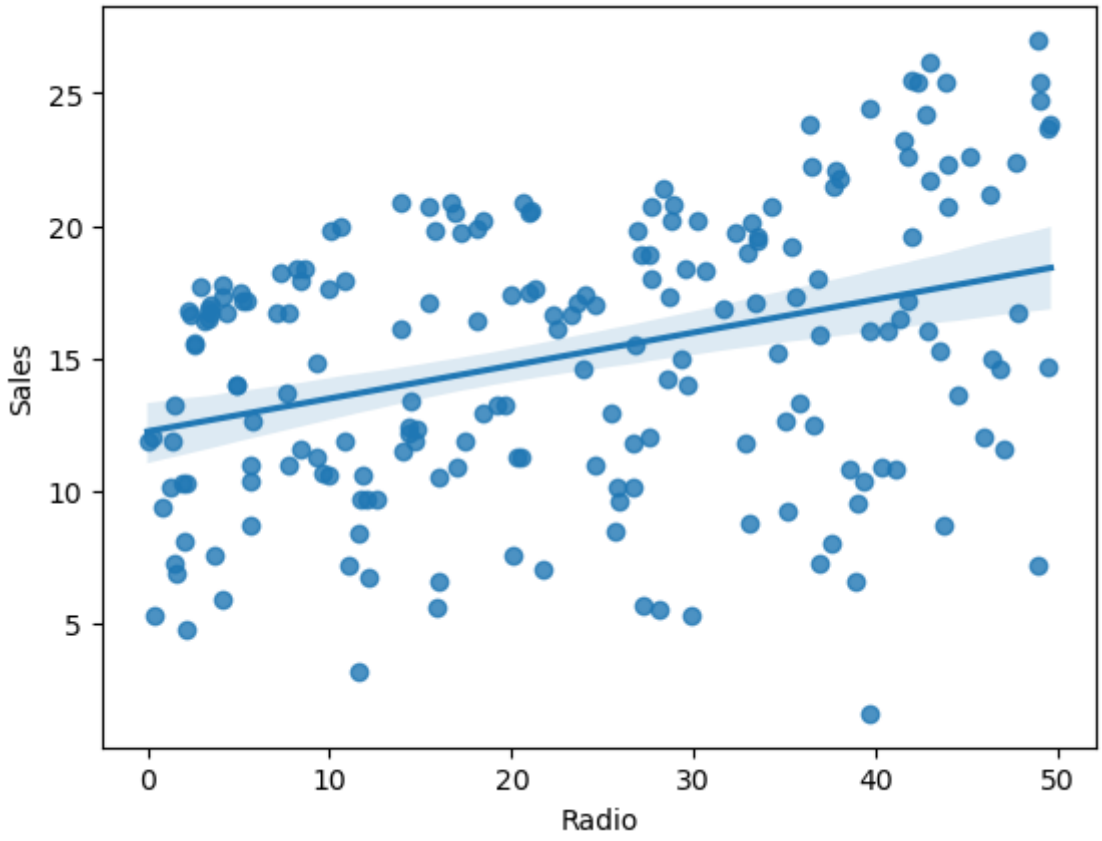
In [7]:
```
sns.regplot(x='TV', y='Sales', data=adv)
```

Out[7]:
```
<AxesSubplot:xlabel='TV', ylabel='Sales'>
```



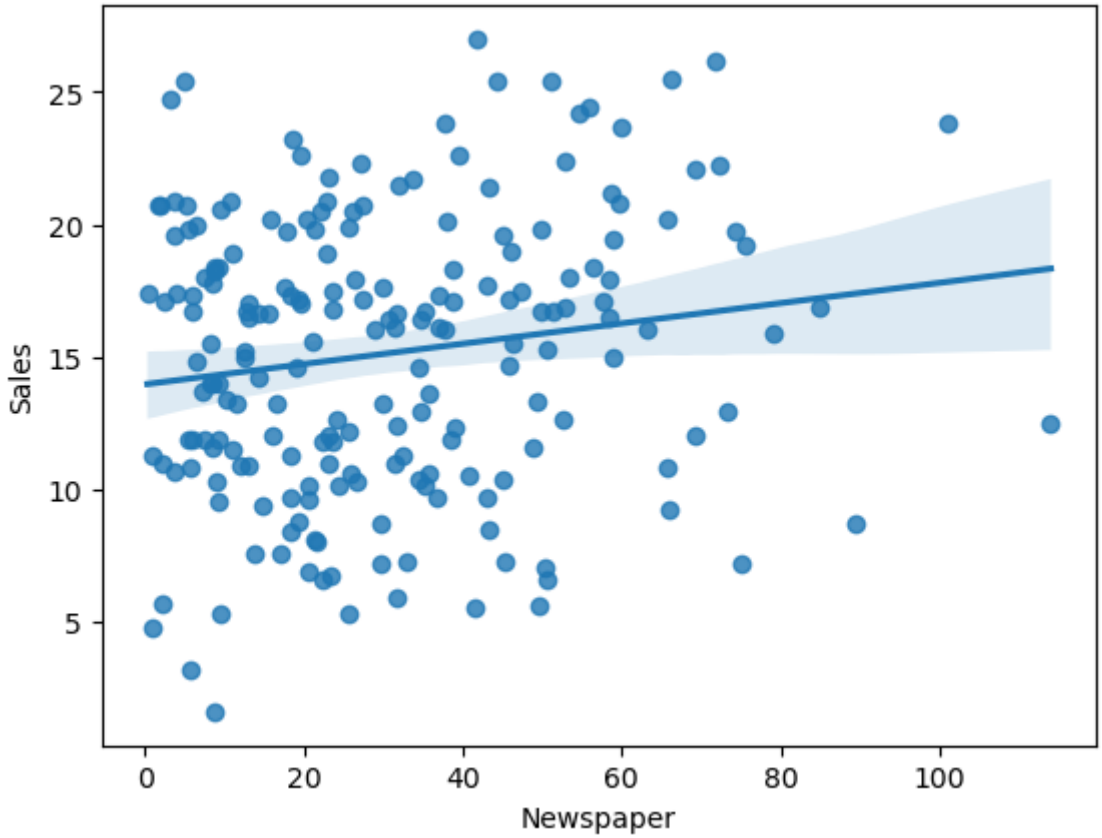
In [8]:
```
sns.regplot(x='Radio', y='Sales', data=adv)
```

Out[8]:
```
<AxesSubplot:xlabel='Radio', ylabel='Sales'>
```



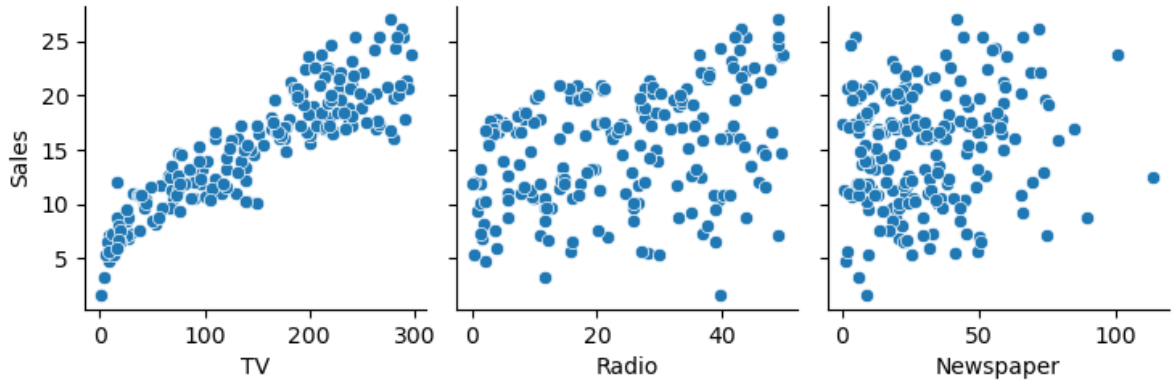
In [9]:
```
sns.regplot(x='Newspaper', y='Sales', data=adv)
```

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 0x241067b26d0>
```



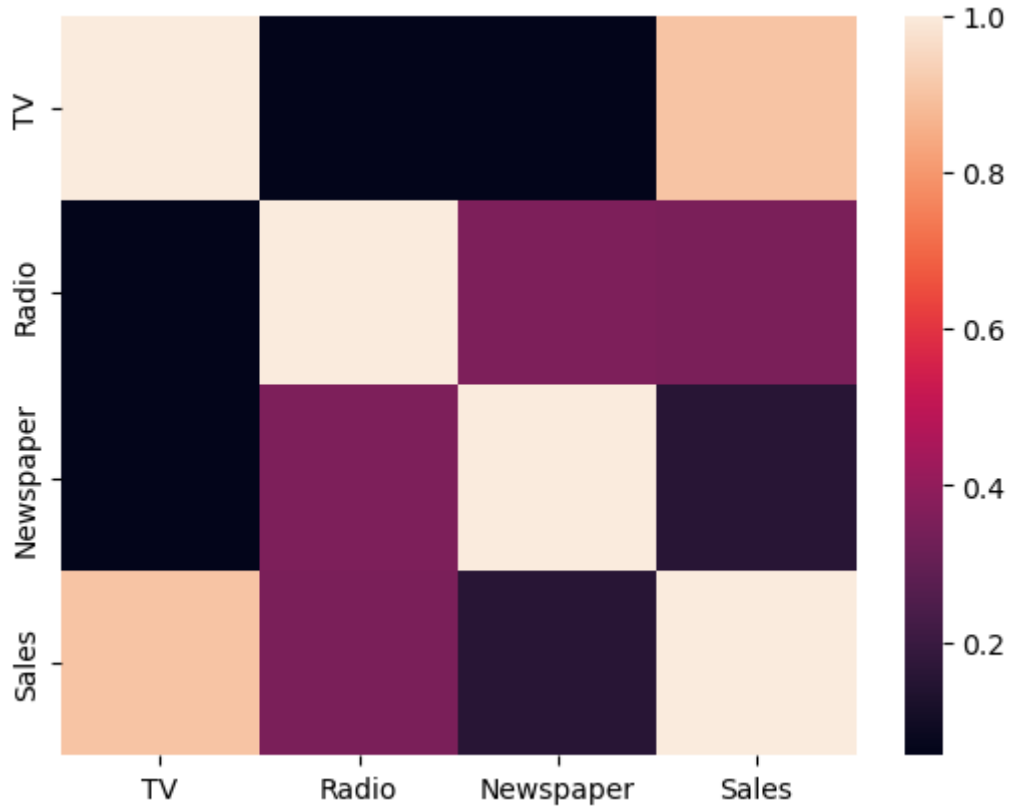
In [11]:
```
adv.corr()
```

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

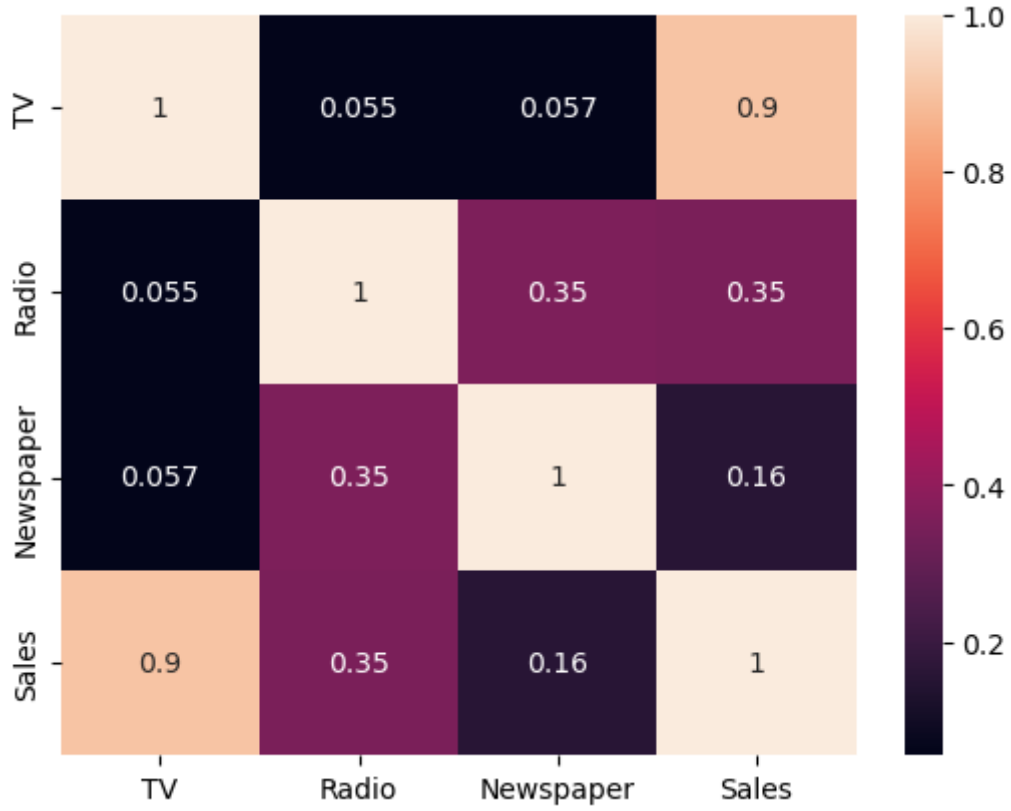
In [12]:
```
sns.heatmap(adv.corr())
```

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_st
```

In [16]:
```
X_train_sm=sm.add_constant(X_train)
X_train_sm.head()
```

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 [17]:
```
lr=sm.OLS(y_train, X_train_sm)
```

In [18]:
```
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, 01 Feb 2023	**Prob (F-statistic):**	1.52e-52
Time:	11:11:22	**Log-Likelihood:**	-321.12
No. Observations:	140	**AIC:**	646.2
Df Residuals:	138	**BIC:**	652.1
Df Model:	1		
Covariance Type:	nonrobust		

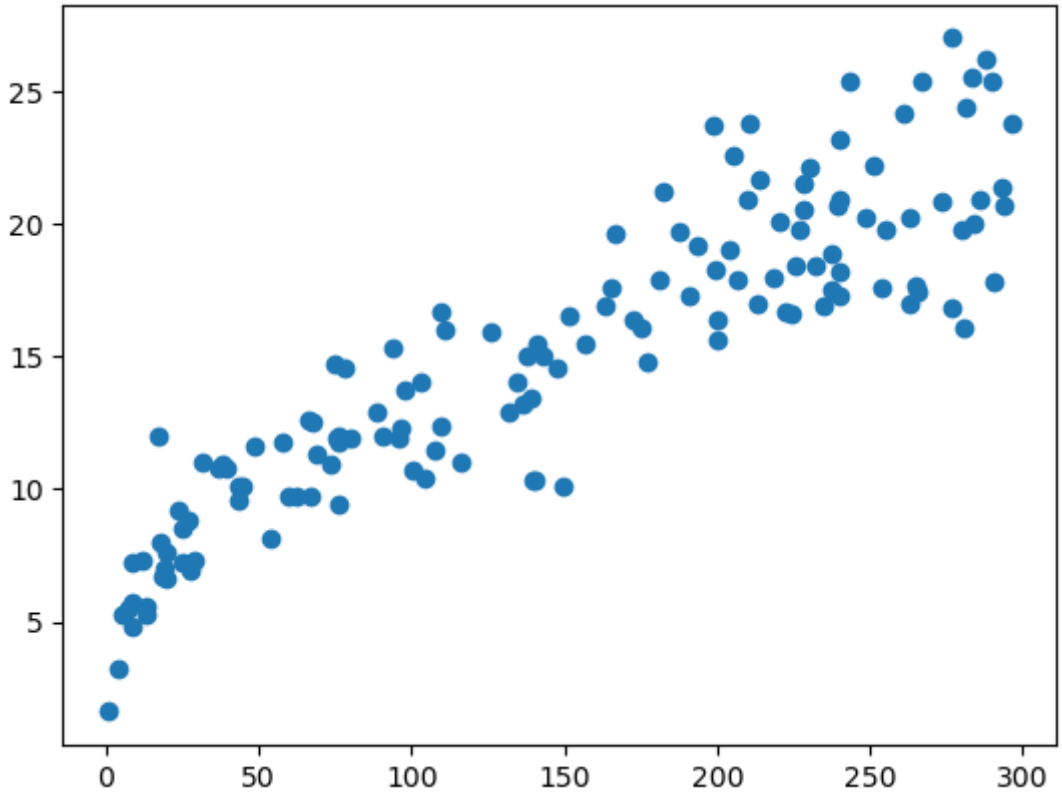
	coef	std err	t	P>|t|	[0.025	0.975]
const	6.9487	0.385	18.068	0.000	6.188	7.709
TV	0.0545	0.002	24.722	0.000	0.050	0.059

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.

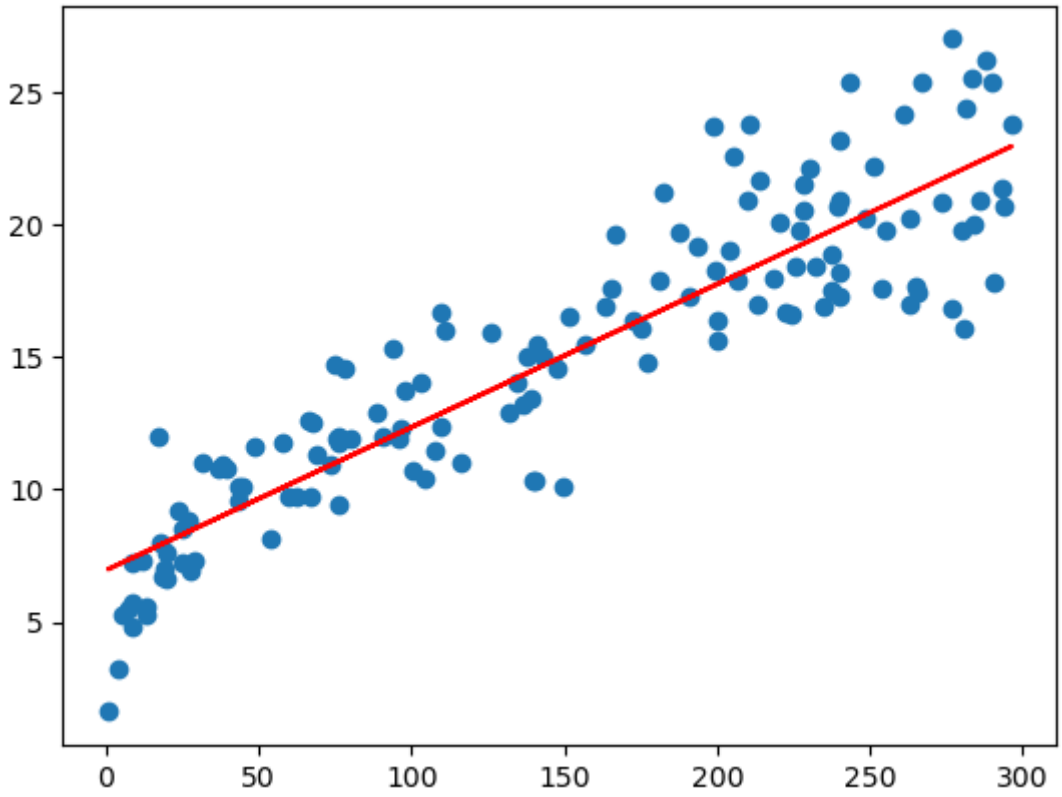
Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

In [20]:
```
plt.scatter(X_train, y_train)
```

Out[20]:
```
<matplotlib.collections.PathCollection at 0x24107af6e50>
```



In [21]:
```
plt.scatter(X_train, y_train)
plt.plot(X_train, 6.948+0.054*X_train,'r')
plt.show()
```



In [22]:
```
y_train_pred=lr_model.predict(X_train_sm)
y_train_pred
```

Out[22]:
```
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
```

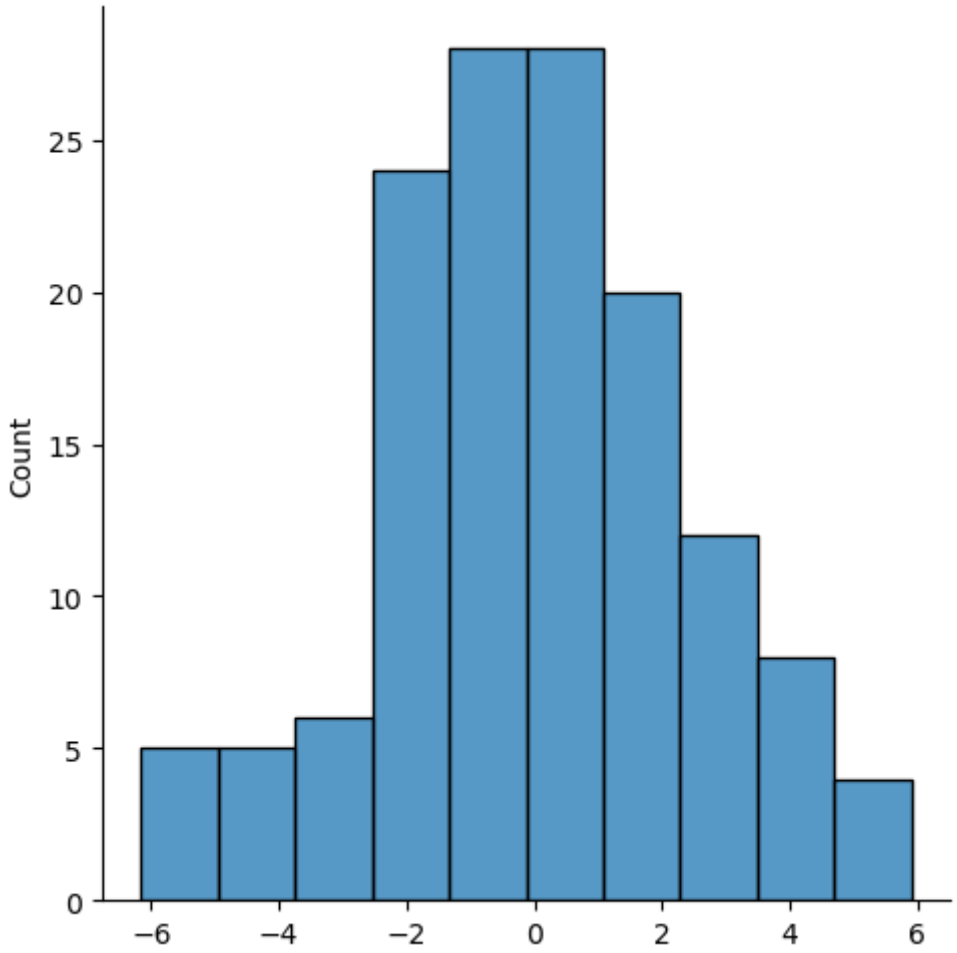
In [23]:
```
residual=y_train-y_train_pred
residual
```

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
```

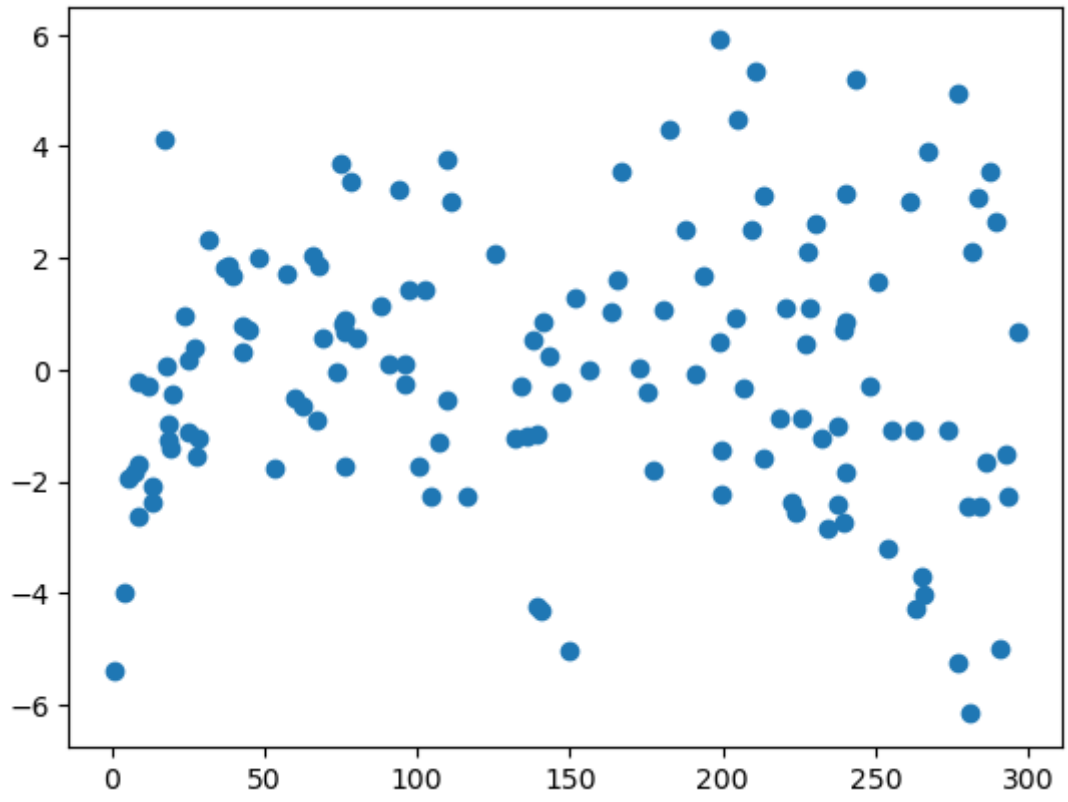
In [24]:
```
plt.figure()
sns.displot(residual)
```

Out[24]:
```
<seaborn.axisgrid.FacetGrid at 0x24107bfd5e0>

<Figure size 640x480 with 0 Axes>
```



In [25]:
```
plt.scatter(X_train, residual)
plt.show()
```



In [ ]: