In [ ]:

In [ ]:

Machine Learning

Machine Learning Procedure

Reading & Studying the Dataset
Data Cleaning & Analysis
Feature Engineering
Data Visualization or EDA (Exploratory Data Analysis)
Encoding
ip/op Creation
Train Test Split
Scaling
ML Algorithm
Prediction
Accuracy

Advertising Dataset

In [1]:

```
#Importing Packages
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:

```
#Reading and Studying the Dataset
adv = pd.read_csv(r"C:\Users\VICTUS\Downloads\advertising.csv")
adv
```

Out[2]:

	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
...	...	...	...	...
195	38.2	3.7	13.8	7.6
196	94.2	4.9	8.1	14.0
197	177.0	9.3	6.4	14.8
198	283.6	42.0	66.2	25.5
199	232.1	8.6	8.7	18.4

200 rows × 4 columns

In [3]:

```
#Data Cleaning and Analysis
adv.isnull().sum()
```

Out[3]:

```
TV           0
Radio        0
Newspaper    0
Sales        0
dtype: int64
```

In [4]:

```
adv.dtypes
```

Out[4]:

```
TV           float64
Radio        float64
Newspaper    float64
Sales        float64
dtype: object
```

In [5]:

```
for i in adv.columns:
    print(i,':','\n',adv[i].unique(),'\n')
```

```
TV :
 [230.1  44.5  17.2 151.5 180.8   8.7  57.5 120.2   8.6 199.8  66.1 214.7
  23.8  97.5 204.1 195.4  67.8 281.4  69.2 147.3 218.4 237.4  13.2 228.3
  62.3 262.9 142.9 240.1 248.8  70.6 292.9 112.9  97.2 265.6  95.7 290.7
 266.9  74.7  43.1 228.  202.5 177.  293.6 206.9  25.1 175.1  89.7 239.9
 227.2  66.9 100.4 216.4 182.6 262.7 198.9   7.3 136.2 210.8 210.7  53.5
 261.3 239.3 102.7 131.1  69.   31.5 139.3 216.8 199.1 109.8  26.8 129.4
 213.4  16.9  27.5 120.5   5.4 116.   76.4 239.8  75.3  68.4 213.5 193.2
  76.3 110.7  88.3 134.3  28.6 217.7 250.9 107.4 163.3 197.6 184.9 289.7
 135.2 222.4 296.4 280.2 187.9 238.2 137.9  25.   90.4  13.1 255.4 225.8
 241.7 175.7 209.6  78.2  75.1 139.2 125.7  19.4 141.3  18.8 224.  123.1
 229.5  87.2   7.8  80.2 220.3  59.6   0.7 265.2   8.4 219.8  36.9  48.3
  25.6 273.7  43.   73.4 193.7 220.5 104.6  96.2 140.3 243.2  38.   44.7
 280.7 121.  171.3 187.8   4.1  93.9 149.8  11.7 131.7 172.5  85.7 188.4
 163.5 117.2 234.5  17.9 206.8 215.4 284.3  50.  164.5  19.6 168.4 276.9
 248.4 170.2 276.7 165.6 156.6 218.5  56.2 287.6 253.8 205.  139.5 191.1
 286.   18.7  39.5  75.5 166.8 149.7  38.2  94.2 283.6 232.1]

Radio :
 [37.8 39.3 45.9 41.3 10.8 48.9 32.8 19.6  2.1  2.6  5.8 24.  35.1  7.6
 32.9 47.7 36.6 39.6 20.5 23.9 27.7  5.1 15.9 16.9 12.6  3.5 29.3 16.7
 27.1 16.  28.3 17.4  1.5 20.   1.4  4.1 43.8 49.4 26.7 37.7 22.3 33.4
  8.4 25.7 22.5  9.9 41.5 15.8 11.7  3.1  9.6 41.7 46.2 28.8 28.1 19.2
 49.6 29.5  2.  42.7 15.5 29.6 42.8  9.3 24.6 14.5 27.5 43.9 30.6 14.3
 33.   5.7 43.7  1.6 28.5 29.9  7.7 20.3 44.5 43.  18.4 40.6 25.5 47.8
  4.9 33.5 36.5 14.  31.6 21.  42.3  4.3 36.3 10.1 17.2 34.3 46.4 11.
  0.3  0.4 26.9  8.2 38.  15.4 20.6 46.8 35.   0.8 36.9 26.8 21.7  2.4
 34.6 32.3 11.8 38.9  0.  49.  12.   2.9 27.2 38.6 47.  39.  28.9 25.9
 17.  35.4 33.2 14.8  1.9  7.3 40.3 25.8 13.9 23.3 39.7 21.1 11.6 43.5
  1.3 18.1 35.8 36.8 14.7  3.4 37.6  5.2 23.6 10.6 20.9 20.1  7.1 30.2
  7.8  2.3 10.   5.4 21.3 45.1 28.7 12.1 41.1 42.  35.6  3.7  8.6]

Newspaper :
 [ 69.2  45.1  69.3  58.5  58.4  75.   23.5  11.6   1.   21.2  24.2   4.
  65.9   7.2  46.   52.9 114.   55.8  18.3  19.1  53.4  49.6  26.2  19.5
  12.6  22.9  40.8  43.2  38.6  30.    0.3   7.4   8.5   5.   45.7  35.1
  32.   31.6  38.7   1.8  26.4  43.3  31.5  35.7  18.5  49.9  36.8  34.6
   3.6  39.6  58.7  15.9  60.   41.4  16.6  37.7   9.3  21.4  54.7  27.3
   8.4  28.9   0.9   2.2  10.2  11.   27.2  31.7  19.3  31.3  13.1  89.4
  20.7  14.2   9.4  23.1  22.3  36.9  32.5  35.6  33.8  65.7  16.   63.2
  73.4  51.4  33.   59.   72.3  10.9   5.9  22.   51.2  45.9  49.8 100.9
  17.9   5.3  29.7  23.2  25.6   5.5  56.5   2.4  10.7  34.5  52.7  14.8
  79.2  46.2  50.4  15.6  12.4  74.2  25.9  50.6   9.2   3.2  43.1   8.7
  43.    2.1  65.6  59.7  20.5   1.7  12.9  75.6  37.9  34.4  38.9   9.
  44.3  11.9  20.6  37.   48.7   9.5   5.7  50.5  24.3  45.2  30.7  49.3
   5.4  84.8  21.6  19.4  57.6   6.4  18.4  47.4  17.   12.8  41.8  20.3
  35.2  23.7  17.6   8.3  27.4  71.8  19.6  26.6  18.2   3.7  23.4   5.8
   6.   13.8   8.1  66.2]

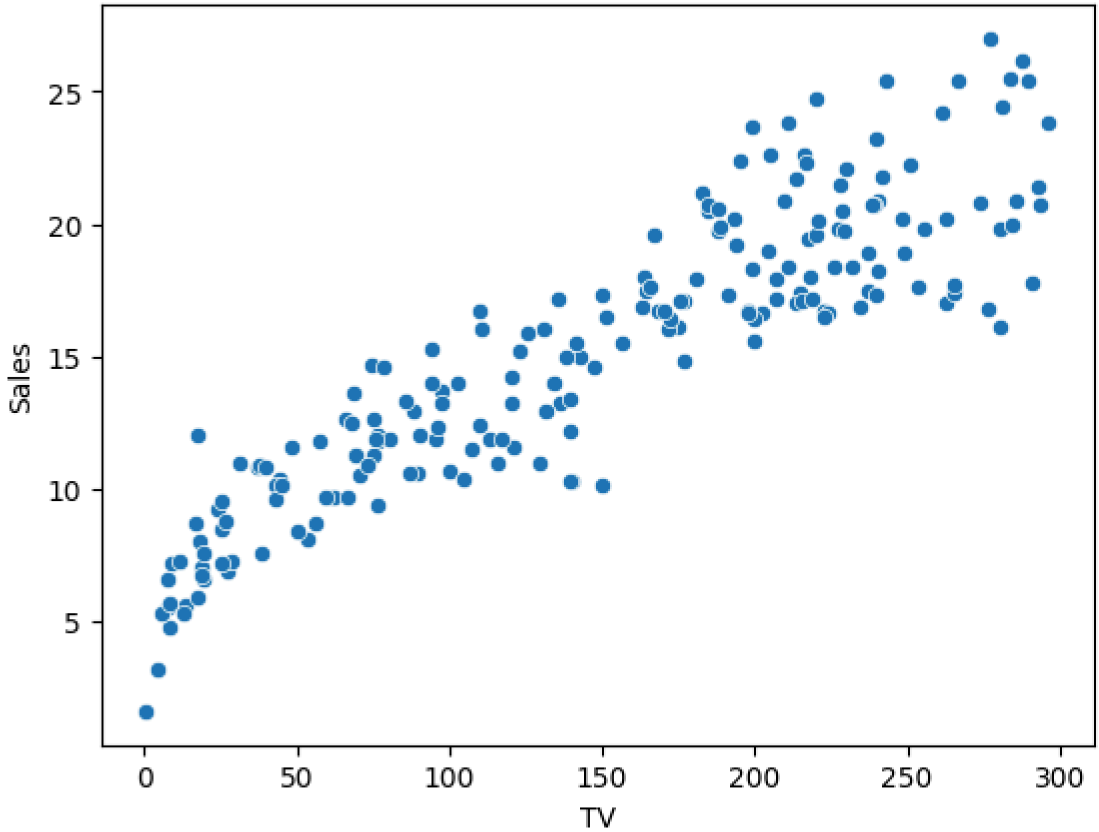
Sales :
 [22.1 10.4 12.  16.5 17.9  7.2 11.8 13.2  4.8 15.6 12.6 17.4  9.2 13.7
 19.  22.4 12.5 24.4 11.3 14.6 18.  17.5  5.6 20.5  9.7 17.  15.  20.9
 18.9 10.5 21.4 11.9 17.8 25.4 14.7 10.1 21.5 16.6 17.1 20.7  8.5 16.1
 10.6 23.2 19.8 16.4 10.7 22.6 21.2 20.2 23.7  5.5 23.8 18.4  8.1 24.2
 14.  16.  11.  13.4 22.3 18.3 12.4  8.8  8.7  6.9 14.2  5.3 17.3 13.6
 21.7 12.9 16.7  7.3 19.4 22.2 11.5 16.9 17.2 19.7 21.8 12.2  9.4 15.9
  6.6 15.5  7.  15.2 24.7  1.6 17.7  5.7 19.6 10.8 11.6  9.5 20.8  9.6
 10.9 19.2 20.1 12.3 10.3 18.2 20.6  3.2 15.3 13.3 19.9  8.  20.   8.4
  7.6 27.  16.8 17.6 26.2  6.7  5.9 14.8 25.5]
```

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

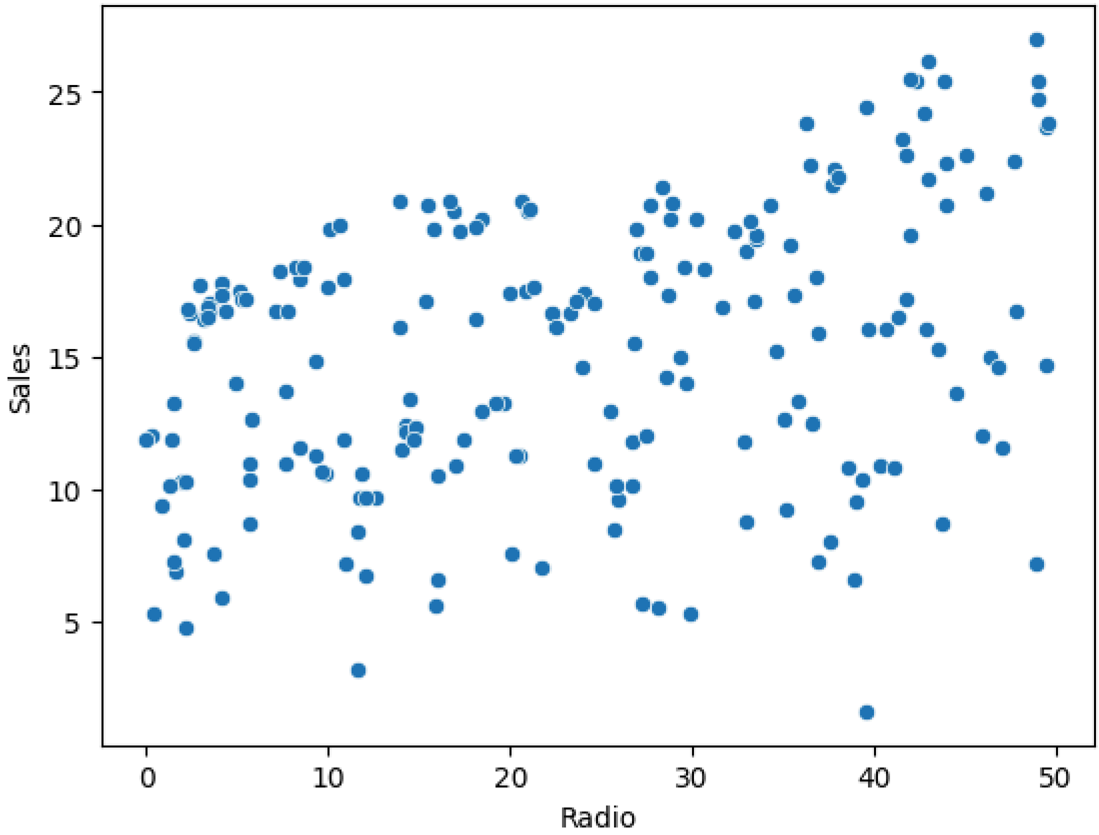
Out[6]:

	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

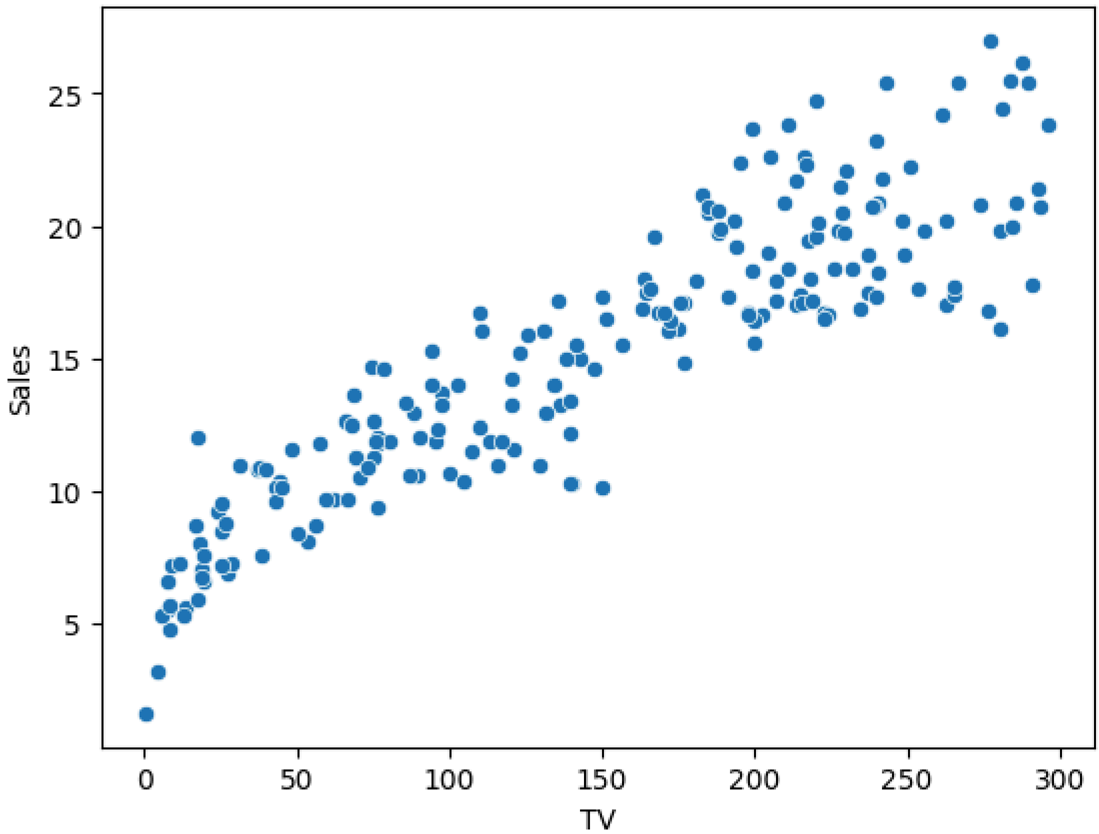
In [7]:
```
#Data Visualization or EDA
sns.scatterplot(x=adv.TV,y=adv.Sales)
plt.show()
```

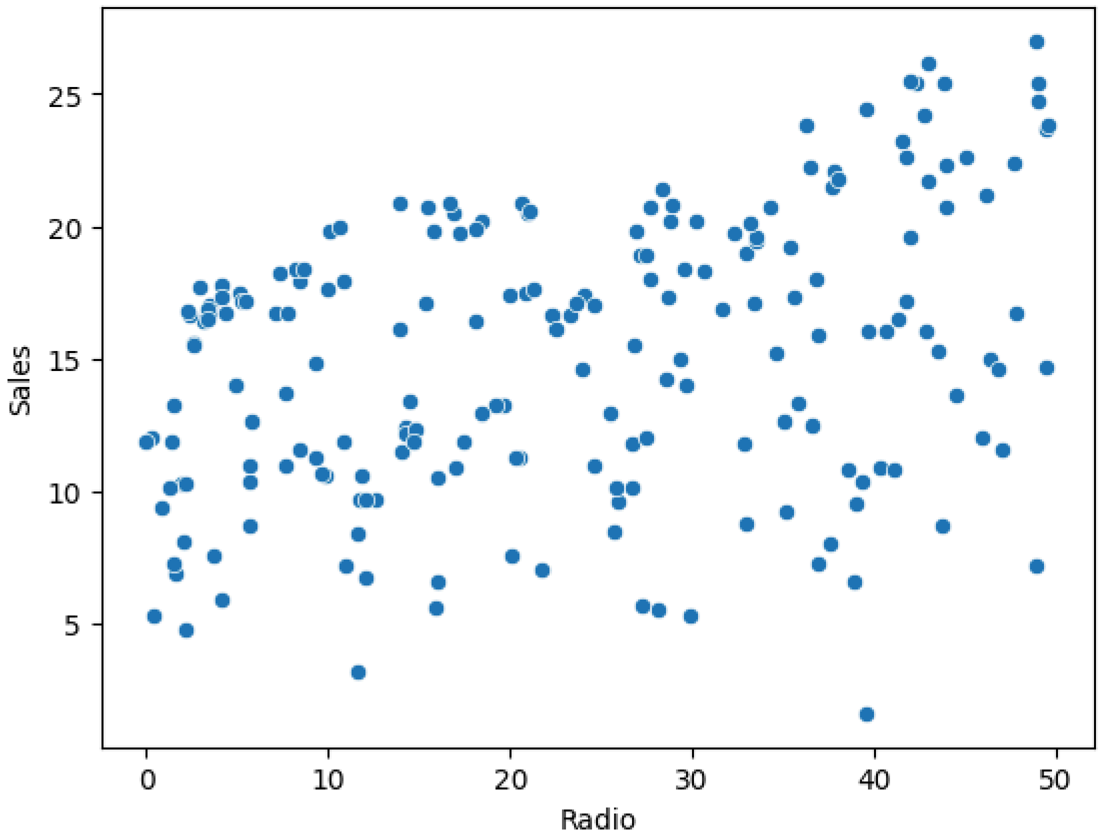


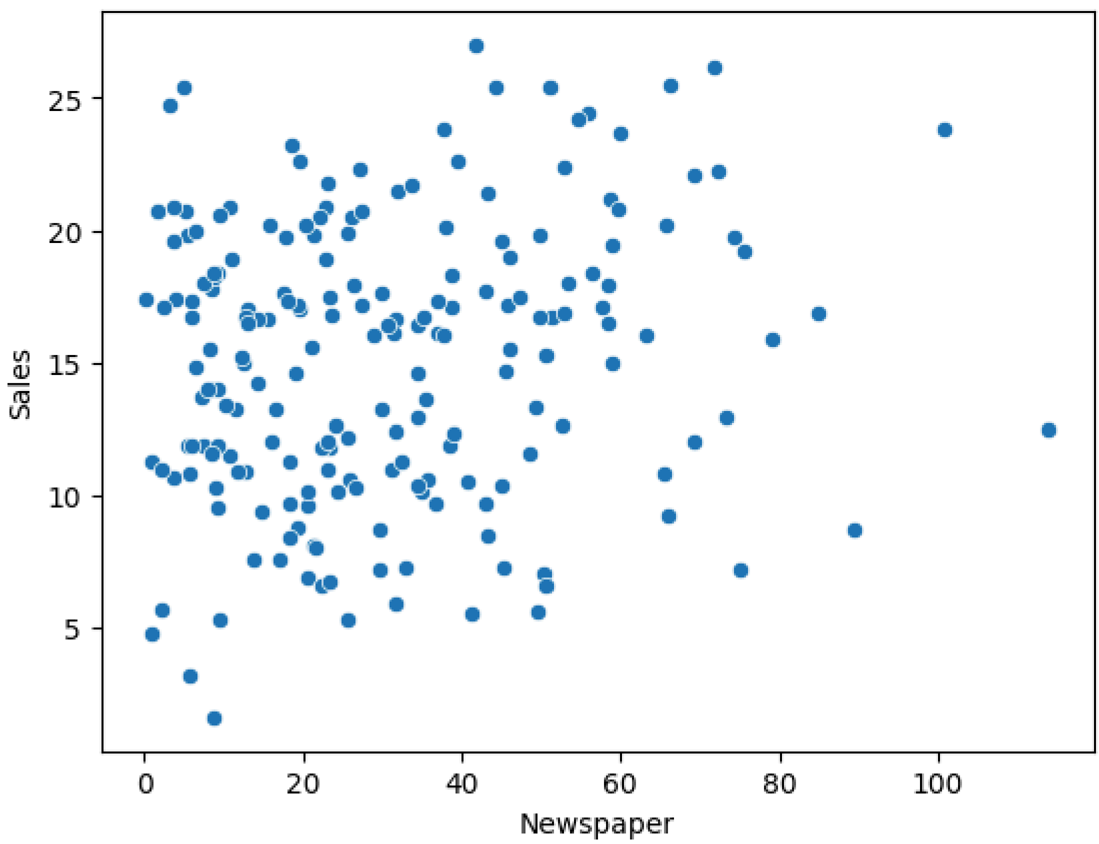
In [8]:
```
sns.scatterplot(x=adv.Radio,y=adv.Sales)
plt.show()
```



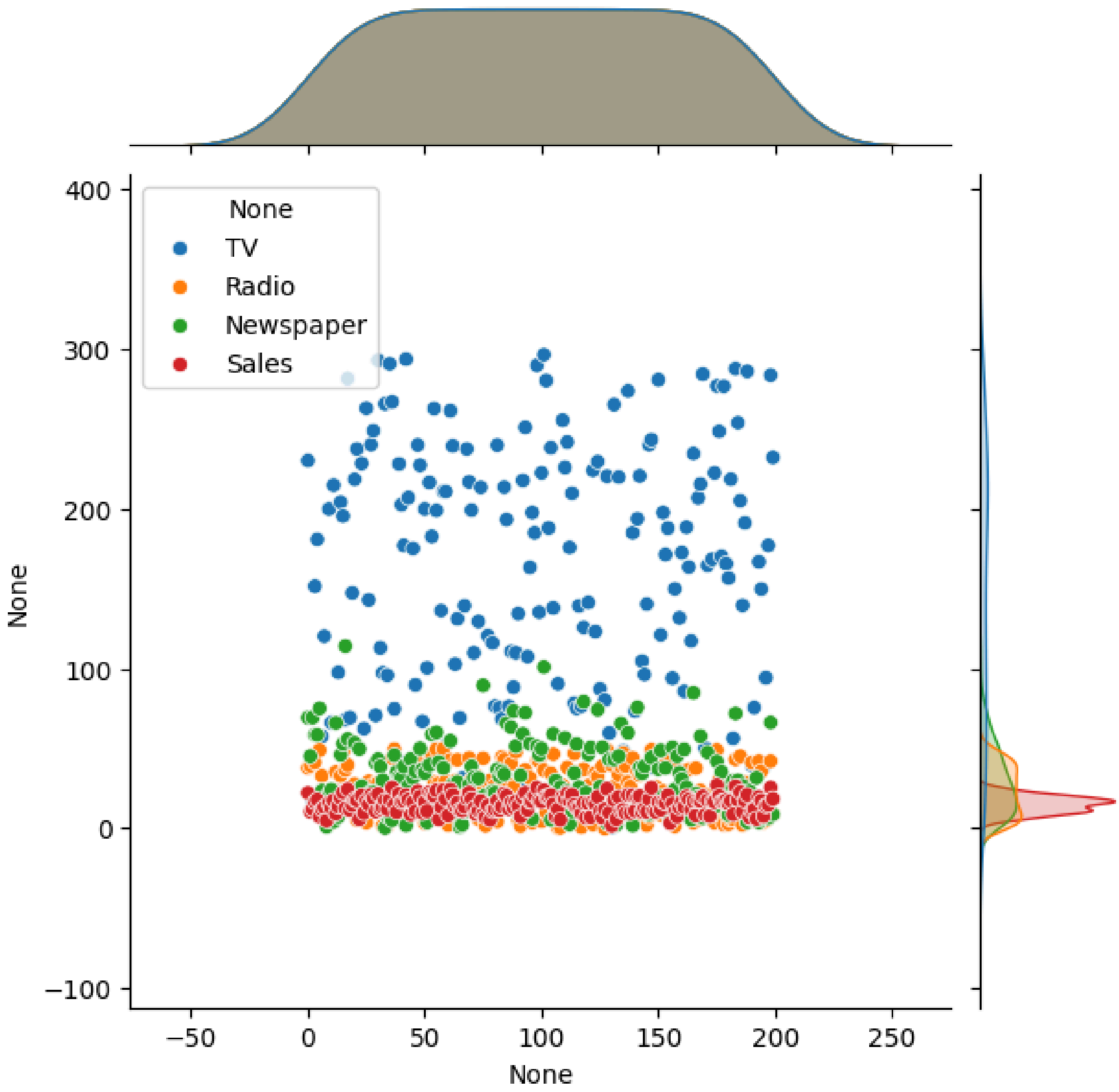
In [9]:
```
for i in ['TV','Radio','Newspaper']:
    sns.scatterplot(x=adv[i],y=adv.Sales)
    plt.show()
```



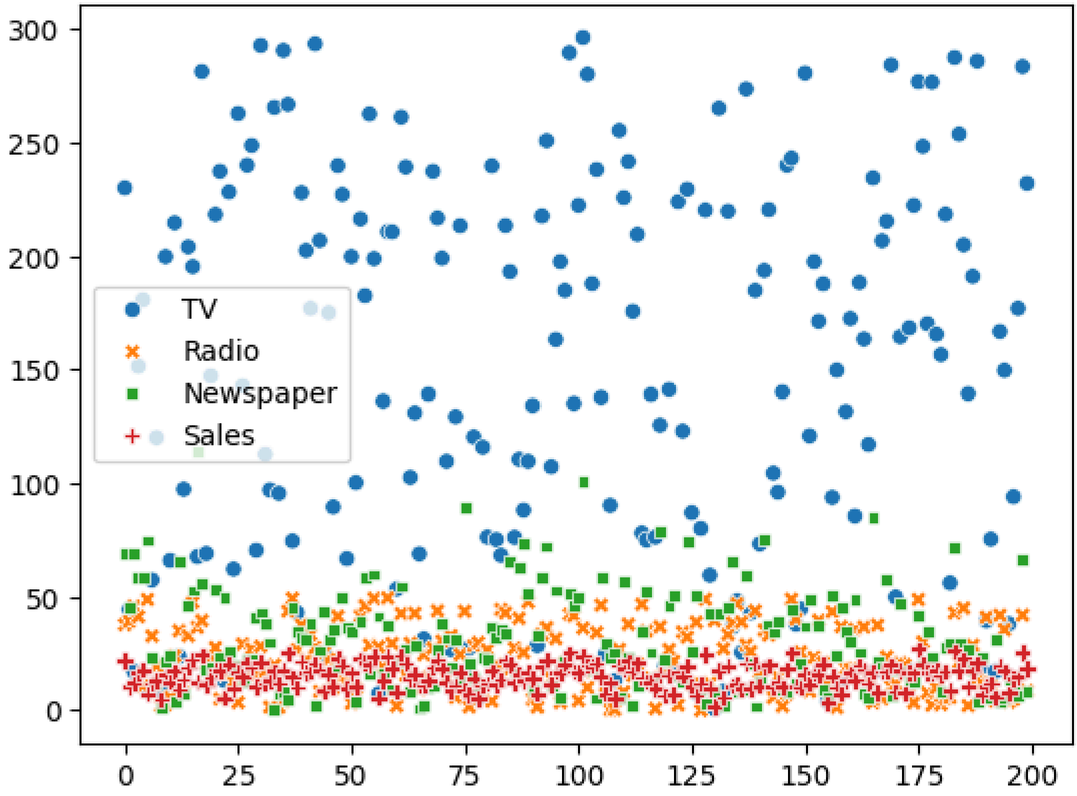




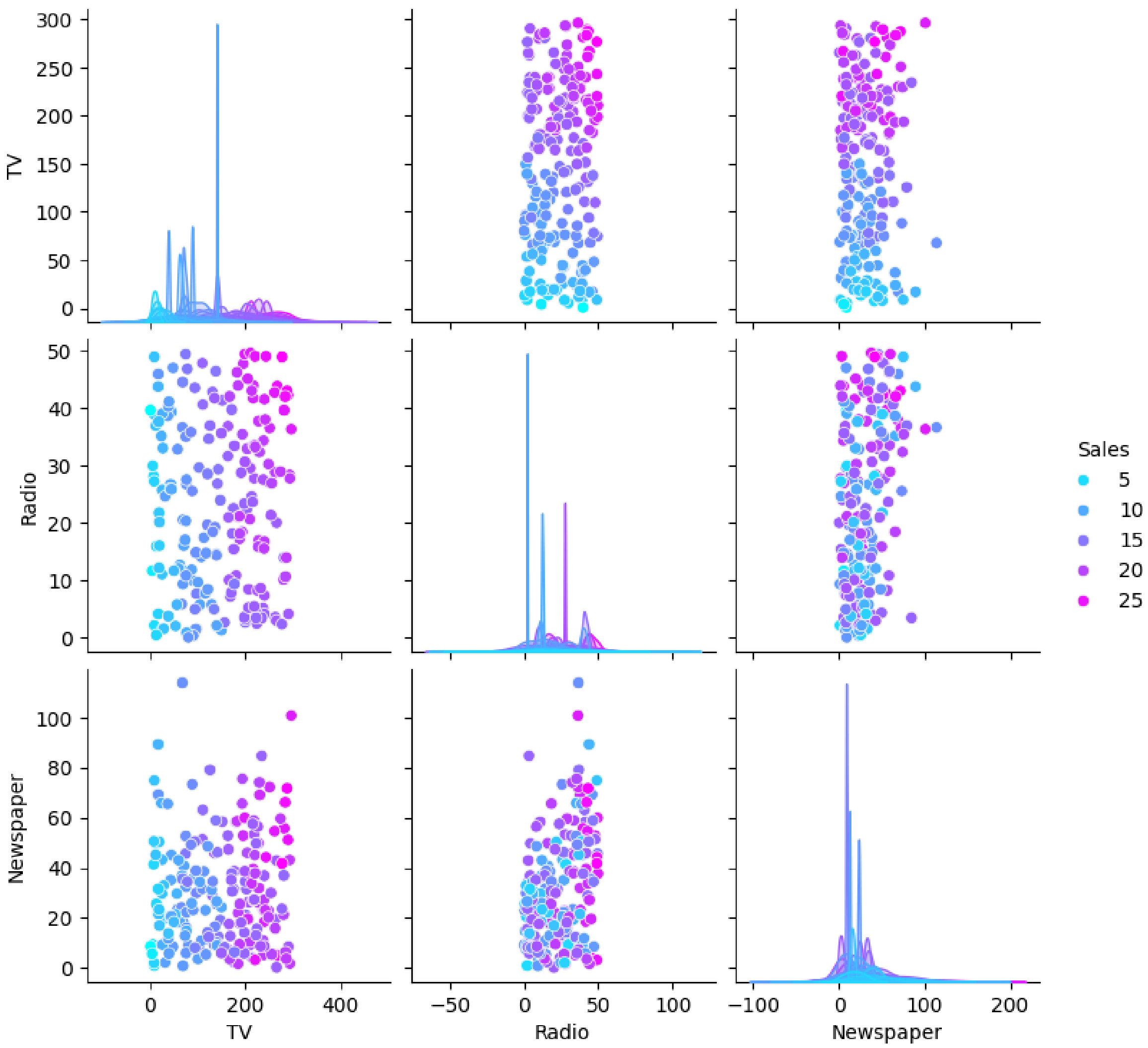
In [10]:
```
sns.jointplot(data=adv)
plt.show()
```



In [11]:
```
sns.scatterplot(data=adv)
plt.show()
```



In [12]:
```
sns.pairplot(adv,hue='Sales',palette='cool')
plt.show()
```

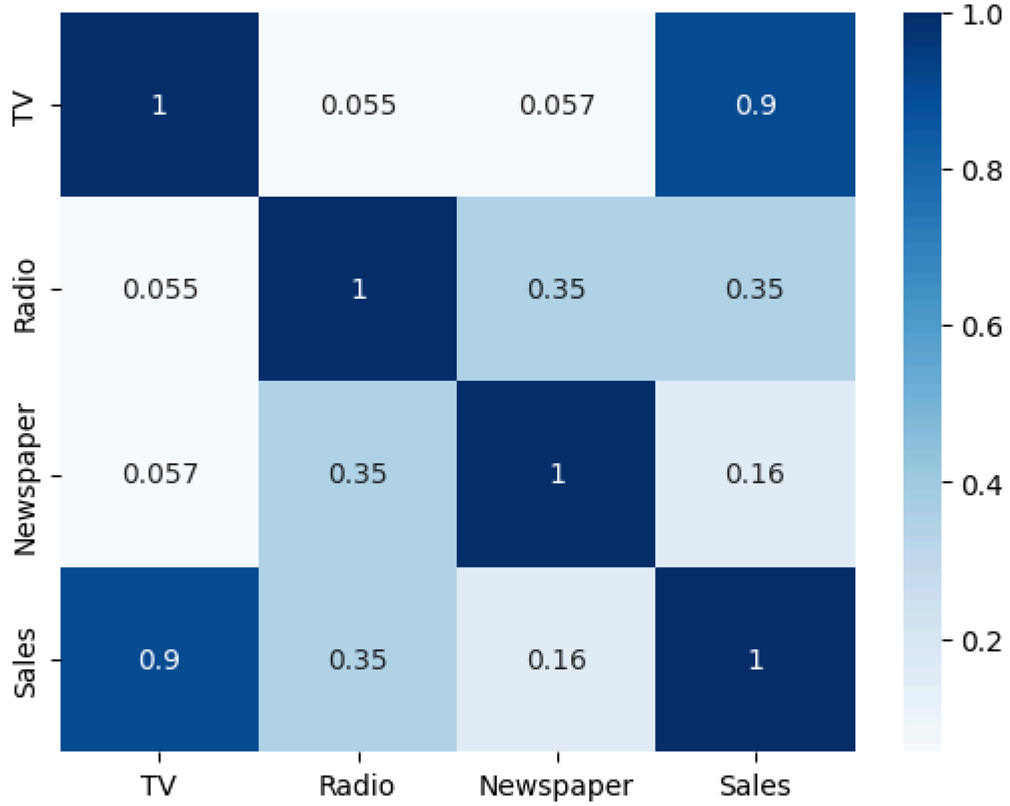


In [13]:
```
c = adv.corr()
c
```

Out[13]:

	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 [14]:
```
sns.heatmap(c,annot=True,cmap='Blues')
plt.show()
```



In [15]:
```
#Encoding
```

In [16]:
```
#ip/op Creation
ip = adv.drop('Sales',axis=1)
op = adv.Sales
```

In [17]:
```
ip.head()
```

Out[17]:

	TV	Radio	Newspaper
0	230.1	37.8	69.2
1	44.5	39.3	45.1
2	17.2	45.9	69.3
3	151.5	41.3	58.5
4	180.8	10.8	58.4

In [18]:
```
op.head()
```

Out[18]:
```
0    22.1
1    10.4
2    12.0
3    16.5
4    17.9
Name: Sales, dtype: float64
```

In [19]:
```
#!pip install scikit-learn
```

In [22]:
```
#Train Test Split
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(ip,op,test_size=0.2,random_s
```

In [23]:
```
x_train
```

Out[23]:

	TV	Radio	Newspaper
156	93.9	43.5	50.5
115	75.1	35.0	52.7
155	4.1	11.6	5.7
15	195.4	47.7	52.9
61	261.3	42.7	54.7
...	...	...	...
0	230.1	37.8	69.2
184	253.8	21.3	30.0
131	265.2	2.9	43.0
152	197.6	23.3	14.2
106	25.0	11.0	29.7

160 rows × 3 columns

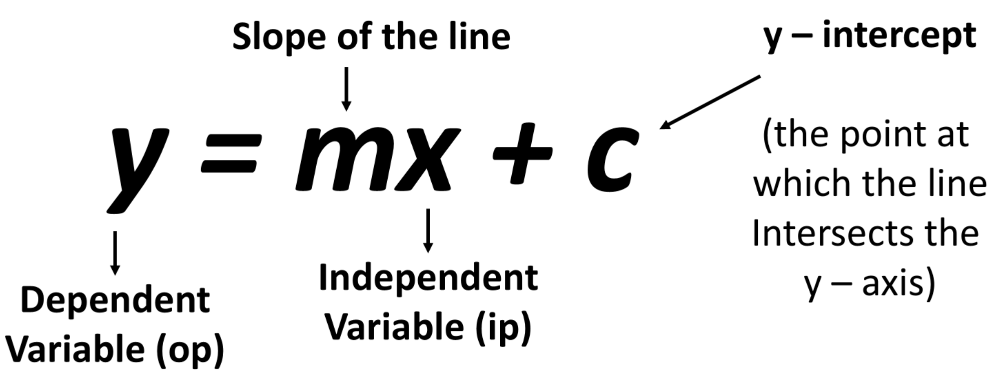
In [24]:
```
print(x_train.shape)
print(y_train.shape)
print(x_test.shape)
print(y_test.shape)
```

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

In [25]:
```
#Scaling
#Standard Scaler Transform
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()

x_train = sc.fit_transform(x_train)
x_test = sc.transform(x_test)
```

Linear Reagression



In [26]:
```
#ML Algorithm
#Linear Regression
from sklearn.linear_model import LinearRegression
lr = LinearRegression()
lr.fit(x_train,y_train)
```

Out[26]:
```
▾ LinearRegression
LinearRegression()
```

In [27]:
```
#Prediction
pred = lr.predict(x_test)
pred
```

Out[27]:
```
array([17.99747206, 11.02863798, 19.14207387, 15.16467067,  8.56496638,
       10.89550601, 24.92202604, 10.61757023, 18.6998404 , 17.29854871,
       14.66680343, 13.03094656, 19.28219899, 10.98418026, 13.7677926 ,
       14.4988402 , 16.92235556, 17.30704485, 17.78993353, 21.29009711,
       19.23977212, 10.98691684,  9.77272715, 11.18064352,  8.34136167,
       13.13093624, 21.59478295, 17.04191764, 24.83365506, 11.62133637,
       16.22765284, 21.95021111,  9.21285178,  9.94421377,  9.82032335,
       10.22691037, 15.74967394,  9.51795157, 13.67254607, 12.42186513])
```

In [28]:
```
y_test
```

Out[28]:
```
40     16.6
51     10.7
139    20.7
197    14.8
170     8.4
82     11.3
183    26.2
46     10.6
70     18.3
100    16.7
179    17.6
83     13.6
25     17.0
190    10.8
159    12.9
173    16.7
95     16.9
3      16.5
41     17.1
58     23.8
14     19.0
143    10.4
12      9.2
6      11.8
182     8.7
161    13.3
128    24.7
122    16.6
101    23.8
86     12.0
64     16.0
47     23.2
158     7.3
34     11.9
38     10.1
196    14.0
4      17.9
72      8.8
67     13.4
145    10.3
Name: Sales, dtype: float64
```

In [29]:
```
#Accuracy
from sklearn.metrics import mean_squared_error, r2_score

mse = mean_squared_error(y_test,pred)
r2 = r2_score(y_test,pred)
```

```
print("MSE : ",mse)
print("R2 Score : ",r2)
```

```
MSE :  1.9901879673862246
R2 Score :  0.9148706512256517
```

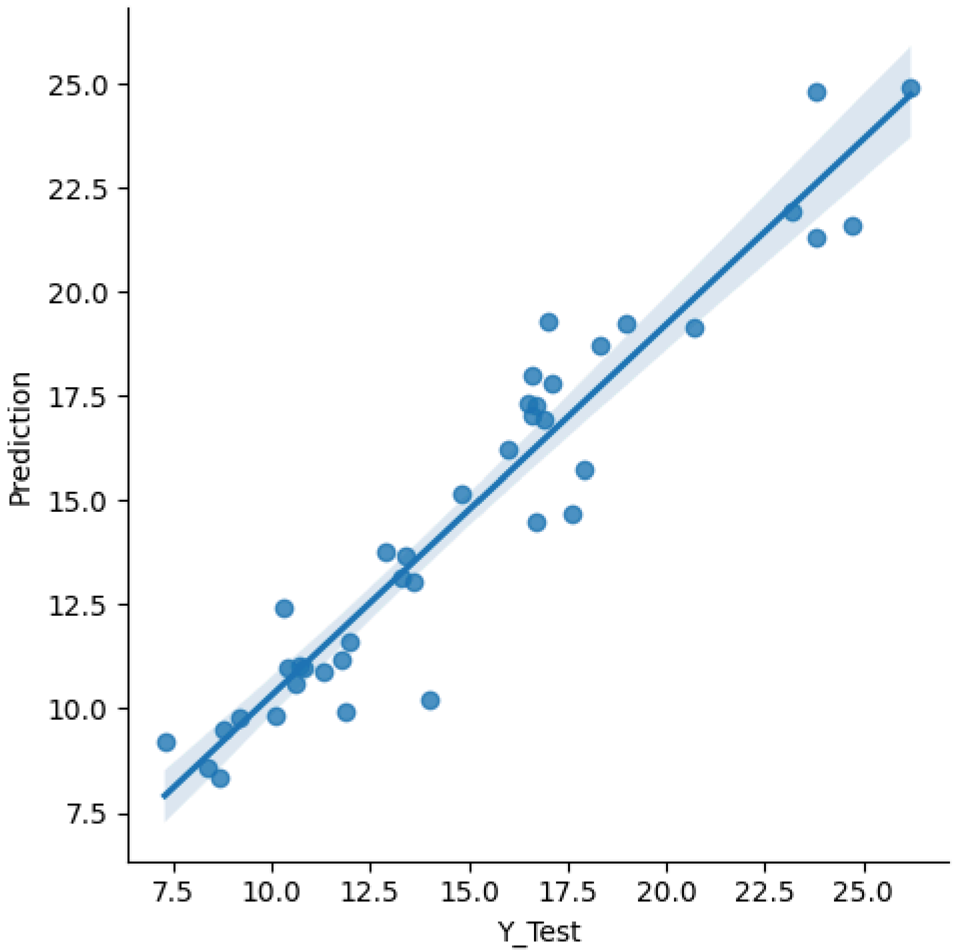
In [33]:
```
df = pd.DataFrame({'Y_Test':list(y_test),'Prediction':pred})
df
```

Out[33]:

	Y_Test	Prediction
0	16.6	17.997472
1	10.7	11.028638
2	20.7	19.142074
3	14.8	15.164671
4	8.4	8.564966
5	11.3	10.895506
6	26.2	24.922026
7	10.6	10.617570
8	18.3	18.699840
9	16.7	17.298549
10	17.6	14.666803
11	13.6	13.030947
12	17.0	19.282199
13	10.8	10.984180
14	12.9	13.767793
15	16.7	14.498840
16	16.9	16.922356
17	16.5	17.307045
18	17.1	17.789934
19	23.8	21.290097
20	19.0	19.239772
21	10.4	10.986917
22	9.2	9.772727
23	11.8	11.180644
24	8.7	8.341362
25	13.3	13.130936
26	24.7	21.594783
27	16.6	17.041918
28	23.8	24.833655
29	12.0	11.621336
30	16.0	16.227653
31	23.2	21.950211
32	7.3	9.212852

	Y_Test	Prediction
33	11.9	9.944214
34	10.1	9.820323
35	14.0	10.226910
36	17.9	15.749674
37	8.8	9.517952
38	13.4	13.672546
39	10.3	12.421865

In [34]:
```
#lmplot - Linear Model Plot
sns.lmplot(x='Y_Test',y='Prediction',data=df)
plt.show()
```



In [ ]:

Classification Models

Maintenance Dataset

In [81]:
```
#Importing Packages
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [82]:
```
#Reading and Studying the Dataset
main = pd.read_csv(r"C:\Users\VICTUS\Downloads\maintenance_data.csv")
main
```

Out[82]:

	lifetime	broken	pressureInd	moistureInd	temperatureInd	team	provider
0	56	0	92.178854	104.230204	96.517159	TeamA	Provider4
1	81	1	72.075938	103.065701	87.271062	TeamC	Provider4
2	60	0	96.272254	77.801376	112.196170	TeamA	Provider1
3	86	1	94.406461	108.493608	72.025374	TeamC	Provider2
4	34	0	97.752899	99.413492	103.756271	TeamB	Provider1
...	...	...	...	...	...	...	...
995	88	1	88.589759	112.167556	99.861456	TeamB	Provider4
996	88	1	116.727075	110.871332	95.075631	TeamA	Provider4
997	22	0	104.026778	88.212873	83.221220	TeamB	Provider1
998	78	0	104.911649	104.257296	83.421491	TeamA	Provider4
999	63	0	116.901354	99.998694	47.641493	TeamB	Provider1

1000 rows × 7 columns

In [83]:
```
#Data Cleaning
main.isnull().sum()
```

Out[83]:
```
lifetime          0
broken            0
pressureInd       0
moistureInd       0
temperatureInd    0
team              0
provider          0
dtype: int64
```

In [84]:
```
main.dtypes
```

Out[84]:
```
lifetime            int64
broken              int64
pressureInd       float64
moistureInd       float64
temperatureInd    float64
team               object
provider           object
dtype: object
```

In [85]:
```
for i in main.columns:
    print(i,':','\n',main[i].unique(),'\n')
```

```
lifetime :
 [56 81 60 86 34 30 68 65 23 38 29 82 80 48 92 88 74 61 35 26 63 79 53 73
 13 36 31 25 58 19 84 12 15 43  1 20 16  3 18  7 47 39 57  4 24 28 49 76
 52  8 40 46  5 41 93 77 62 85 55 33 17 45  9 72 50 42 44 54 64 27 22 59
 66 83 14 51 71 21 78  6 69 89  2 67 87 11 10 32 37 90]

broken :
 [0 1]

pressureInd :
 [ 92.17885406  72.07593772  96.27225443  94.40646126  97.75289859
  87.67880097  94.61417404  96.48330289 105.486158    99.17823531
  97.81784409  67.81225145  86.36611059  76.14465414 103.1072633
  88.41407945  84.35504868  79.66925455  86.22910861  84.17942039
 100.0059233  115.6075596   97.69718903 101.4156229  118.9786971
 102.1127749  129.1243378  109.0330362  107.2980695  127.2639544
 138.1911205   72.55408417  95.21464918  91.24713174  81.55537698
  69.13459519 132.8574784   54.73533145  84.89864628  94.15228726
  84.34406647  95.75352436 123.9284399  101.5053508  120.9455502
  83.06857115 113.3491219   75.64669299 113.4358321   81.77978353
  68.85065142 150.665421    72.42312878  97.13286233 113.965257
  57.46321326 144.3445174   80.69223153  93.91332598  73.32115289
  83.95831157  56.17177135 105.9000372  115.698401   119.7459957
 105.8937636   87.39284133  82.88180029 122.287991    85.07220883
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129.7877454	100.8153492	118.0945448	116.8030671	117.1148201
44.05861937	53.86889154	80.80015925	94.92339697	97.14318758
83.07660209	92.11820297	129.3959183	112.045723	107.9998787
123.3471888	102.0829817	105.0559928	120.1119781	109.8030349
103.6083438	76.75715125	90.89449635	137.7316507	91.46616916
114.6999018	124.5943298	104.0160769	121.5605208	119.1640431
86.81560948	148.7948773	102.8293459	92.40268117	102.97026

90.9112721	92.08460808	95.21773293	71.41243434	85.15456641
114.635357	83.12919201	107.2202127	139.8641702	90.69467731
123.5756211	114.6860223	114.0438889	86.09168244	106.784924
87.98640894	112.342235	77.62546519	120.325407	101.3321156
80.05832135	87.98386127	111.4629184	92.79820374	109.7438203
129.9878939	76.08557046	100.6230519	75.19061894	110.2672376
77.21030463	93.00411663	92.92996339	77.07077762	93.34575008
124.736851	76.55626608	136.030098	128.7880801	75.9997621
84.81261253	108.8943008	107.4600703	84.04405964	73.29702688
127.4278908	124.484758	87.67851893	128.812916	112.167476
135.1693172	101.8822342	103.595199	120.4686983	73.96276076
103.067457	126.8485419	80.72306687	85.16860071	95.60684471
118.6429881	88.76889673	106.5479672	121.0385472	90.37342086
86.140575	121.6596974	104.2853153	90.687831	111.6442027
107.1263062	132.8960253	112.0732419	108.5662	80.10887306
91.46874009	98.27463019	71.80056052	123.3052926	119.9772055
117.8775732	83.42249496	137.4741755	105.3091613	125.6032844
92.37923722	105.1152794	119.8540501	102.4971134	42.27959777
105.8270944	99.98644583	141.8914187	108.3030495	81.18539743
91.39246184	102.8762405	96.76267759	92.79302585	100.4592065
104.753569	114.6001775	93.4643859	120.353069	111.5351793
99.81819568	99.63780661	67.25648332	90.11035352	75.30231632
104.1224911	90.7504789	112.6088848	127.0598802	119.861342
115.0832449	80.75742109	115.3353489	92.80935236	98.51566602
113.5163748	107.6967466	93.35842227	102.7250535	54.85463932
79.45524105	109.7863541	116.1649707	111.15933	88.37180867
97.35961631	83.03736305	132.4949068	102.7298925	91.10385148
95.52186729	134.0993917	100.0956146	111.9665528	77.19401385
89.47804982	82.35935334	82.37295228	60.61123187	85.28897211
99.32586687	110.9381936	121.4210197	105.3645153	110.1829006
127.5978295	84.35551244	57.34534891	65.21580585	77.59314255
96.76811894	87.05655228	107.4768874	76.54239502	92.02624326
106.5518926	109.8760155	123.0878047	117.8925563	114.1714076
73.99386306	93.02570296	104.9696808	111.5631001	112.4952072
101.92534	121.3259062	91.72599463	99.08231665	76.29286351
101.5804487	73.71605989	91.67263447	81.90237741	114.5670649
95.9716024	102.6007936	138.311966	81.39597051	104.7856021
86.63390737	130.5570767	65.18346688	114.9243374	119.5940377
63.18449738	70.92465014	110.7122015	93.91395318	87.24826931
82.13596405	106.7305167	128.3033183	80.55511582	46.85704695
91.61400596	64.88013098	96.95931027	128.3332476	112.4178876
80.99028054	97.91723838	97.78208935	120.3658475	93.40801931
149.924611	80.76109253	88.43730614	96.3568589	73.31904291
114.8743613	86.83447267	108.4264351	84.6399811	84.74365498
109.8976734	99.76389665	124.5358699	119.151983	101.1478423
117.1686465	95.26037259	71.32737145	124.6895599	110.7019087
77.81619344	106.867088	92.74548648	108.621829	78.4914549
53.68552772	99.18399217	127.3901657	129.6915102	115.4800775
99.01180073	86.52544178	69.38011409	72.22892252	122.1541802
95.78505053	93.85869715	119.595801	133.4597497	135.8513241
98.22838553	125.4883602	113.188661	103.6789277	93.48403916
112.9856511	100.1692002	82.56648328	114.2516554	136.1321316
105.6019068	93.4746867	133.6236876	76.443343	143.3595386
62.95617977	89.58568737	101.3501698	88.69819983	114.3900269
91.440331	96.46031059	116.5434247	93.0974028	78.25048078
87.017921	44.33108441	102.3655284	95.55979966	129.203039
69.53376531	123.3805805	110.8264747	118.0431521	85.37598469
111.2401286	118.0588863	96.96869193	103.4074918	104.4062563
109.5085553	89.18130235	66.33906123	95.73557981	108.0423921
106.6359452	114.3053581	92.50320389	82.23645826	91.12806915

```
 96.27540641  98.43332131  84.73797429  84.82670487 101.7005933
106.3987993  101.4990011  104.2267675   90.21907271  92.27922542
 93.81460506 123.2548138   66.868012   132.6489933  111.9414802
 99.79866988  76.26973887  89.08310201 109.636018    96.71791287
 96.28547323 127.8021082  112.9373963  114.6269398  112.4831253
128.2809537  110.1142502   81.1547673   60.70238138 117.2177177
 93.16406456  86.24532972  90.70206847  88.00175655 124.0469975
117.2735726  107.2609915  104.0767926  122.9497116  121.1105841
143.9519908   87.93739852  99.6011896  104.29978    114.9546663
 86.05930834 101.1799657  110.3341415  112.9557703  107.1117844
103.262856    99.49648475  82.25351215 102.3134457   76.71751602
 70.32511371 110.0930537  122.1599585   58.30095817 110.2320489
106.6508842  114.1031517  101.2066501  118.0273944   75.63057702
 99.86145565  95.07563134  83.22122036  83.42149109  47.64149344]

team :
 ['TeamA' 'TeamC' 'TeamB']

provider :
 ['Provider4' 'Provider1' 'Provider2' 'Provider3']
```

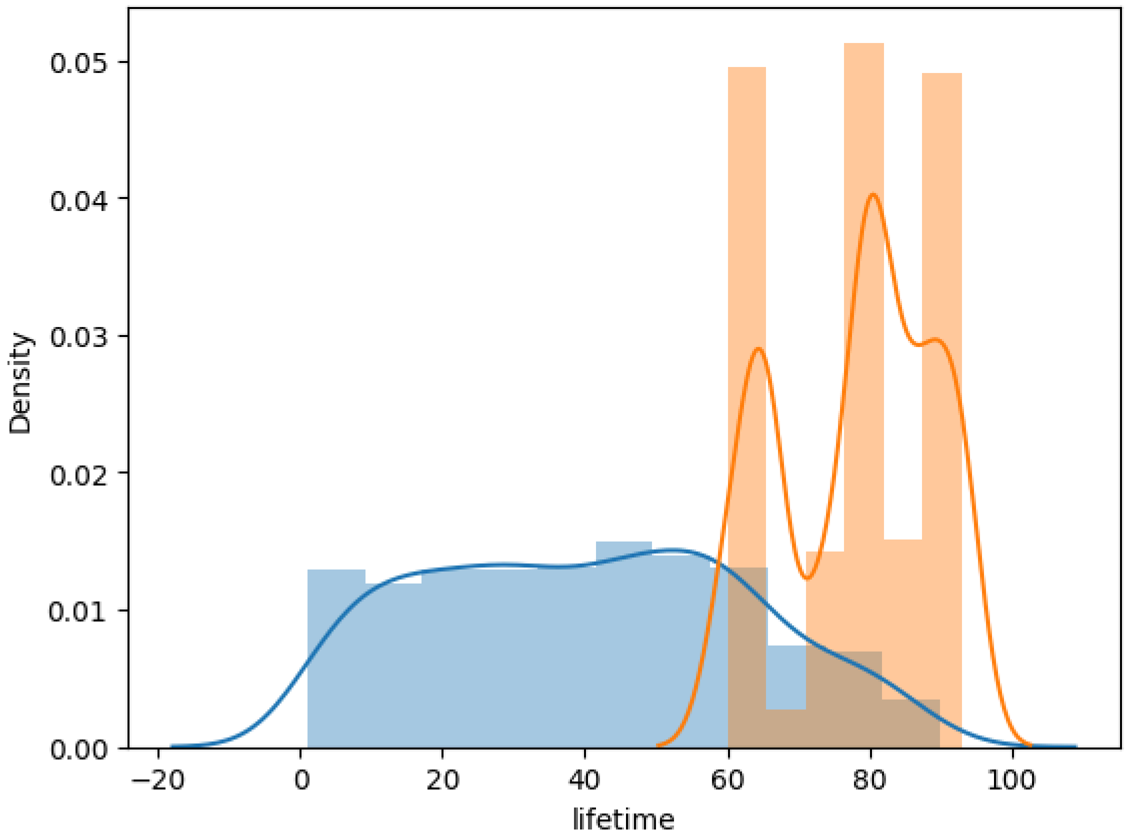
In [86]:
```
main.describe(include='all')
```

Out[86]:

	lifetime	broken	pressureInd	moistureInd	temperatureInd	team	p
count	1000.000000	1000.000000	1000.000000	1000.000000	1000.000000	1000	
unique	NaN	NaN	NaN	NaN	NaN	3	
top	NaN	NaN	NaN	NaN	NaN	TeamB	Pı
freq	NaN	NaN	NaN	NaN	NaN	356	
mean	55.195000	0.397000	98.599338	99.376723	100.628541	NaN	
std	26.472737	0.489521	19.964052	9.988726	19.633060	NaN	
min	1.000000	0.000000	33.481917	58.547301	42.279598	NaN	
25%	34.000000	0.000000	85.558076	92.771764	87.676913	NaN	
50%	60.000000	0.000000	97.216997	99.433959	100.592277	NaN	
75%	80.000000	1.000000	112.253190	106.120762	113.662885	NaN	
max	93.000000	1.000000	173.282541	128.595038	172.544140	NaN	

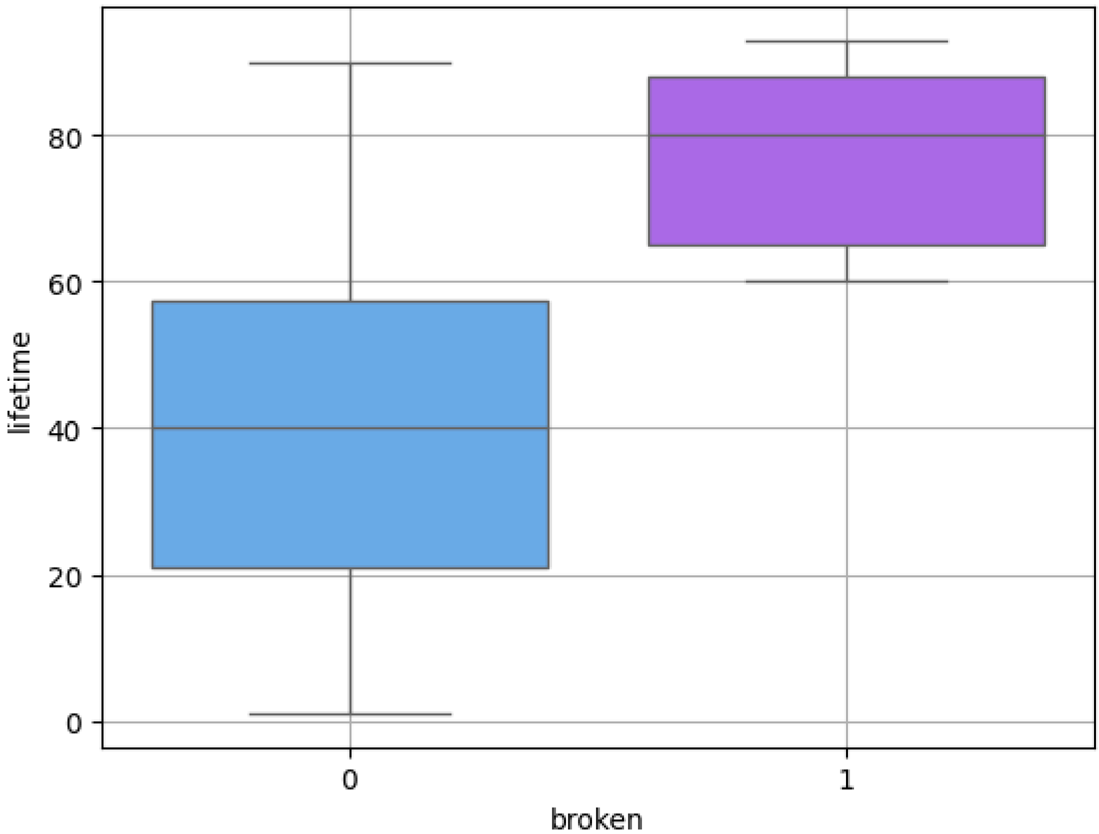
In [87]:
```
#Data Visualization or EDA
import warnings
warnings.filterwarnings('ignore')
```

In [272…
```
sns.distplot(main.lifetime[main.broken==0])
sns.distplot(main.lifetime[main.broken==1])
plt.show()
```



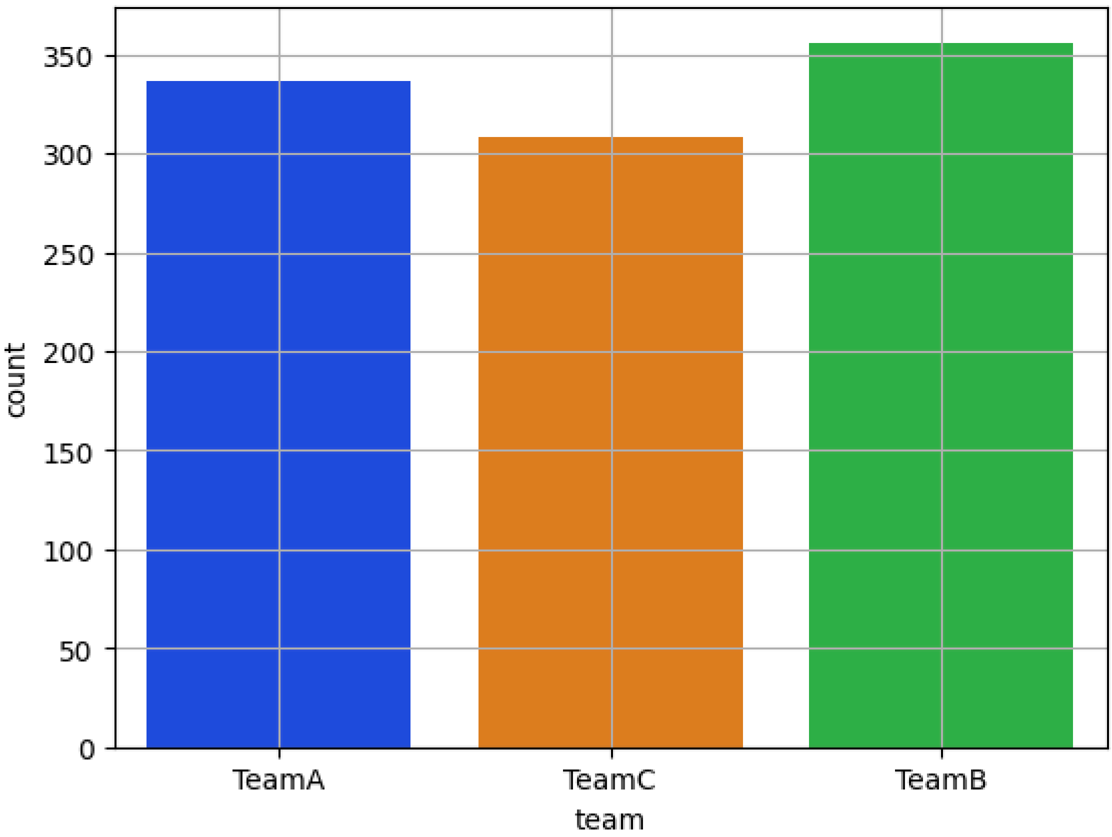
In [271…

```
sns.boxplot(x=main.broken,y=main.lifetime,palette='cool')
plt.grid()
plt.show()
```

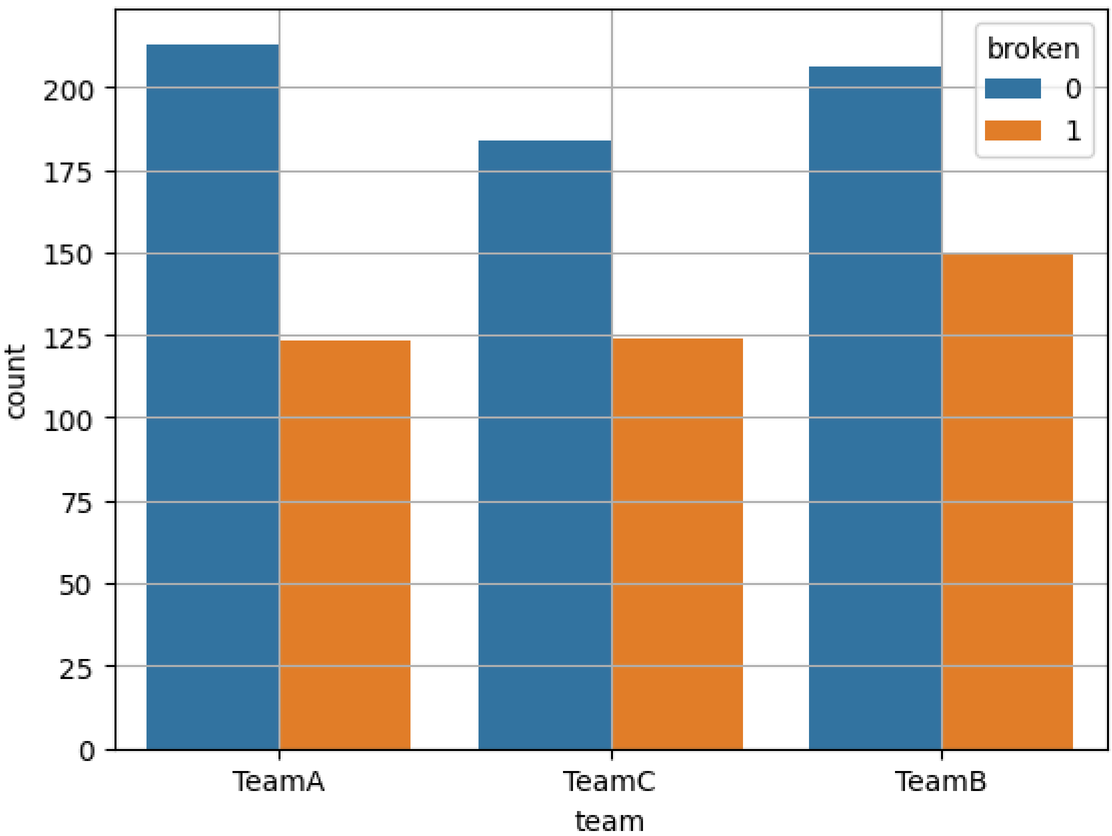


In [88]:

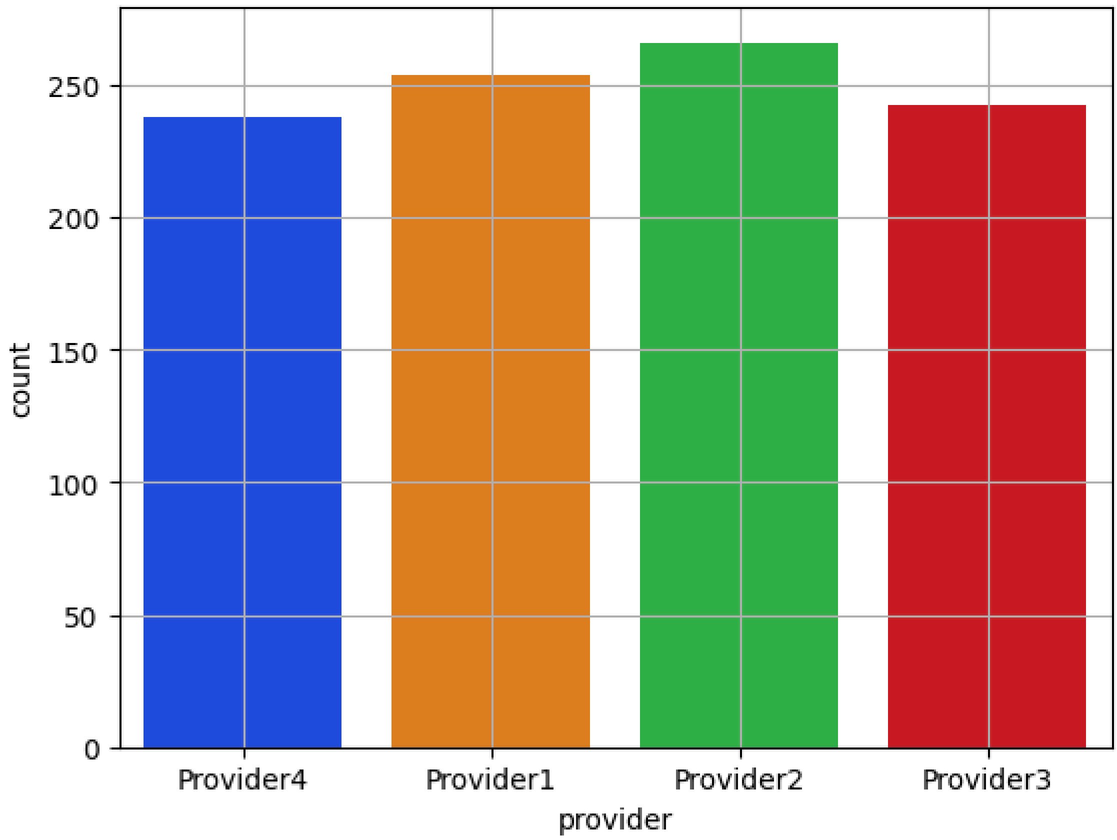
```
sns.countplot(x=main.team,palette='bright')
plt.grid()
plt.show()
```



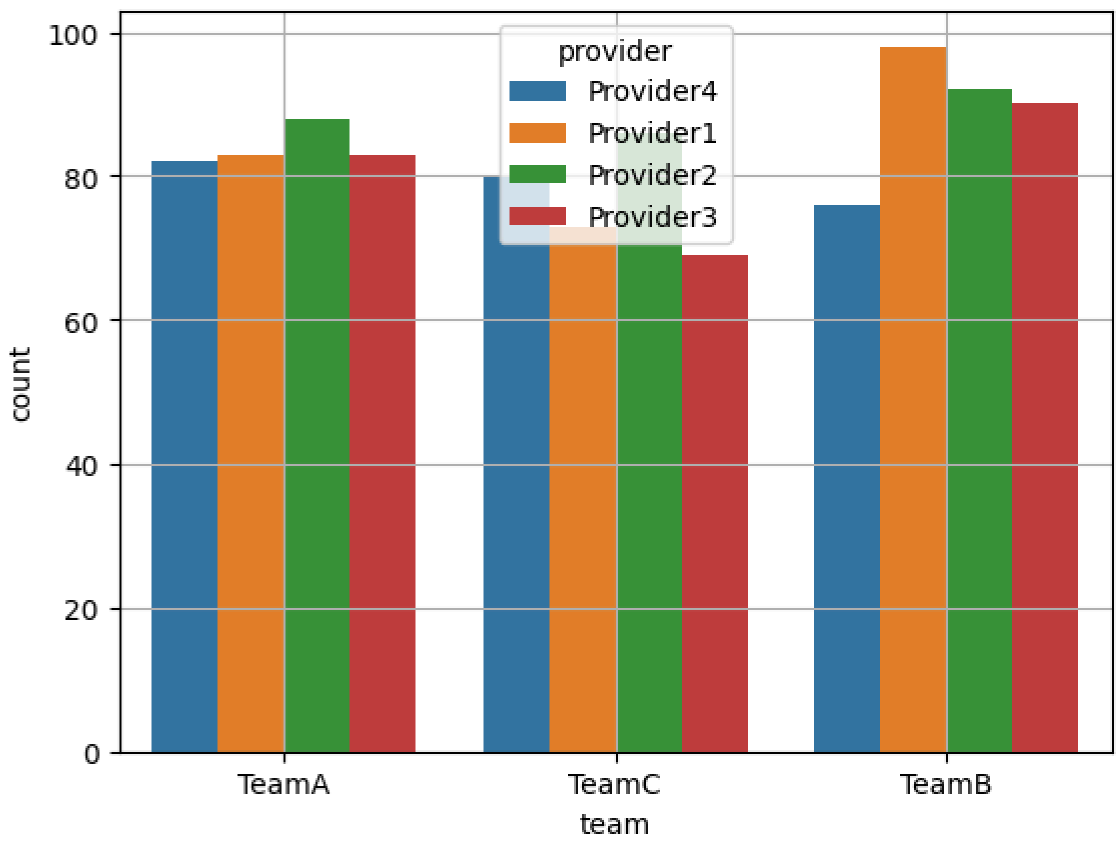
In [89]:
```
sns.countplot(x=main.team,hue=main.broken)
plt.grid()
plt.show()
```



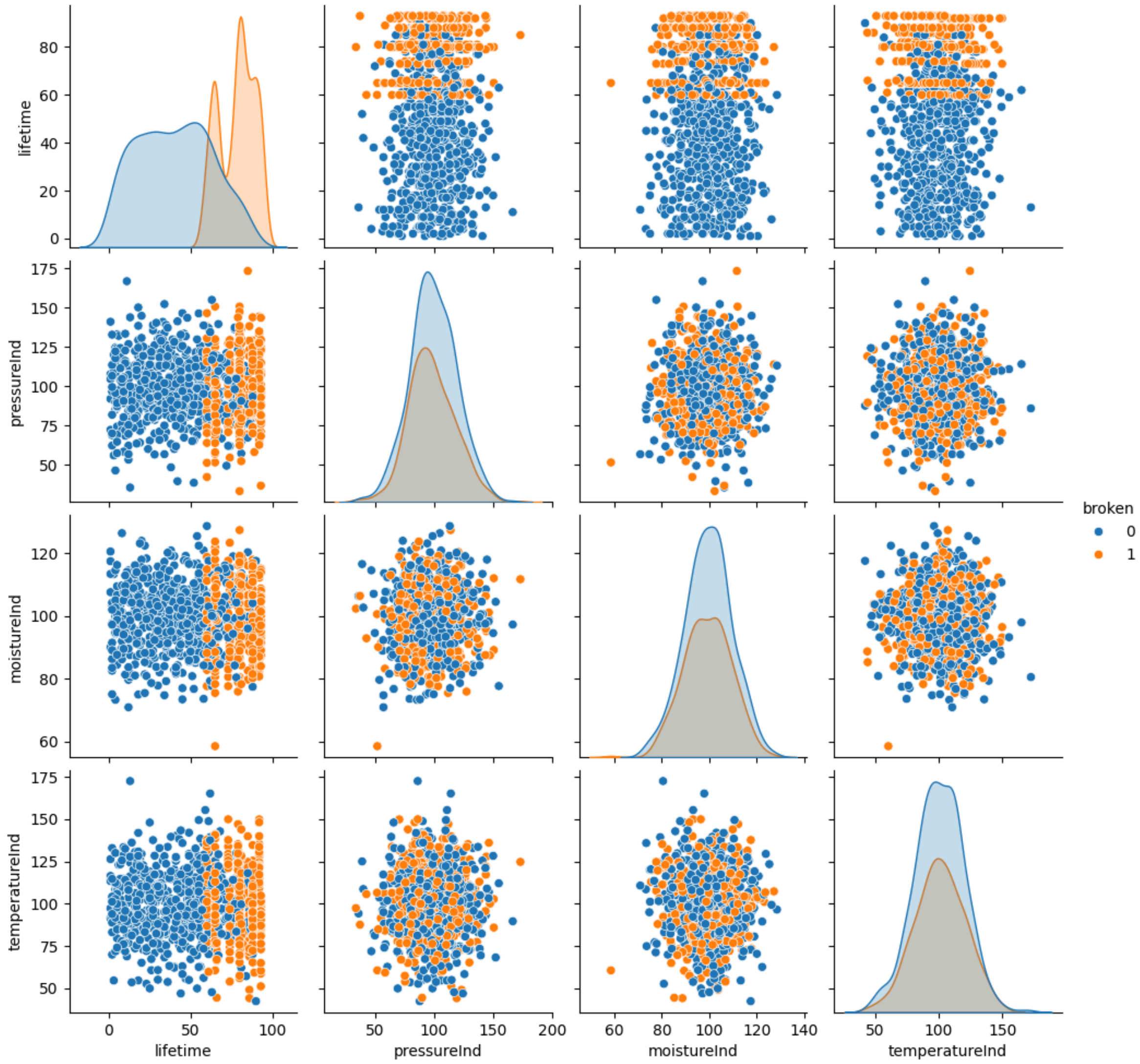
In [90]:
```
sns.countplot(x=main.provider,palette='bright')
plt.grid()
plt.show()
```



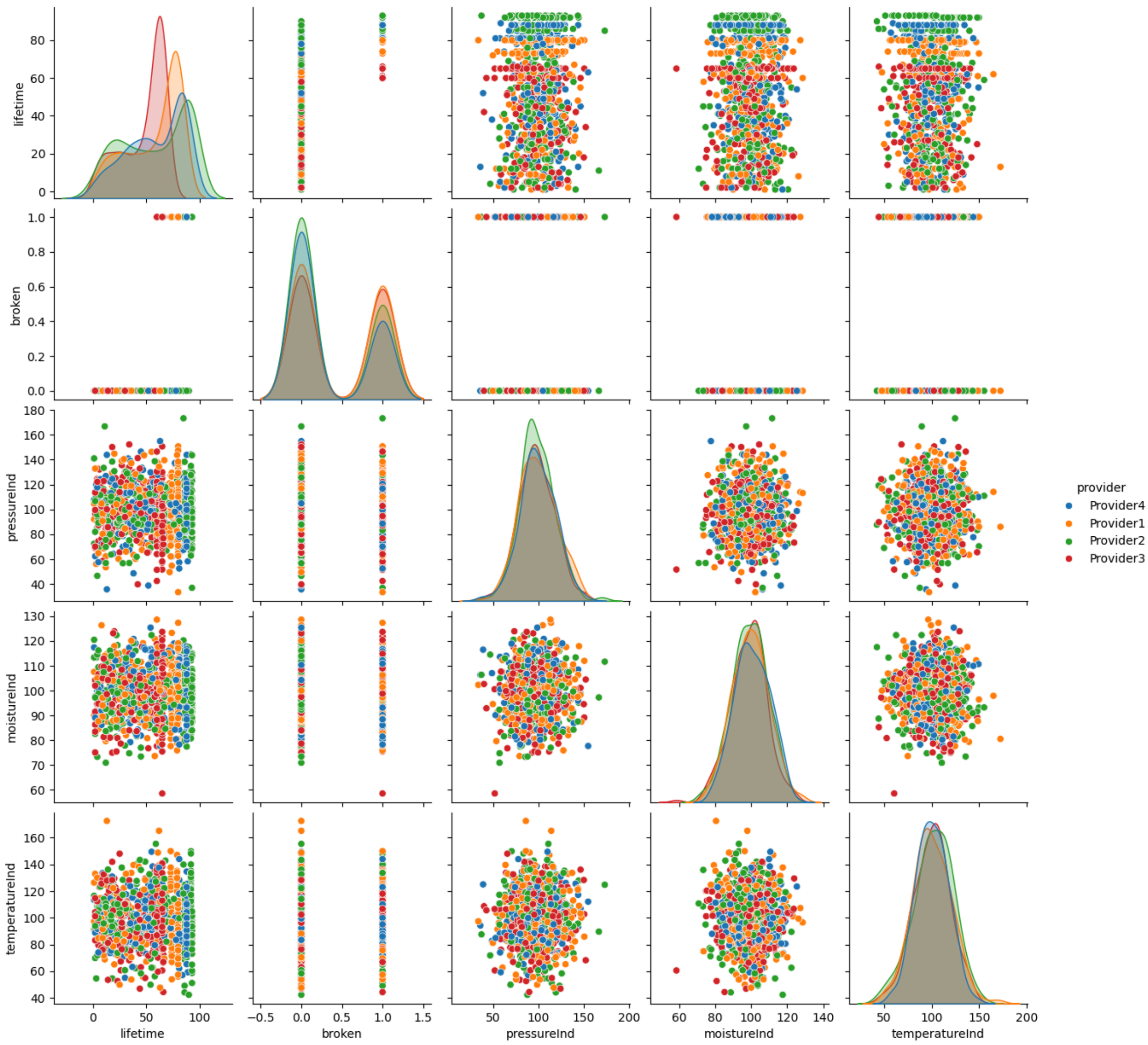
In [91]:
```
sns.countplot(x=main.team,hue=main.provider)
plt.grid()
plt.show()
```



In [92]:
```
sns.pairplot(main,hue='broken')
plt.show()
```



In [93]:
```
sns.pairplot(main,hue='provider')
plt.show()
```



Encoding : It is use to convert string to numbers.

```
Types of Encoding :-
--> Label Encoding
--> One-Hot Encoding
--> Frequency Encoding
--> Target Encoding
--> Ordinal Encoding
--> Dummy Encoding
```

In [94]:
```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
```

In [95]:
```
main.team = le.fit_transform(main.team)
main.team.unique()
```

Out[95]:
```
array([0, 2, 1])
```

In [96]:
```
le.inverse_transform([0,2,1])
```

Out[96]:
```
array(['TeamA', 'TeamC', 'TeamB'], dtype=object)
```

In [97]:
```
main.provider = le.fit_transform(main.provider)
main.provider.unique()
```

Out[97]:
```
array([3, 0, 1, 2])
```

In [98]:
```
le.inverse_transform([3,0,1,2])
```

Out[98]:
```
array(['Provider4', 'Provider1', 'Provider2', 'Provider3'], dtype=object)
```

In [99]:
```
main
```

Out[99]:

	lifetime	broken	pressureInd	moistureInd	temperatureInd	team	provider
0	56	0	92.178854	104.230204	96.517159	0	3
1	81	1	72.075938	103.065701	87.271062	2	3
2	60	0	96.272254	77.801376	112.196170	0	0
3	86	1	94.406461	108.493608	72.025374	2	1
4	34	0	97.752899	99.413492	103.756271	1	0
...	...	...	...	...	...	...	...
995	88	1	88.589759	112.167556	99.861456	1	3
996	88	1	116.727075	110.871332	95.075631	0	3
997	22	0	104.026778	88.212873	83.221220	1	0
998	78	0	104.911649	104.257296	83.421491	0	3
999	63	0	116.901354	99.998694	47.641493	1	0

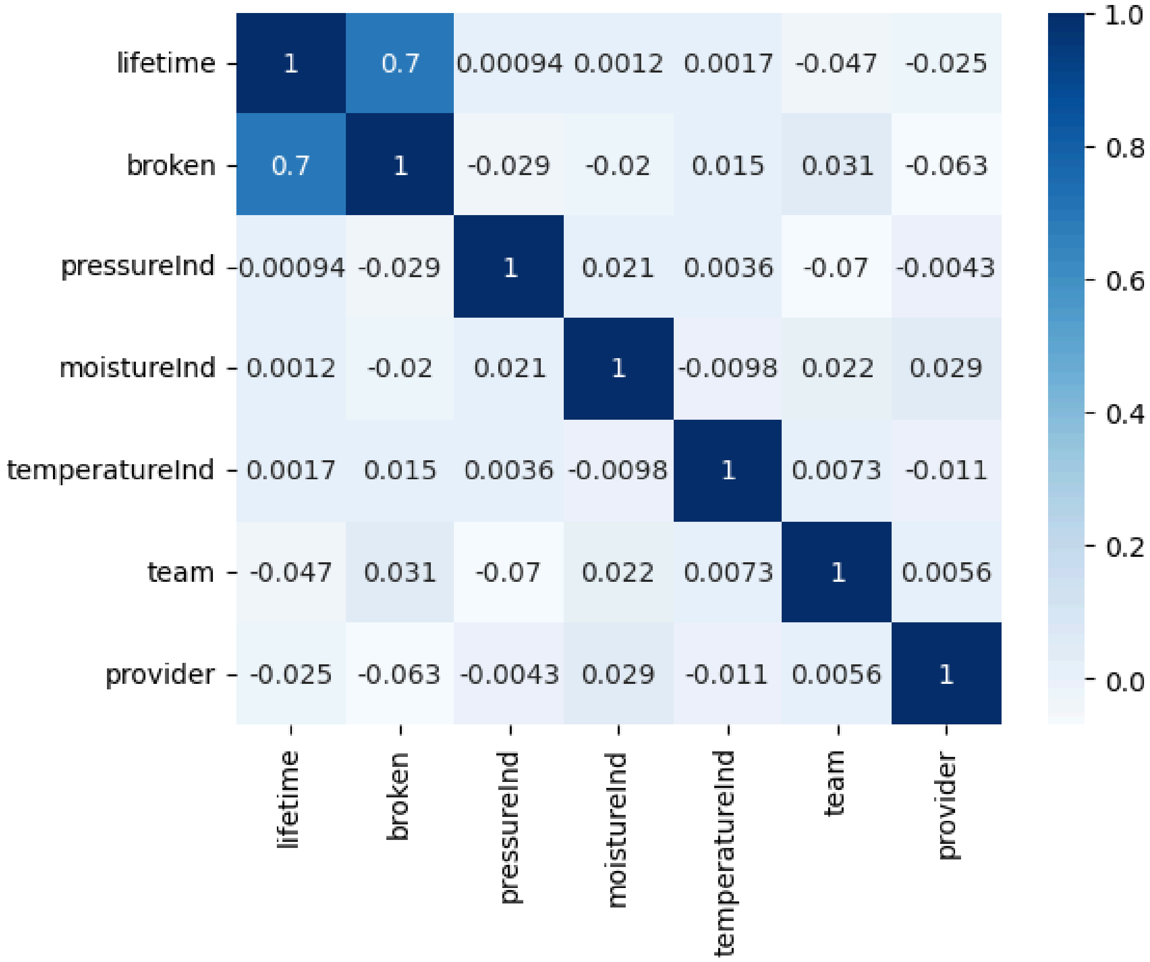
1000 rows × 7 columns

In [100…
```
c = main.corr()
c
```

Out[100…

	lifetime	broken	pressureInd	moistureInd	temperatureInd	te
lifetime	1.000000	0.702656	0.000943	0.001196	0.001744	-0.046!
broken	0.702656	1.000000	-0.028942	-0.019520	0.015364	0.030!
pressureInd	0.000943	-0.028942	1.000000	0.020543	0.003641	-0.069!
moistureInd	0.001196	-0.019520	0.020543	1.000000	-0.009842	0.022‹
temperatureInd	0.001744	0.015364	0.003641	-0.009842	1.000000	0.007:
team	-0.046537	0.030876	-0.069528	0.022420	0.007310	1.000(
provider	-0.025172	-0.062972	-0.004337	0.028906	-0.010822	0.005(

In [101…
```
sns.heatmap(c,annot=True,cmap='Blues')
plt.show()
```



In [102…
```
#ip/op Creation
ip = main.drop('broken',axis=1)
op = main.broken
```

In [117…
```
#Train Test Split
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(ip,op,test_size=0.2)
```

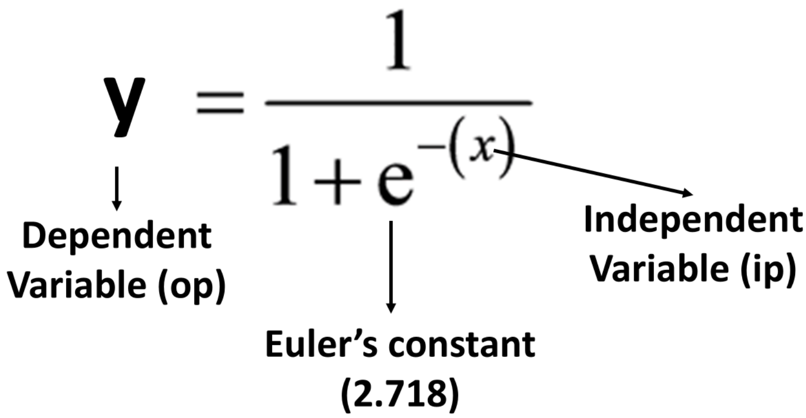
In [118…
```
print(x_train.shape)
print(y_train.shape)
print(x_test.shape)
print(y_test.shape)
```

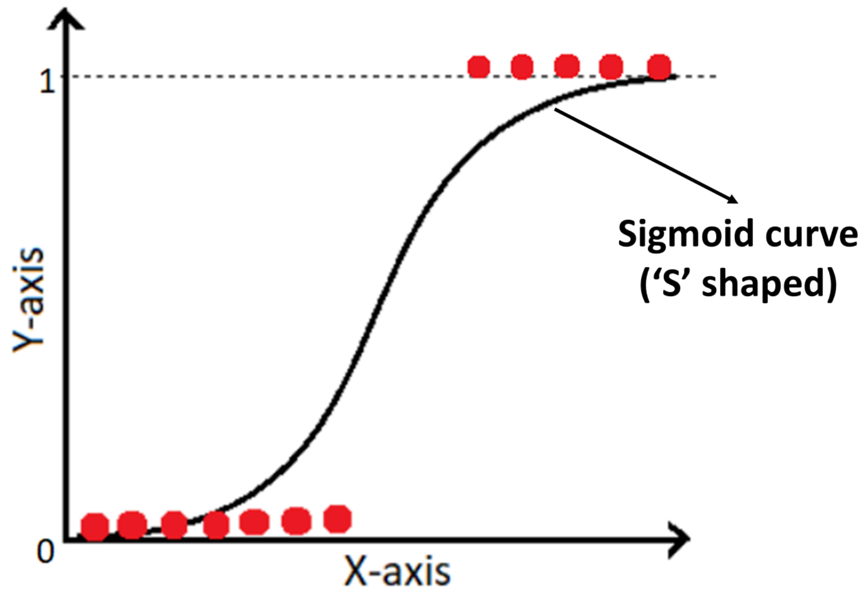
```
(800, 6)
(800,)
(200, 6)
(200,)
```

In [119…
```
#Scaling
#Standard Scaler Transform
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()

x_train = sc.fit_transform(x_train)
x_test = sc.transform(x_test)
```

Logistic Regresssion





In [120...
```python
from sklearn.linear_model import LogisticRegression
lr = LogisticRegression()
lr.fit(x_train,y_train)
```

Out[120...
```
▾ LogisticRegression
LogisticRegression()
```

In [121...
```python
#Prediction
pred = lr.predict(x_test)
pred
```

Out[121…

```
array([0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 1, 1, 1, 0,
       1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0,
       1, 1, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1,
       1, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 1, 0,
       1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1,
       0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1, 1, 1,
       0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 1,
       0, 0, 1, 1, 0, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0,
       0, 0], dtype=int64)
```

In [122…

```
y_test
```

Out[122…

```
201    0
899    0
438    0
211    0
135    1
      ..
303    0
975    1
988    0
660    0
250    0
Name: broken, Length: 200, dtype: int64
```

In [123…

```
#Accuracy
from sklearn.metrics import accuracy_score, recall_score, precision_score, f1_sc

ac = accuracy_score(y_test,pred)
re = recall_score(y_test,pred)
pr = precision_score(y_test,pred)
f1 = f1_score(y_test,pred)

print("Accuracy : ",ac)
print("Recall : ",re)
print("Precision : ",pr)
print("F1 Score : ",f1)
```

```
Accuracy :  0.835
Recall :  0.8082191780821918
Precision :  0.7564102564102564
F1 Score :  0.7814569536423841
```

In [124…

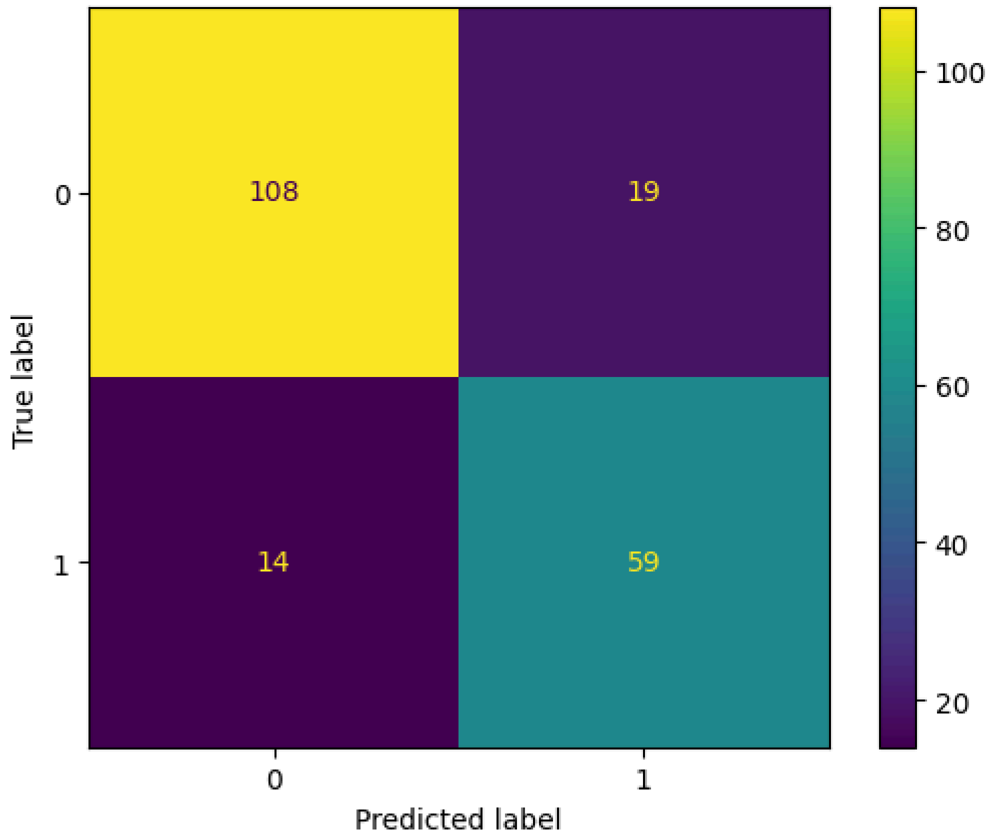
```
#Confusion Matrix
from sklearn.metrics import confusion_matrix,ConfusionMatrixDisplay

cm = confusion_matrix(y_test,pred)
cm
```

Out[124…

```
array([[108,  19],
       [ 14,  59]], dtype=int64)
```

In [125…

```
cmd = ConfusionMatrixDisplay(cm)
cmd.plot()
plt.show()
```



In [126…

```
df = pd.DataFrame({'Y_Test':list(y_test),'Prediction':pred})
df
```

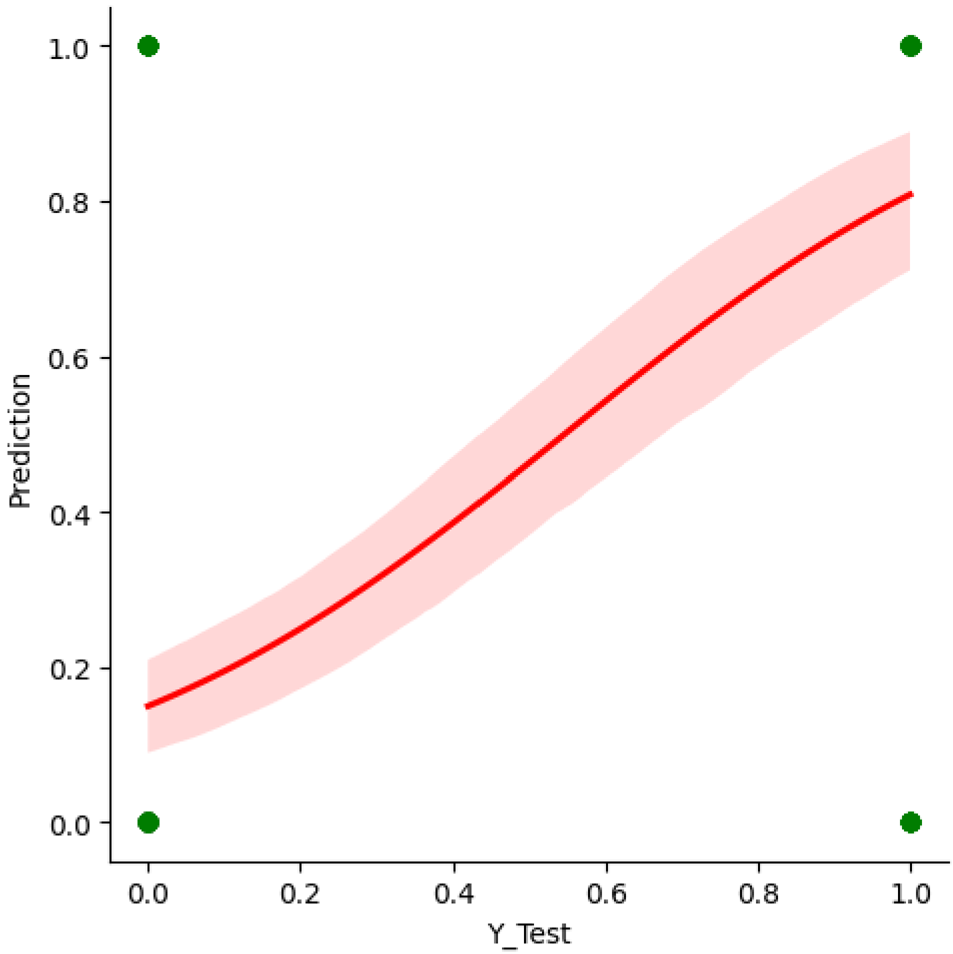
Out[126…

	Y_Test	Prediction
0	0	0
1	0	0
2	0	1
3	0	0
4	1	1
...	...	...
195	0	0
196	1	1
197	0	0
198	0	0
199	0	0

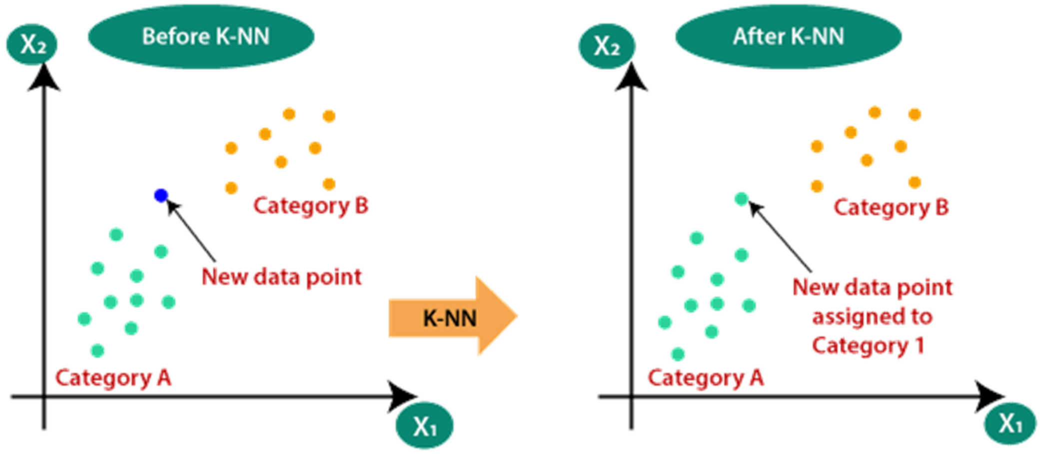
200 rows × 2 columns

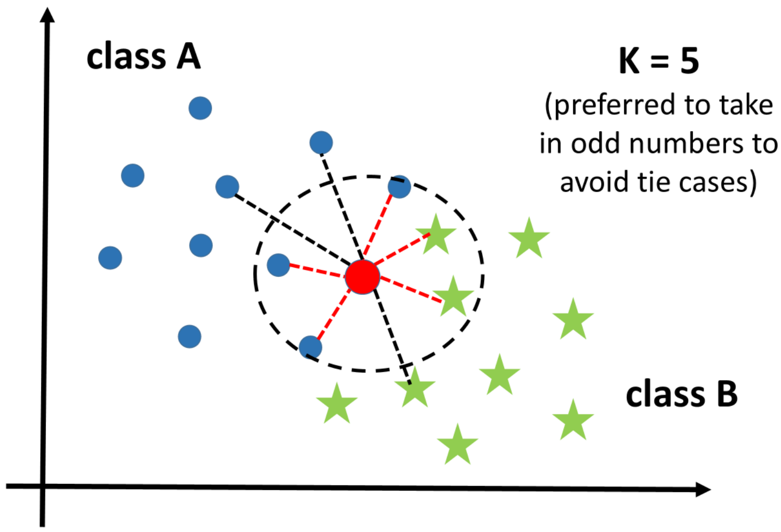
In [131…

```
#lmplot
sns.lmplot(x='Y_Test',y='Prediction',data=df,logistic=True,
           scatter_kws={'color':'green'},line_kws={'color':'red'})
plt.show()
```



KNN : K-Nearest Neighbors





Euclidean Distance Formula

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

In [132…

```
from sklearn.neighbors import KNeighborsClassifier
knn = KNeighborsClassifier(n_neighbors=7)
```

```
knn.fit(x_train,y_train)
```

Out[132…

```
▾ KNeighborsClassifier
KNeighborsClassifier(n_neighbors=7)
```

In [133…

```
pred1 = knn.predict(x_test)
pred1
```

Out[133…

```
array([0, 0, 1, 1, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 1, 0, 1,
       0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0,
       1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1,
       1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 1, 0,
       0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0,
       1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 1, 1,
       1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 1,
       1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 1,
       0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0, 1, 0,
       0, 0], dtype=int64)
```

In [138…

```
#Accuracy
from sklearn.metrics import accuracy_score, recall_score, precision_score, f1_sc

ac = accuracy_score(y_test,pred1)
re = recall_score(y_test,pred1)
pr = precision_score(y_test,pred1)
f1 = f1_score(y_test,pred1)

print("Accuracy : ",ac)
print("Recall : ",re)
print("Precision : ",pr)
print("F1 Score : ",f1)
```

```
Accuracy :  0.8
Recall :  0.8356164383561644
Precision :  0.6853932584269663
F1 Score :  0.7530864197530864
```

In [139…

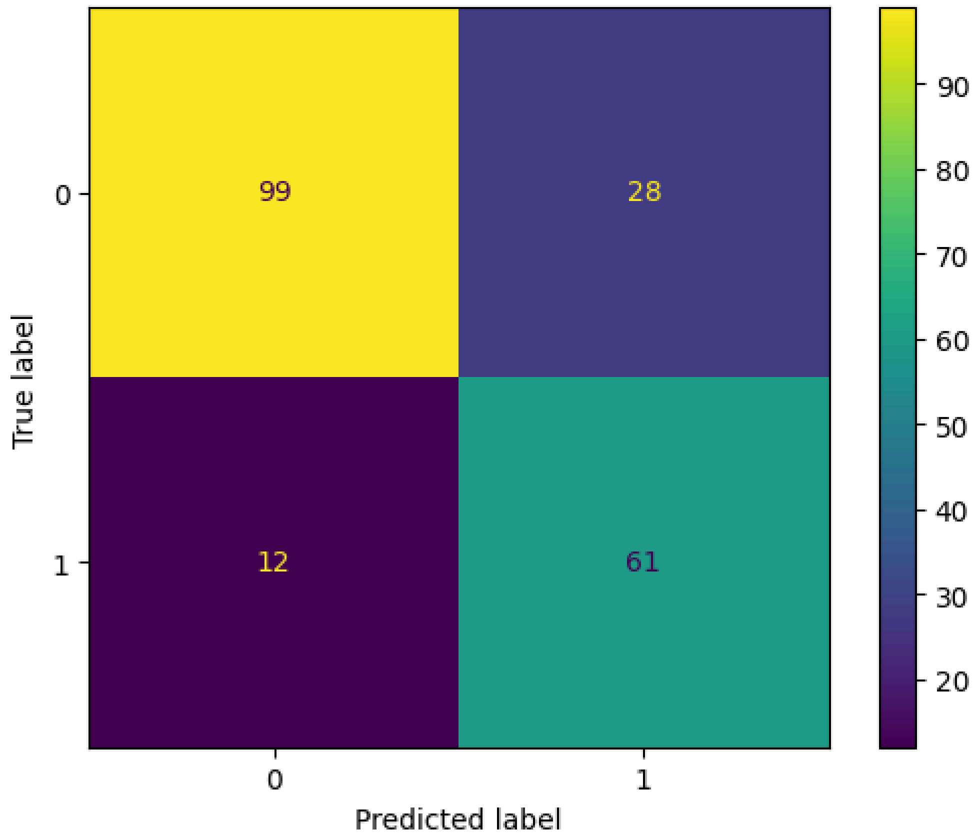
```
cm = confusion_matrix(y_test,pred1)
cm
```

Out[139…

```
array([[99, 28],
       [12, 61]], dtype=int64)
```

In [140…

```
cmd = ConfusionMatrixDisplay(cm)
cmd.plot()
plt.show()
```



99
28
12
61
0
1
True label
0
1
Predicted label
90
80
70
60
50
40
30
20


```
In [ ]:
```

```
In [ ]:
```