Machine Learning:

Machine Learning Procedure:-

- Dataset Reading and Studying
- Data Cleaning and Analysis
- Data Visualization or EDA (Exploratory Data Analysis)
- Encoding (converting of string columns to integer columns)
- ip/op Creation (separating input data and output/target data)
- Train Test Split (separate the training data and testing data)
- Standard Scaler Transform (standardizing all the input datas)
- Machine Learning Algorithm
- Prediction
- Accuracy

Regression Model:-

Linear Regression:-

In [1]:
```
# Importing the packages:
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:
```
# Reading the Dataset:-
adv = pd.read_csv(r"C:\Users\lab25\Downloads\archive (9)\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:-
# Checking null values:
adv.isnull().sum()
```

Out[3]:
```
TV           0
Radio        0
Newspaper    0
Sales        0
dtype: int64
```

In [4]:
```
# checking the datatypes:
adv.dtypes
```

Out[4]:
```
TV           float64
Radio        float64
Newspaper    float64
Sales        float64
dtype: object
```

In [5]:
```
# checking the unique values:
for i in adv.columns:
    print(f"{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]:
```
# to check the information of the dataset:
adv.info()
```

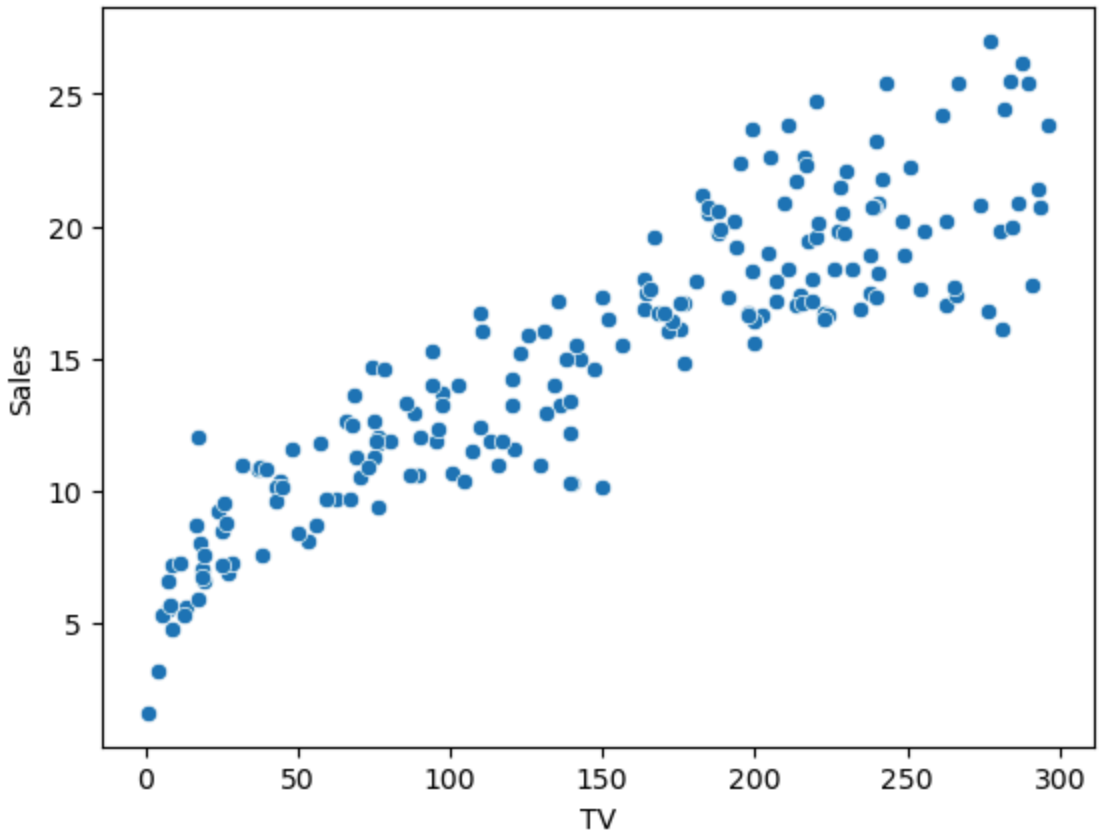
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 4 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   TV         200 non-null    float64
 1   Radio      200 non-null    float64
 2   Newspaper  200 non-null    float64
 3   Sales      200 non-null    float64
dtypes: float64(4)
memory usage: 6.4 KB
```

In [7]:
```
# to check the statistical value of all columns:
adv.describe()
```

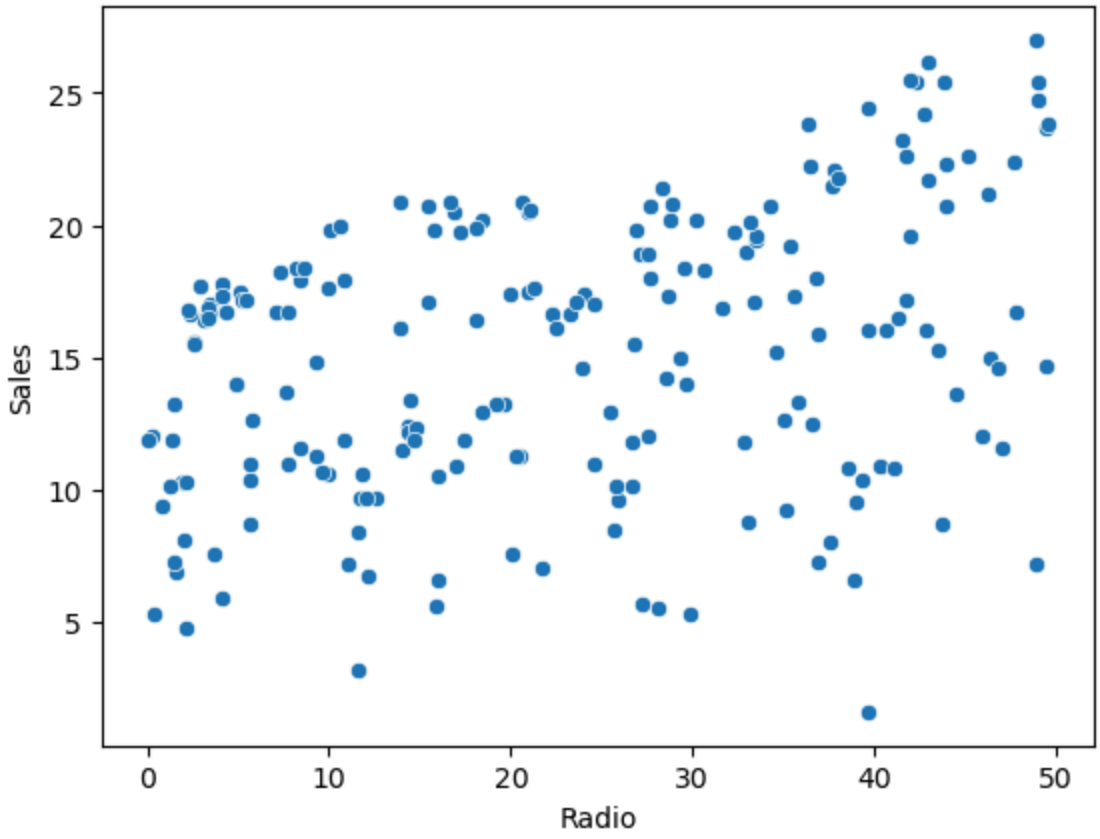
Out[7]:

	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

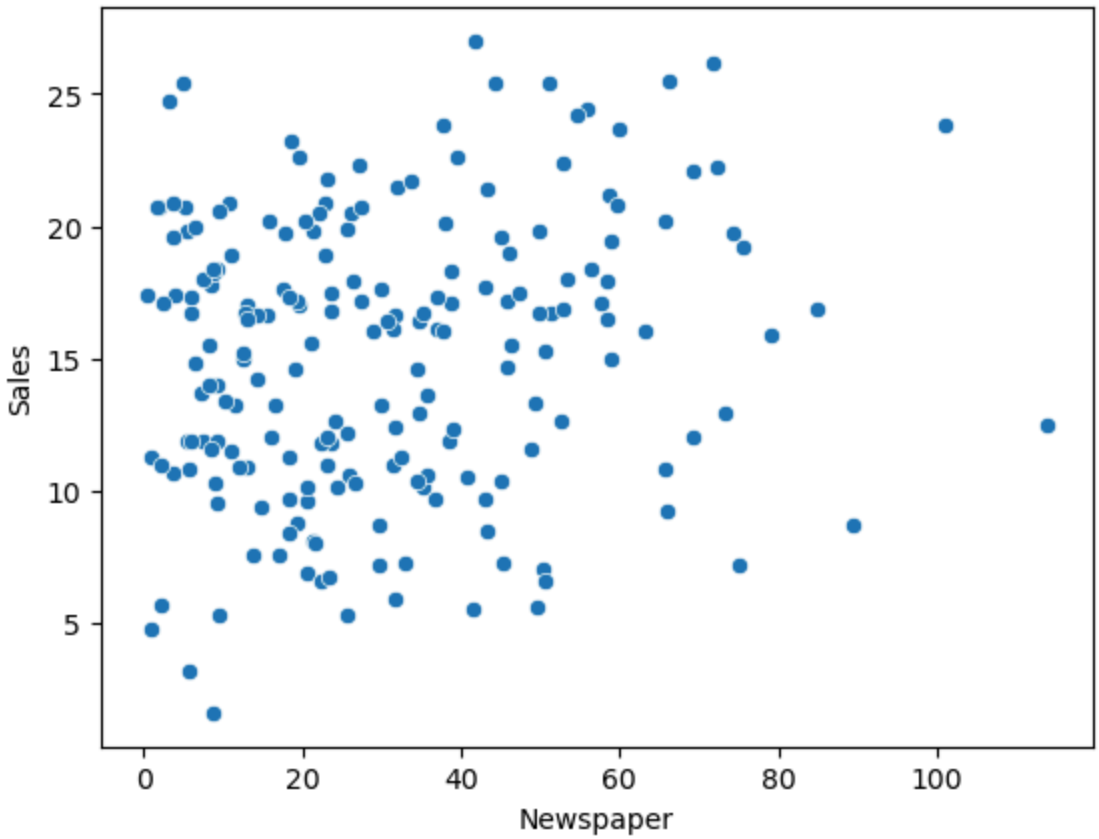
In [8]:
```
# Data Visualization:
sns.scatterplot(x=adv.TV, y=adv.Sales)
plt.show()
```



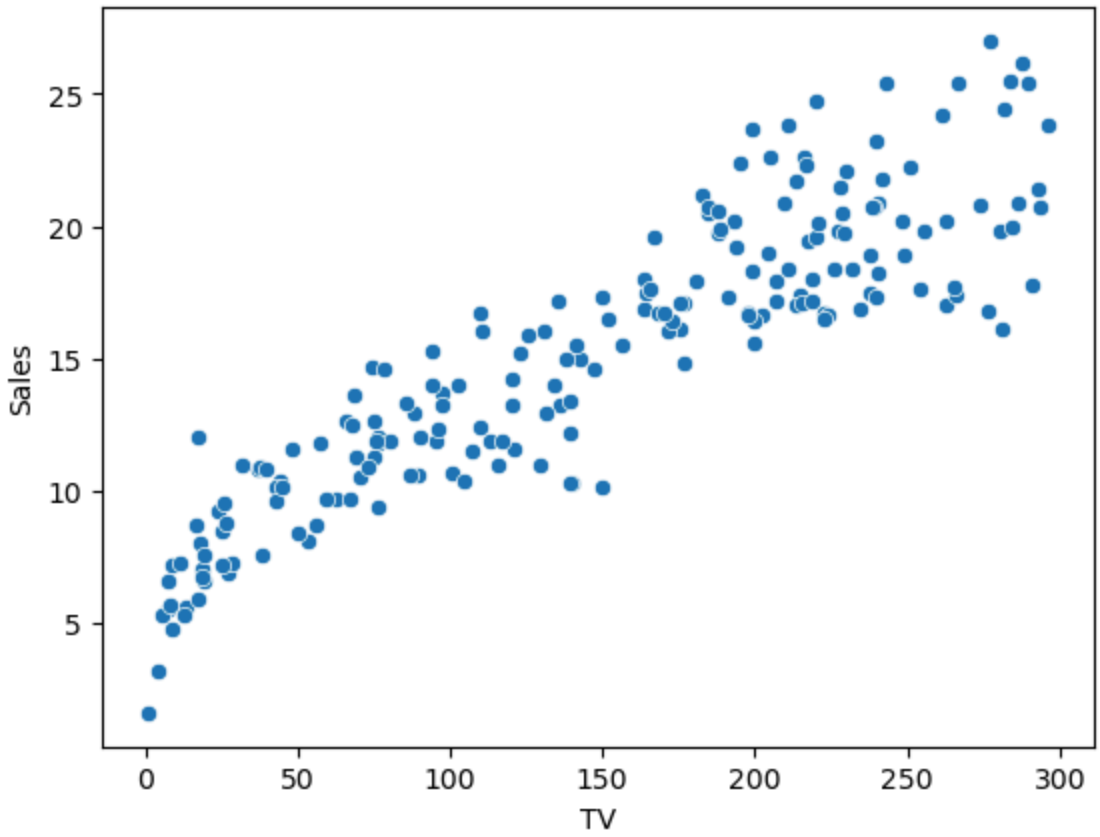
In [9]:
```
sns.scatterplot(x=adv.Radio, y=adv.Sales)
plt.show()
```

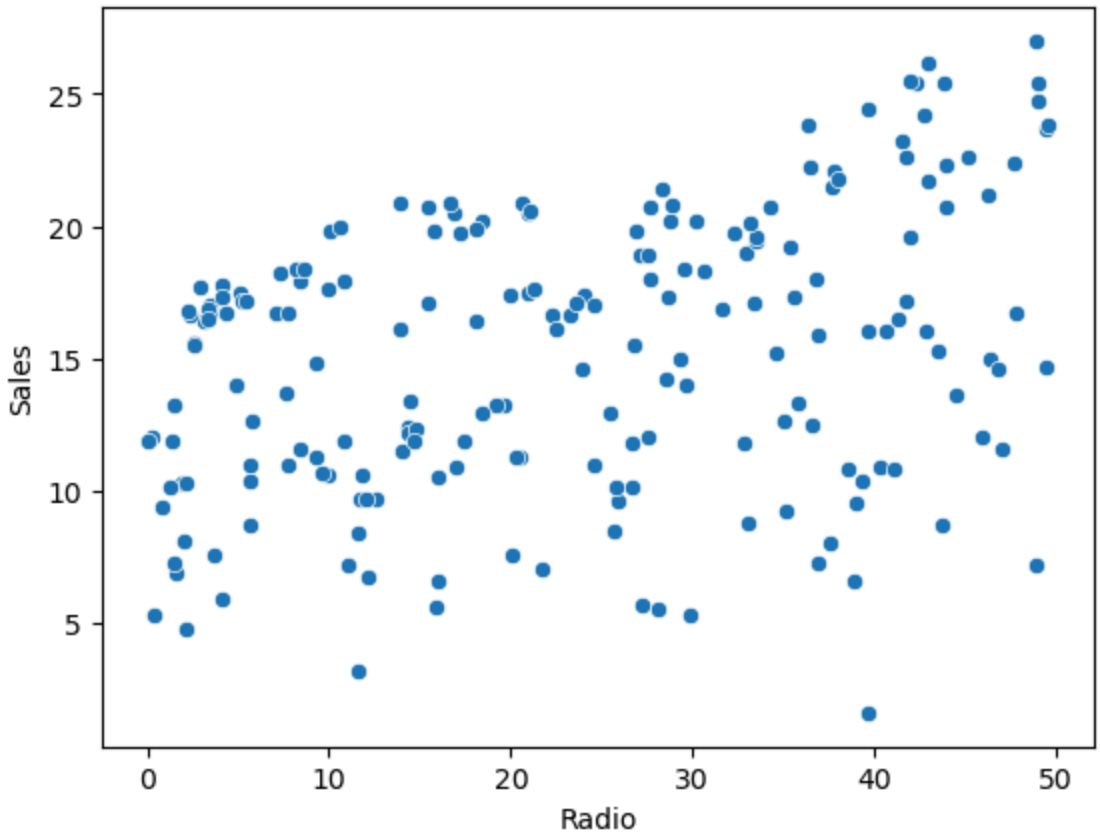


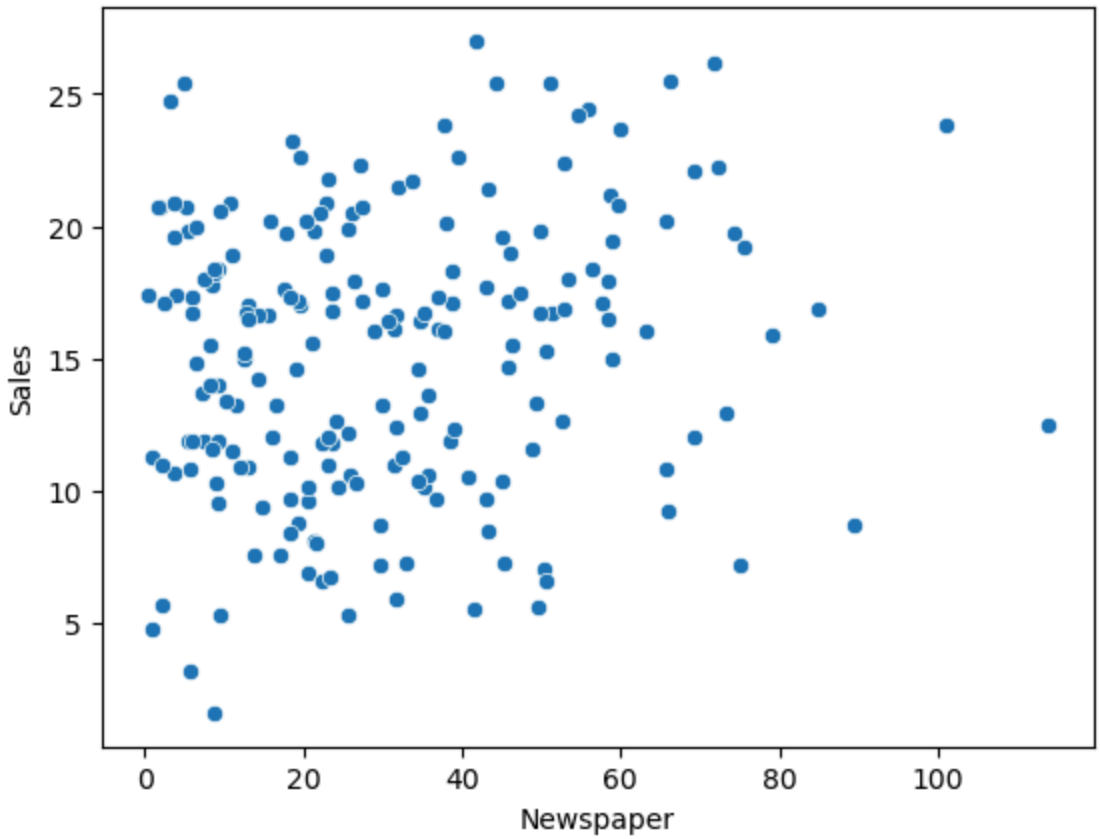
In [10]:
```
sns.scatterplot(x=adv.Newspaper, y=adv.Sales)
plt.show()
```



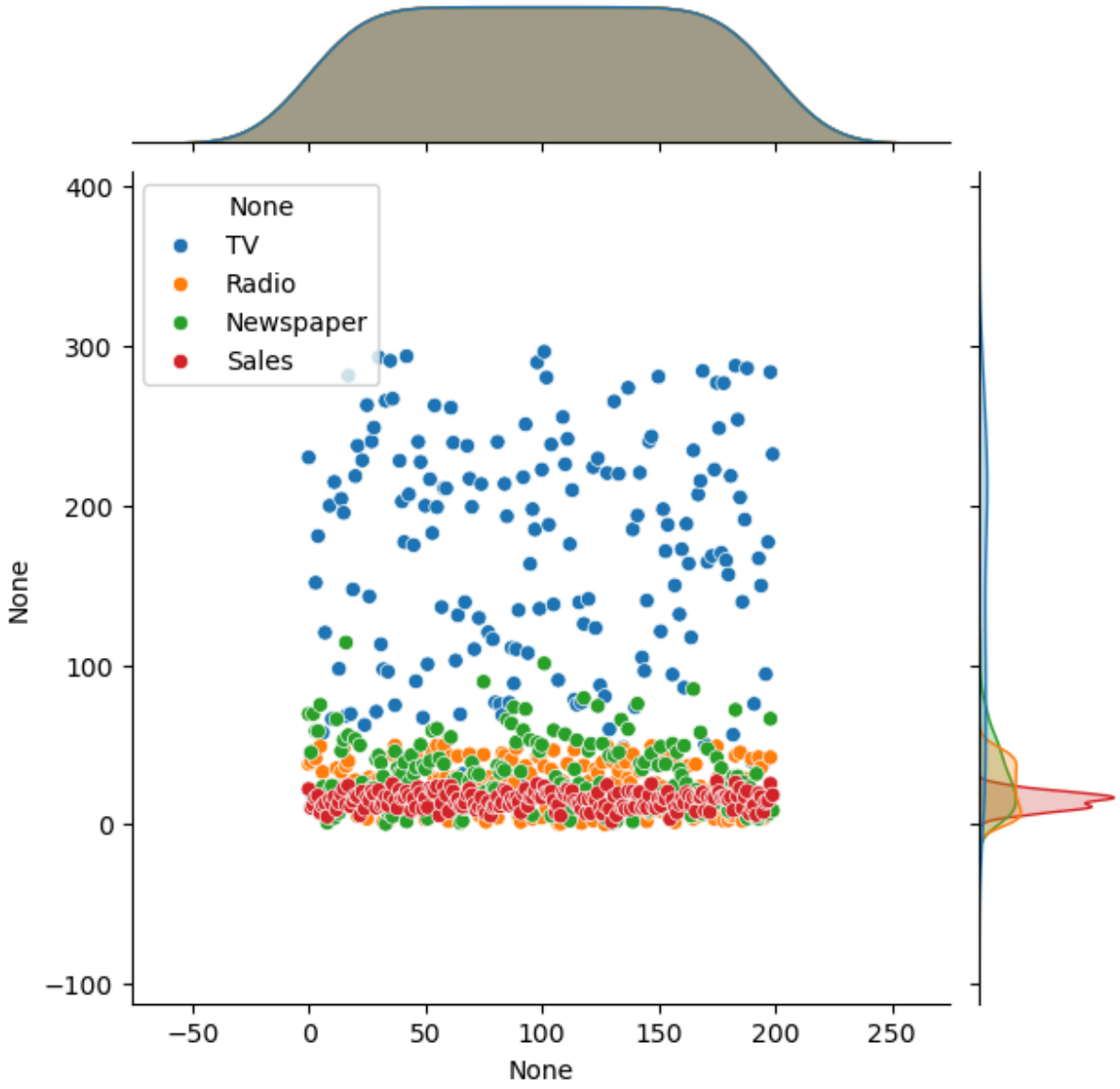
In [11]:
```
# Plotting the scatterplot for all the continuous columns at a time.
for i in ['TV','Radio','Newspaper']:
    sns.scatterplot(x=adv[i], y=adv.Sales)
    plt.show()
```


Sales
TV
0
50
100
150
200
250
300
5
10
15
20
25

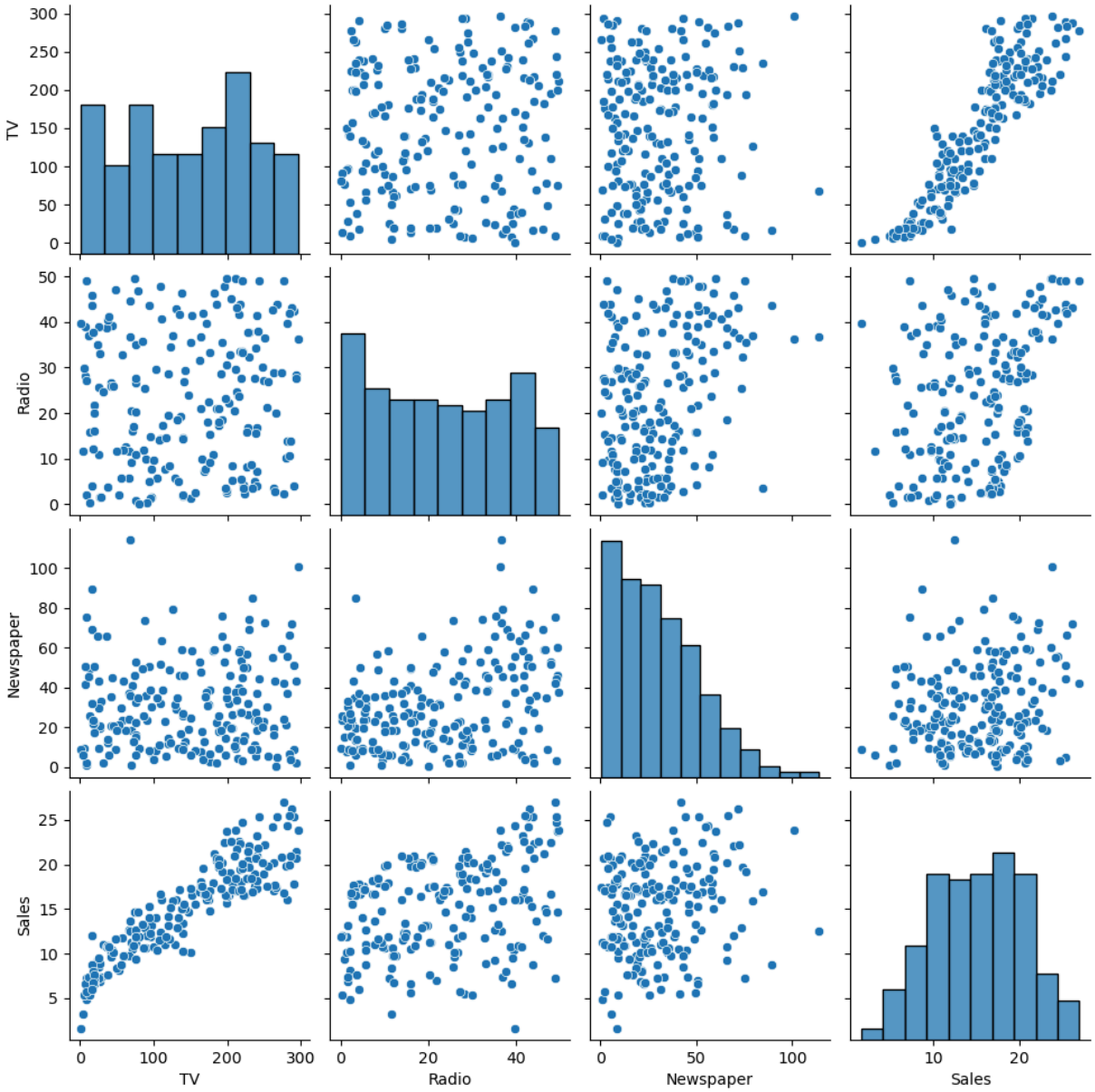

Sales
Radio
0
10
20
30
40
50
5
10
15
20
25



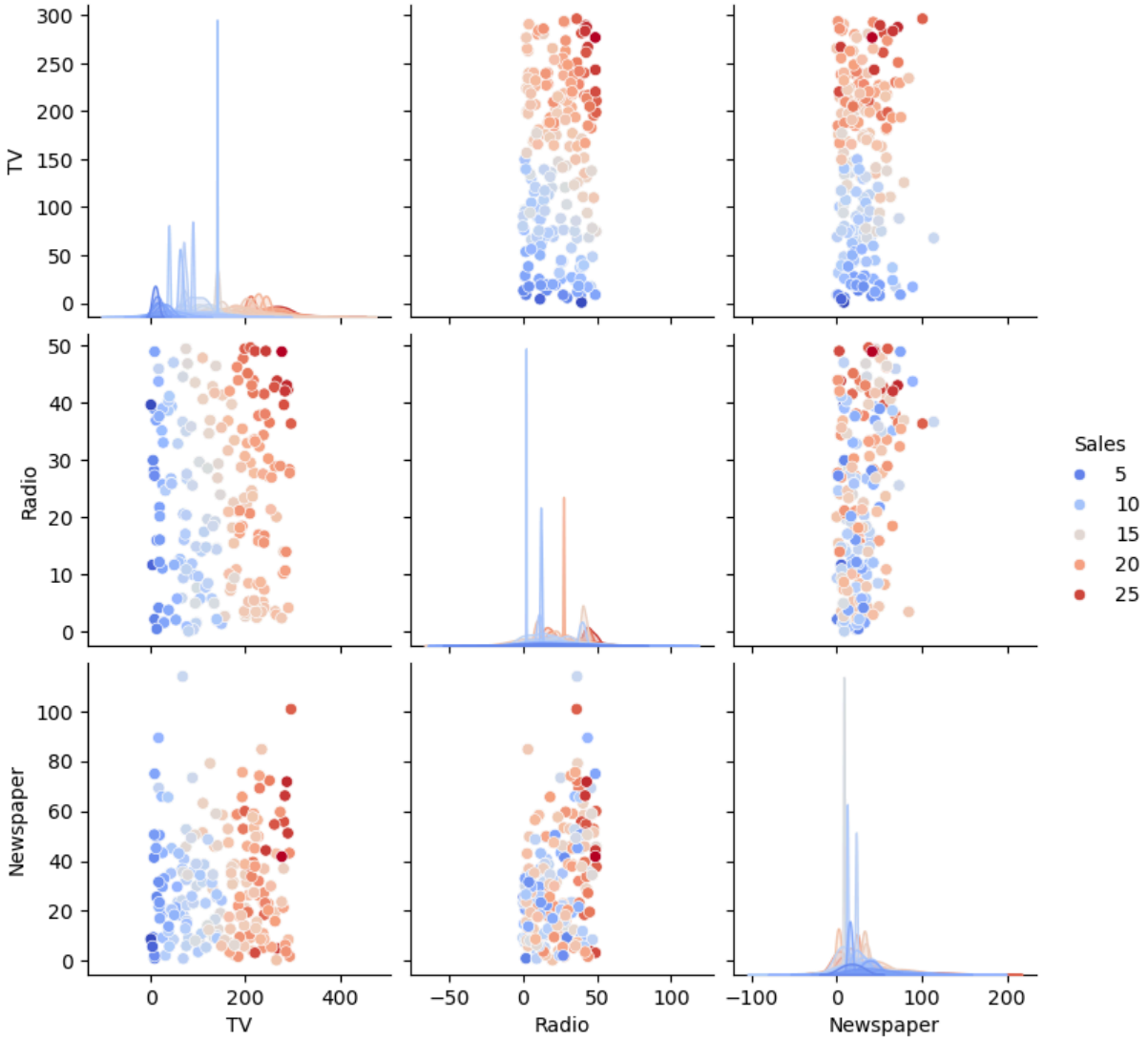
In [12]:
```
sns.jointplot(data=adv)
plt.show()
```



In [13]:
```
sns.pairplot(adv)
plt.show()
```



In [14]:
```
sns.pairplot(adv,hue='Sales',palette='coolwarm')
plt.show()
```

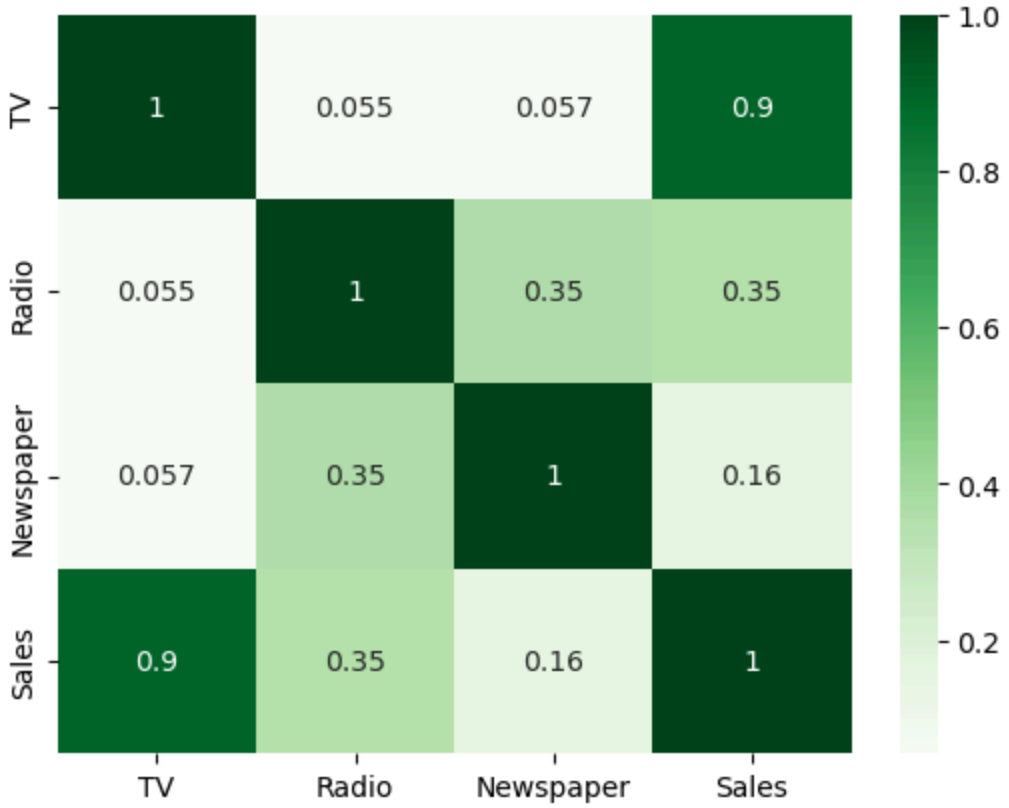


In [15]:
```
# Correlation: finds the statistical relationship between 2 varibales.
c = adv.corr()
c
```

Out[15]:

	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 [16]:
```
# plotting the correlation using heatmap:
sns.heatmap(c,annot=True,cmap='Greens')
plt.show()
```



In [17]:
```
# Encoding:- As the dataset doesnot contain any string columns therefore this step
```

In [18]:
```
# Creation of ip/op:- separating the input columns from output columns
adv
```

Out[18]:

	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 [19]:
```
# ip will store all the input columns except the target one.
ip = adv.drop('Sales',axis=1)
ip.head()
```

Out[19]:

	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 [20]:
```
op = adv.Sales
op.head()
```

Out[20]:
```
0    22.1
1    10.4
2    12.0
3    16.5
4    17.9
Name: Sales, dtype: float64
```

In [54]:
```
# Train Test Split: splitting of the 100% datas into training and testing datas.
from sklearn.model_selection import train_test_split
xtrain,xtest,ytrain,ytest = train_test_split(ip,op,test_size=0.15,random_state = 5)
```

In [55]:
```
xtrain.head()
```

Out[55]:

	TV	Radio	Newspaper
25	262.9	3.5	19.5
156	93.9	43.5	50.5
42	293.6	27.7	1.8
141	193.7	35.4	75.6
50	199.8	3.1	34.6

In [37]:
```
xtest.head()
```

Out[37]:

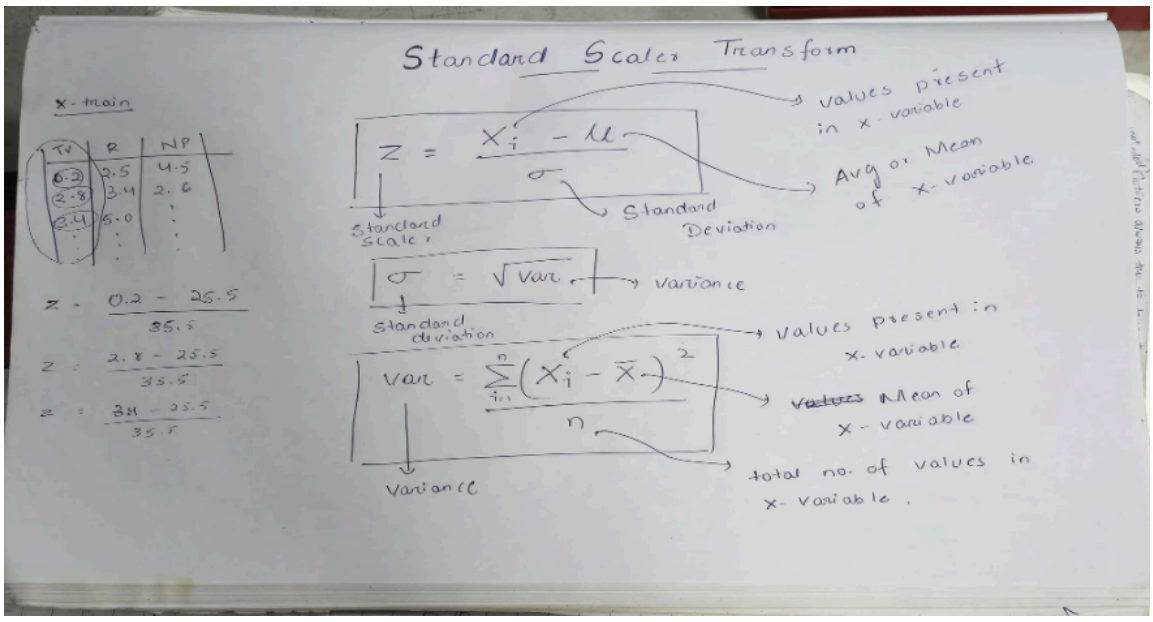
	TV	Radio	Newspaper
167	206.8	5.2	19.4
83	68.4	44.5	35.6
169	284.3	10.6	6.4
53	182.6	46.2	58.7
89	109.8	47.8	51.4

In [38]:
```
ytrain.head()
```

Out[38]:
```
124    19.7
56      5.5
82     11.3
109    19.8
105    15.0
Name: Sales, dtype: float64
```

In [39]:
```
ytest.head()
```

Out[39]:
```
167    17.2
83     13.6
169    20.0
53     21.2
89     16.7
Name: Sales, dtype: float64
```



In [40]:
```
# Stadardizing the datas using Standard Scaler Transform:
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
```

In [41]:
```
xtrain = sc.fit_transform(xtrain)
xtest = sc.fit_transform(xtest)
```

In [42]:
```
xtrain
```

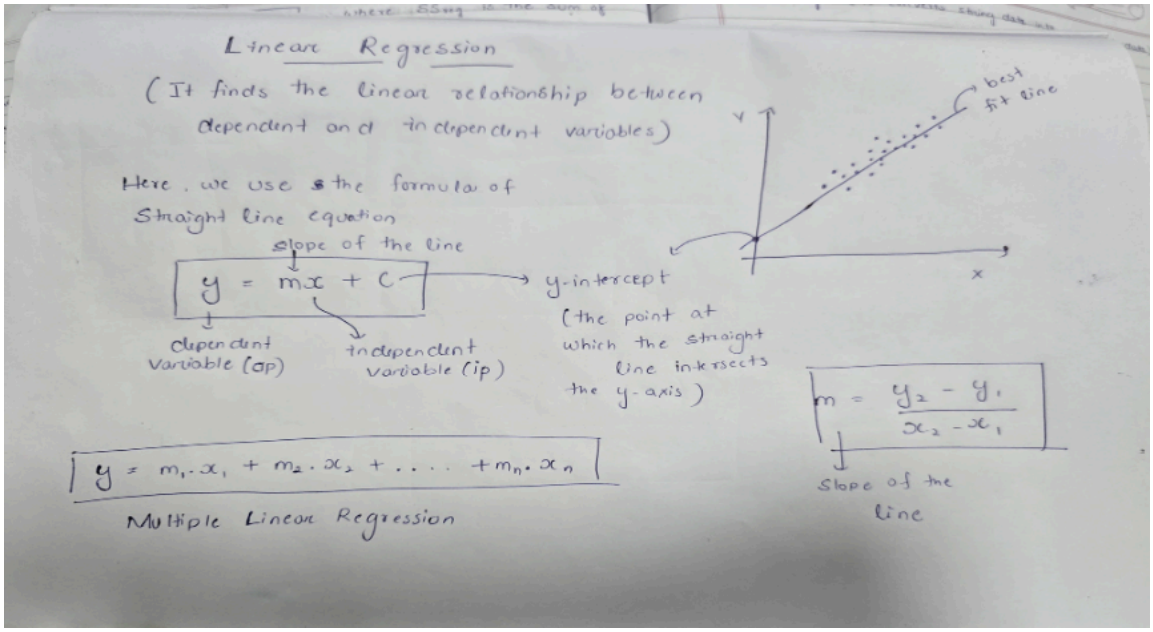
Out[42]:
```
array([[ 9.67084192e-01,  6.44367653e-01,  2.04456991e+00],
       [-1.64923057e+00,  3.60702365e-01,  5.34507019e-01],
       [-8.48558187e-01, -1.66104600e-01,  1.24764343e-01],
       [ 1.27204617e+00,  2.79655139e-01, -1.11827524e+00],
       [-1.11468609e-01,  1.59667255e+00,  1.34478467e+00],
       [ 1.02595716e+00, -1.30751969e+00,  2.53257805e+00],
       [ 6.17378754e-01, -1.36155117e+00, -3.95470740e-01],
       [ 9.40002626e-01, -4.70031694e-01,  9.25834294e-01],
       [ 1.06952316e+00,  7.79446362e-01, -1.12748294e+00],
       [-1.53266209e+00,  1.56290287e+00,  1.81898125e+00],
       [ 4.83148383e-01, -3.14691179e-01, -1.92901327e-01],
       [ 1.34151628e+00,  1.34677694e+00,  1.14681911e+00],
       [ 2.01735589e-01, -1.25580987e-01,  8.10738036e-01],
       [ 3.26546284e-01, -1.75180200e-02,  7.87258400e-02],
       [ 1.39214703e+00, -1.86366406e-01, -1.35767545e+00],
       [-1.27008865e+00,  1.23871397e+00, -1.10446369e+00],
       [ 8.37563660e-01, -1.17244098e+00, -1.10032022e-01],
       [ 8.17546850e-01,  1.42782416e+00, -1.19239723e-01],
       [-1.44082026e+00, -7.94220596e-01, -4.14346526e-03],
       [ 9.49422302e-01,  1.00908017e+00,  1.01745091e-01],
       [ 2.47656505e-01, -1.05762408e+00, -7.82194165e-01],
       [ 1.08247521e+00, -4.90293501e-01, -1.14635872e-01],
       [-7.14349893e-02,  2.72901204e-01,  7.55491833e-01],
       [ 6.17378754e-01, -1.32778150e+00,  2.21445199e-01],
       [ 9.52954680e-01, -3.95738405e-01, -1.65278225e-01],
       [ 5.91474647e-01, -1.30076575e+00, -1.09985983e+00],
       [-2.85732598e-01,  7.99708168e-01, -8.00609566e-01],
       [-5.03562585e-01, -1.15217917e+00,  2.12237498e-01],
       [-1.14645541e+00, -7.53696983e-01, -5.24378548e-01],
       [-1.43964280e+00,  1.98607914e-01,  6.21980174e-01],
       [-1.53266209e+00, -1.26024214e+00,  8.33296903e-02],
       [ 1.35800071e+00,  4.07979913e-01, -6.39474806e-01],
       [ 8.01062418e-01,  5.67752698e-02,  1.28033077e+00],
       [-1.72694289e+00,  1.13740494e+00, -9.70952027e-01],
       [ 5.65570540e-01,  1.68447371e+00,  1.06394980e+00],
       [-1.22770011e+00,  2.66147268e-01,  2.44464451e-01],
       [-1.63274614e+00,  1.76552094e+00,  2.08140072e+00],
       [-8.35606133e-01, -1.48312201e+00, -6.90117159e-01],
       [-8.50913105e-01,  8.26723910e-01,  1.05474210e+00],
       [-1.36428540e+00,  1.24314624e-01, -1.27020230e+00],
       [-5.25934314e-01,  4.62011396e-01, -9.84763577e-01],
       [-1.31485418e-01, -2.40397890e-01, -6.07247854e-01],
       [ 9.23518195e-01, -9.83330788e-01,  1.22968841e+00],
       [ 2.14687642e-01, -8.61759950e-01, -5.61209351e-01],
       [ 6.78606642e-01,  1.50887139e+00, -4.69132345e-01],
       [-6.08356471e-01, -1.44259840e+00, -1.03080208e+00],
       [ 7.00978370e-01, -9.69822917e-01, -1.56070525e-01],
       [ 1.09189489e+00, -4.09246276e-01, -3.17205285e-01],
       [-1.07345293e+00, -1.15217917e+00, -4.14346526e-03],
       [-1.84471091e-01, -2.94429373e-01,  2.21445199e-01],
       [-1.41138377e+00, -1.42909053e+00, -4.18489992e-01],
       [-1.68690927e+00, -7.53696983e-01, -1.10906754e+00],
       [-8.14411864e-01,  1.62368829e+00,  2.16841349e-01],
       [-1.28775054e+00,  1.18468249e+00, -8.23628817e-01],
       [-8.46203268e-01, -8.07728466e-01, -1.09525598e+00],
       [ 3.93661470e-01, -8.07728466e-01,  1.31716157e+00],
```

```
[-9.36867641e-01,  9.34786877e-01,  3.87690233e+00],
[-1.21121568e+00,  1.11714313e+00,  7.04849480e-01],
[ 7.92820203e-01,  8.37910115e-02, -1.18733299e+00],
[-1.63392360e+00, -1.39532085e+00, -1.32544850e+00],
[ 7.45721827e-01,  4.55257461e-01, -9.43328925e-01],
[ 4.41937305e-01,  1.42782416e+00, -1.29322155e+00],
[ 1.18962402e+00,  5.02535009e-01, -4.36905393e-01],
[-5.53015880e-01, -8.88775692e-01, -1.20574839e+00],
[-7.08440519e-01, -7.40189112e-01, -1.79089776e-01],
[-3.10459245e-01, -9.69822917e-01,  8.70588090e-01],
[ 9.74148949e-01,  1.01583410e+00,  1.81437740e+00],
[-8.55622943e-01,  1.79929061e+00,  7.32472581e-01],
[ 7.32769774e-01, -1.45842793e-01, -8.78875021e-01],
[-4.05833456e-01, -3.61968727e-01,  4.05599211e-01],
[ 8.12837012e-01,  1.27923758e+00,  4.51637714e-01],
[-1.63627852e+00,  2.99916946e-01, -1.27480615e+00],
[-1.43260012e-01,  1.27923758e+00,  7.41680282e-01],
[ 1.09189489e+00, -1.04411621e+00, -9.70952027e-01],
[-1.28539562e+00, -1.28725788e+00, -7.36155662e-01],
[ 5.45553731e-01,  8.53739652e-01,  2.10902382e+00],
[-1.53857147e-01, -1.20621066e+00, -9.43328925e-01],
[ 6.06781619e-01,  1.79929061e+00,  1.39082317e+00],
[ 1.72183566e+00,  3.33686623e-01, -1.28861770e+00],
[ 1.08716297e-01, -1.36155117e+00, -9.89367428e-01],
[-1.59742236e+00,  9.55048683e-01,  7.09453330e-01],
[ 2.74715994e-02,  8.67247523e-01, -1.09525598e+00],
[ 1.71359345e+00,  3.74210235e-01,  6.17376324e-01],
[-1.10524433e+00, -1.40207479e+00, -3.86263040e-01],
[ 1.36035563e+00, -1.30076575e+00, -4.73736195e-01],
[ 2.95932340e-01, -3.14691179e-01,  4.18950377e-02],
[ 1.08836251e+00, -1.26024214e+00,  3.27333756e-01],
[-9.22738128e-01, -9.09037498e-01, -1.33005235e+00],
[-3.55202702e-01, -5.44324984e-01, -1.12287909e+00],
[-6.26018362e-01, -1.20621066e+00, -9.98575128e-01],
[-3.16346542e-01,  3.87718106e-01, -7.17740261e-01],
[-1.43375550e+00,  1.09688133e+00, -9.43328925e-01],
[ 1.68768934e+00, -1.26024214e+00, -9.80159727e-01],
[ 1.11073424e+00,  1.02934197e+00, -3.03393734e-01],
[ 1.08953997e+00,  1.26572971e+00, -5.19774698e-01],
[-1.22887757e+00,  2.12115785e-01, -4.27697692e-01],
[-1.16647222e+00,  1.63719616e+00, -9.80159727e-01],
[-1.50440307e+00, -1.79612471e-01, -5.88832452e-01],
[-9.49841771e-02, -5.57832855e-01, -9.01894272e-01],
[-8.35606133e-01,  2.66147268e-01, -3.44828387e-01],
[ 2.86490588e-02, -1.44935233e+00, -2.52751381e-01],
[-2.55118654e-01,  9.55048683e-01,  2.27476243e+00],
[-1.00162791e+00, -6.86157629e-01, -5.28982399e-01],
[ 4.41937305e-01, -1.18827052e-01, -3.58639938e-01],
[-9.56884450e-01, -1.14542524e+00, -2.57355231e-01],
[ 8.52870632e-01,  7.25414878e-01,  7.04849480e-01],
[ 1.67591474e+00,  1.31976120e+00,  9.85684348e-01],
[ 1.38743719e+00, -1.34128937e+00,  6.08168624e-01],
[-1.64334327e+00,  1.09012739e+00,  9.58061246e-01],
[ 2.68850774e-01, -1.01034653e+00,  2.49068301e-01],
[ 1.56994340e+00, -5.98356468e-01,  3.31937606e-01],
[ 1.52519994e+00,  1.76552094e+00,  5.52922420e-01],
```

```
       [-9.26292584e-02, -1.39532085e+00, -1.46862824e-01],
       [-1.51382274e+00, -7.15495036e-02,  9.48853545e-01],
       [-1.39843172e+00, -1.43584446e+00,  1.47783594e-01],
       [-5.25956391e-02,  4.41749590e-01, -7.91401865e-01],
       [ 2.81802828e-01,  1.14415888e+00,  3.64164558e-01],
       [ 9.97698137e-01, -9.56315046e-01, -9.70952027e-01],
       [-7.90862676e-01, -1.53715349e+00, -9.47932775e-01],
       [-1.30070259e+00,  1.06986559e+00,  1.64863879e+00],
       [ 1.06010348e+00,  3.20178752e-01, -8.65063470e-01],
       [-1.58093793e+00, -1.51013775e+00, -1.92901327e-01],
       [ 7.78690690e-01,  1.36703875e+00,  1.84614397e-01],
       [ 6.09136538e-01,  5.29550751e-01,  4.10203061e-01],
       [ 1.56405610e+00, -8.55006015e-01, -3.86263040e-01],
       [-1.51500020e+00, -7.19927306e-01, -2.94186034e-01],
       [-6.79004034e-01, -8.68513885e-01,  2.72087552e-01],
       [ 1.21906050e+00,  9.28032941e-01,  1.95709676e+00],
       [-1.57976047e+00, -4.63277759e-01,  9.12022743e-01],
       [ 9.02323926e-01, -1.37505904e+00, -6.53286356e-01],
       [ 1.75480452e+00,  9.14525071e-01,  3.27379794e+00],
       [-7.26102410e-01,  8.80755393e-01,  8.98211192e-01],
       [-4.70593722e-01, -5.91602532e-01, -8.69667320e-01],
       [ 5.14939787e-01,  4.01225977e-01, -5.33586249e-01],
       [ 1.65118810e+00,  1.36703875e+00,  1.93407751e+00],
       [-3.19878921e-01, -2.13382148e-01, -8.37440368e-01],
       [-5.87162202e-01, -1.02385440e+00, -1.04000978e+00],
       [ 5.39666434e-01, -2.94429373e-01,  1.65324264e+00],
       [-6.29550740e-01,  1.40080842e+00,  9.53457396e-01],
       [ 2.28817155e-01,  1.29949939e+00, -1.20574839e+00],
       [ 1.25320682e+00, -9.85652453e-02,  9.66808561e-03],
       [-9.03898778e-01, -4.56523824e-01,  5.06883917e-01],
       [-7.87425967e-04,  7.70370761e-02, -4.92151596e-01],
       [-1.05814596e+00,  6.78137330e-01, -2.89582183e-01],
       [ 5.91474647e-01,  3.65134635e-02, -7.17740261e-01],
       [ 7.77513231e-01,  1.24314624e-01, -7.68382614e-01],
       [ 4.86658684e-02,  1.25222184e+00,  1.32176542e+00],
       [ 7.46899286e-01,  1.81279848e+00,  3.64164558e-01],
       [ 6.49170157e-01, -3.10258909e-02,  8.33296903e-02],
       [-8.32095832e-02, -1.40882872e+00, -9.57140476e-01],
       [ 1.48752124e+00,  4.14733848e-01,  1.37701162e+00],
       [-5.90694580e-01, -1.43584446e+00,  9.66808561e-03],
       [ 4.77261086e-01, -3.75476598e-01, -5.47397800e-01],
       [-8.36783593e-01,  3.20178752e-01, -6.34870955e-01],
       [ 8.36386200e-01,  3.33686623e-01,  1.08696905e+00],
       [ 4.76083627e-01, -1.12073116e-01, -9.34121224e-01],
       [ 1.89960995e-01,  9.48294748e-01, -1.03080208e+00],
       [-3.69332215e-01, -1.01710047e+00, -3.07997585e-01],
       [ 1.12839613e+00,  1.77227487e+00,  6.68018677e-01],
       [ 8.83484576e-01, -1.30751969e+00, -7.68382614e-01]])
```

In [43]:
```
xtest
```

Out[43]:
```
array([[ 0.69056448, -1.37075383, -0.6619611 ],
       [-0.87481303,  1.31171227,  0.0927025 ],
       [ 1.56713064, -1.0021707 , -1.26755536],
       [ 0.41684963,  1.4277477 ,  1.16879691],
       [-0.40655704,  1.53695752,  0.82873244],
       [ 0.84325665,  1.61886488, -1.41662471],
       [-0.89177883, -0.92708895,  0.14860351],
       [-0.97434571, -0.90661211,  0.4420838 ],
       [-0.18487063, -1.33662576, -0.10760944],
       [-0.07402743, -0.749623  , -0.37313923],
       [-0.16564273,  1.19567684, -0.21941146],
       [ 0.81384927,  0.56089479,  1.18277216],
       [ 1.58635855, -0.77692546, -1.39333262],
       [ 0.35351065,  0.55406917,  0.23711344],
       [ 1.48117061, -1.56869662, -0.46164916],
       [-1.45730539,  1.25710736,  2.59893103],
       [-0.40655704, -0.749623  , -0.08897577],
       [ 0.33880696, -0.67454125, -1.45389205],
       [-0.39637756,  1.04551335,  1.37842569],
       [ 1.55921327,  1.14107194,  1.51817821],
       [ 0.35351065, -1.09090368, -1.26755536],
       [-1.14287262,  0.03532255, -0.60606009],
       [-1.5873765 ,  0.3151727 , -1.12780284],
       [-0.86576461, -0.32643497, -0.71320369],
       [ 1.3703274 ,  1.26393298, -1.3327732 ],
       [ 1.03666673, -1.37757944, -0.47096599],
       [ 1.16560679,  0.12405553, -0.4989165 ],
       [ 1.5343301 ,  0.97725721,  1.03370281],
       [-1.37926272,  0.6701046 ,  1.50420296],
       [ 0.86700877, -1.43218435,  0.75419777],
       [-0.62598135, -1.70520889, -0.48494124],
       [-0.56038027, -0.71549493,  0.24643028],
       [ 0.84551876,  0.54041795,  0.1998461 ],
       [ 0.19855637,  0.43120813,  0.8986087 ],
       [-1.42902906, -0.63358757, -0.526867  ],
       [-0.81826038, -0.56533144, -0.96475823],
       [-1.34533113,  0.52676672, -0.66661952],
       [-1.44599486,  0.84074494, -0.55947592],
       [ 0.66002605,  0.51994111,  0.57717791],
       [-0.64973346,  0.01484571,  1.85358426]])
```



In [44]:
```
# ML Algorithm:
from sklearn.linear_model import LinearRegression
lr = LinearRegression()
```

In [45]:
```
lr.fit(xtrain,ytrain)
```

Out[45]:
```
LinearRegression()
```

In [46]:
```
# Prediction using testing datas:
pred = lr.predict(xtest)
pred
```

Out[46]:
```
array([16.21375041, 13.07305678, 20.80573612, 19.23335092, 15.59141155,
       21.43673599,  9.60048754,  9.2566498 , 12.23666993, 13.63292997,
       16.16363508, 19.75128128, 21.23344345, 17.59630996, 19.56677706,
       10.35463546, 12.1041476 , 15.62942503, 14.90464767, 24.07846796,
       15.06974993,  9.88528382,  8.24712093, 10.61334999, 23.33287492,
       17.80484703, 20.67680631, 23.70495488,  9.80147872, 16.96482411,
        9.63377765, 11.45301753, 19.84566215, 16.70874248,  7.55171926,
       10.46497914,  9.6949092 ,  9.70875028, 18.96643154, 12.18217054])
```

To find the accuracy of the model we need to find the MSE (Mwean Squared Error) and r2Score.

In [47]:
```
# to find the MSE:
from sklearn.metrics import mean_squared_error
error = mean_squared_error(pred,ytest)
error
```

Out[47]:
```
1.6817270605441905
```

In [48]:
```
# r2Score:- finds the accuracy of the model.
from sklearn.metrics import r2_score
acc = r2_score(pred,ytest)
acc
```

Out[48]:
```
0.9255606971704308
```

To plot the Best fit line:

lmplot: stands for linear model plot

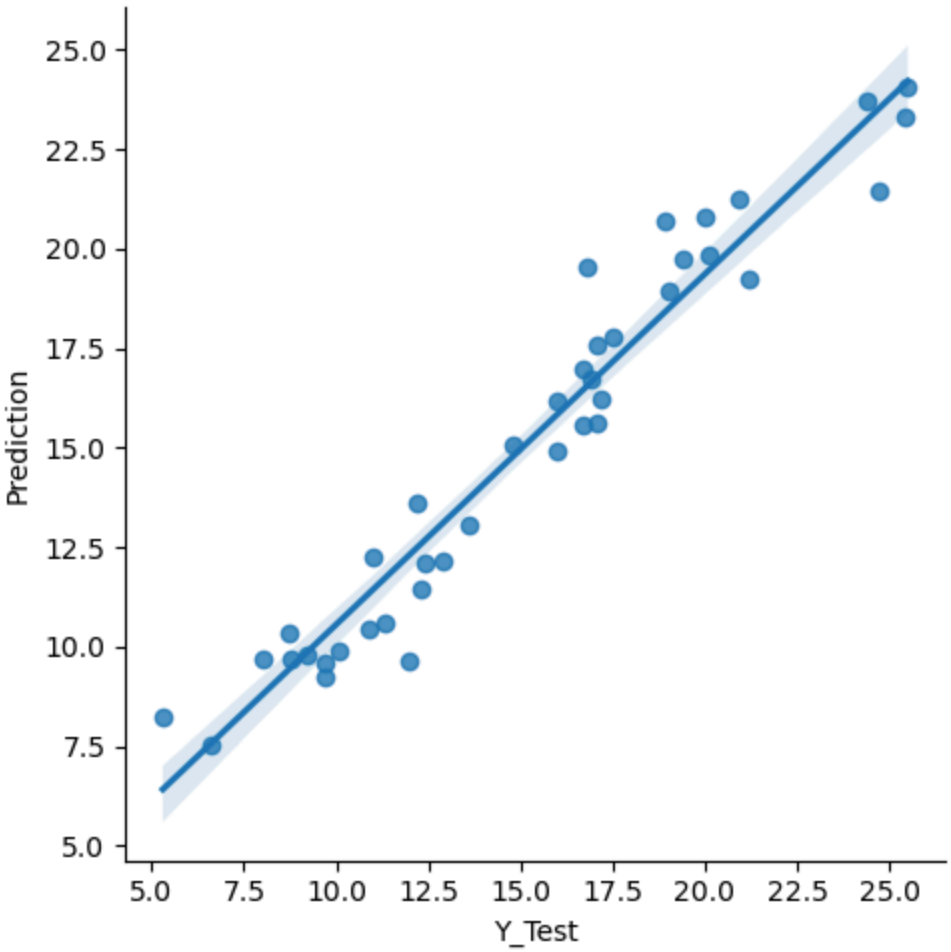
In [51]:
```
df = pd.DataFrame({'Y_Test':list(ytest),
                   'Prediction':list(pred)})
df
```

Out[51]:

	Y_Test	Prediction
0	17.2	16.213750
1	13.6	13.073057
2	20.0	20.805736
3	21.2	19.233351
4	16.7	15.591412
5	24.7	21.436736
6	9.7	9.600488
7	9.7	9.256650
8	11.0	12.236670
9	12.2	13.632930
10	16.0	16.163635
11	19.4	19.751281
12	20.9	21.233443
13	17.1	17.596310
14	16.8	19.566777
15	8.7	10.354635
16	12.4	12.104148
17	17.1	15.629425
18	16.0	14.904648
19	25.5	24.078468
20	14.8	15.069750
21	10.1	9.885284
22	5.3	8.247121
23	11.3	10.613350
24	25.4	23.332875
25	17.5	17.804847
26	18.9	20.676806
27	24.4	23.704955
28	9.2	9.801479
29	16.7	16.964824

	Y_Test	Prediction
30	12.0	9.633778
31	12.3	11.453018
32	20.1	19.845662
33	16.9	16.708742
34	6.6	7.551719
35	10.9	10.464979
36	8.8	9.694909
37	8.0	9.708750
38	19.0	18.966432
39	12.9	12.182171

In [52]:
```
# to plot the best fit line:
sns.lmplot(x='Y_Test',y='Prediction',data=df)
plt.show()
```



Classification Model:-

The nature of the output column/dependent column should be categorical.
Eg: (0/1), (True/False), (Male/Female) etc.

In [56]:
```
# Data Reading:-
main = pd.read_csv(r"C:\Users\lab25\Downloads\maintenance_data (1).csv")
main
```

Out[56]:

	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 [57]:
```
# Data Cleaning:
main.isnull().sum()
```

Out[57]:
```
lifetime          0
broken            0
pressureInd       0
moistureInd       0
temperatureInd    0
team              0
provider          0
dtype: int64
```

In [58]:
```
main.dtypes
```

Out[58]:
```
lifetime            int64
broken              int64
pressureInd       float64
moistureInd       float64
temperatureInd    float64
team               object
provider           object
dtype: object
```

In [59]:
```
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
 119.204381   107.7859931   90.67123432  66.63788383 107.8373588
 113.2726053   85.33137798  82.52821911  90.63682861 112.60533
  78.66593081  70.10171881  99.12691885 129.8155876  129.3586686
  86.43068027 127.6432644   95.24539906  83.49423659  96.21961865
  79.1113931  106.8671887  111.2558114   96.12034618  86.10751429
 108.4133588  100.2518501  117.9043996  121.6736792   60.23306632
  94.23091985  74.48747426  92.453609   112.047415   125.0326918
  96.00878453 109.6711377  154.9245853  105.7582145   93.35727589
  99.96158153  95.92226826 111.7239334   97.9282765  128.7277348
 133.1077066  126.7058619  150.6956895   80.01967528  74.57754143
 140.9858744   35.76360199  91.60822135 103.7075508  111.8094367
 124.8601041  112.7364301  102.194994   128.3172975   94.01171684
  91.39931729 102.7097196   77.4666105  143.8647421   93.91140451
 122.8634385  120.0742901   65.11291145  75.99730079  90.59983598
  85.97976393 111.6690617   86.99664346  93.62245547 143.8612427
  64.28565742  97.53345121  77.83610485  95.78219396  80.16096302
 114.6298749   82.67022466 101.1211088   85.4702501  129.5853061
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 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']
```

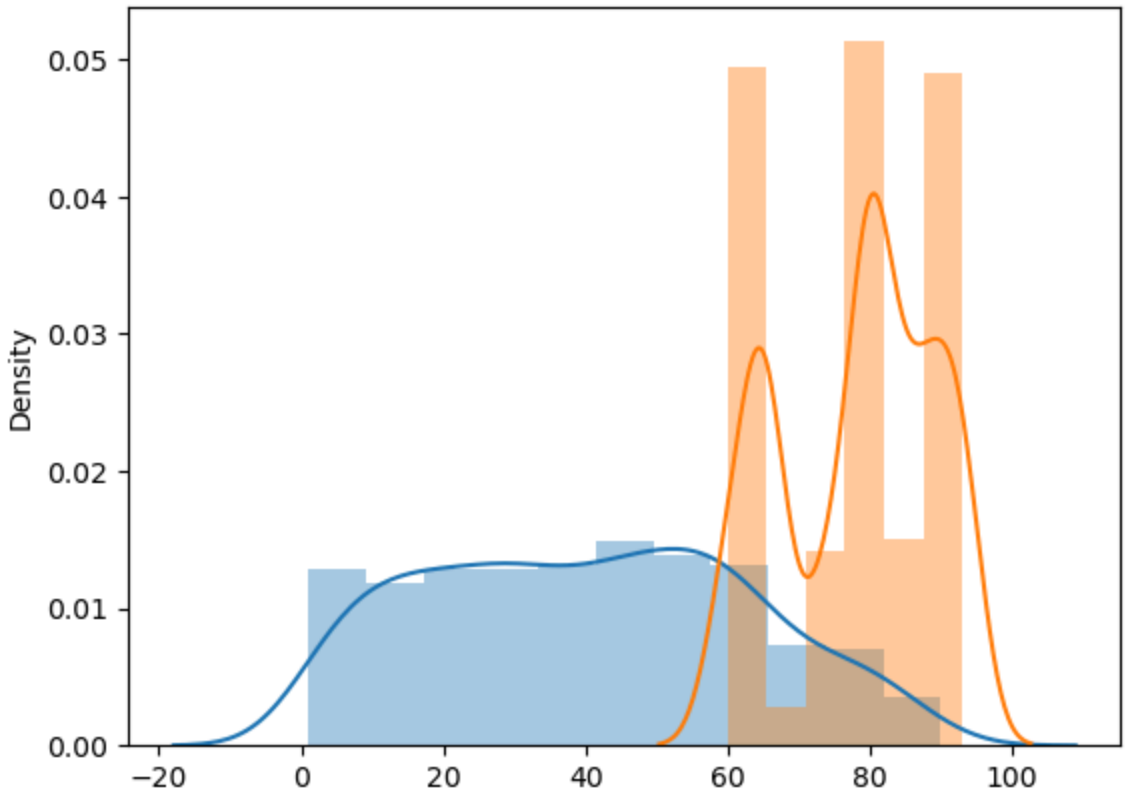
In [60]:
```
main.describe(include='all')
```

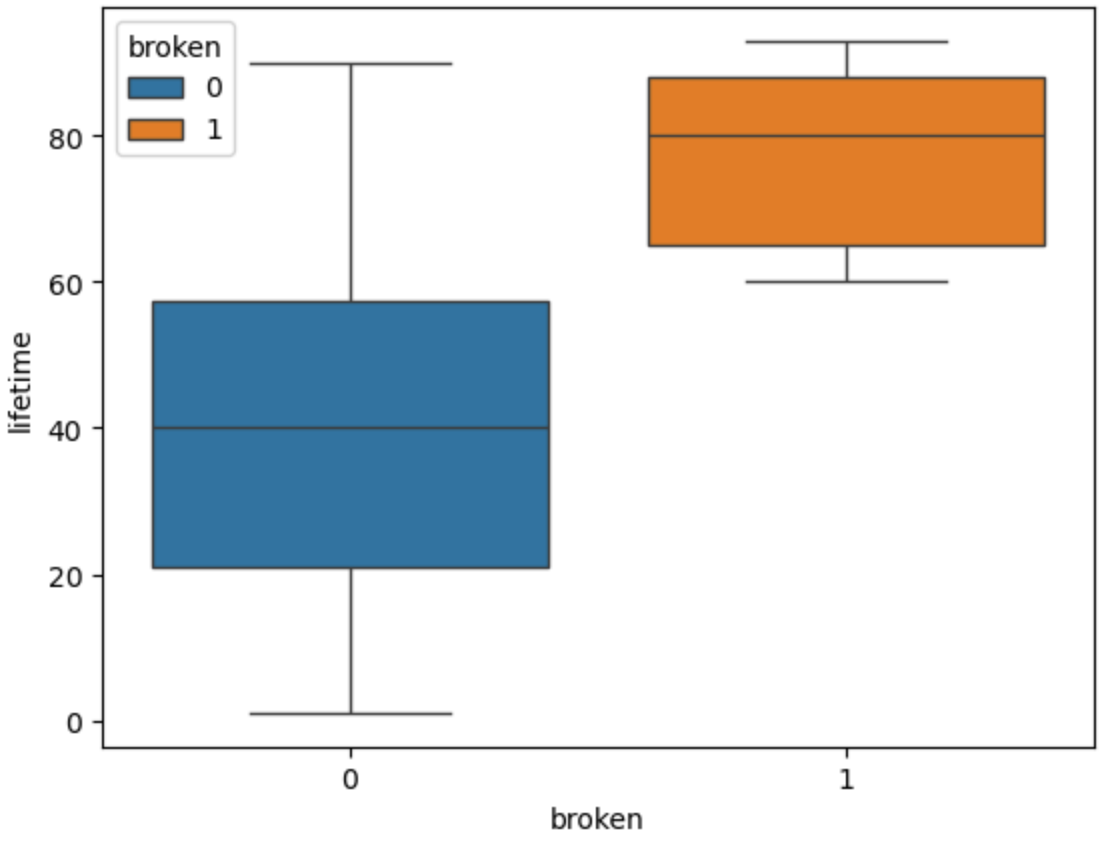
Out[60]:

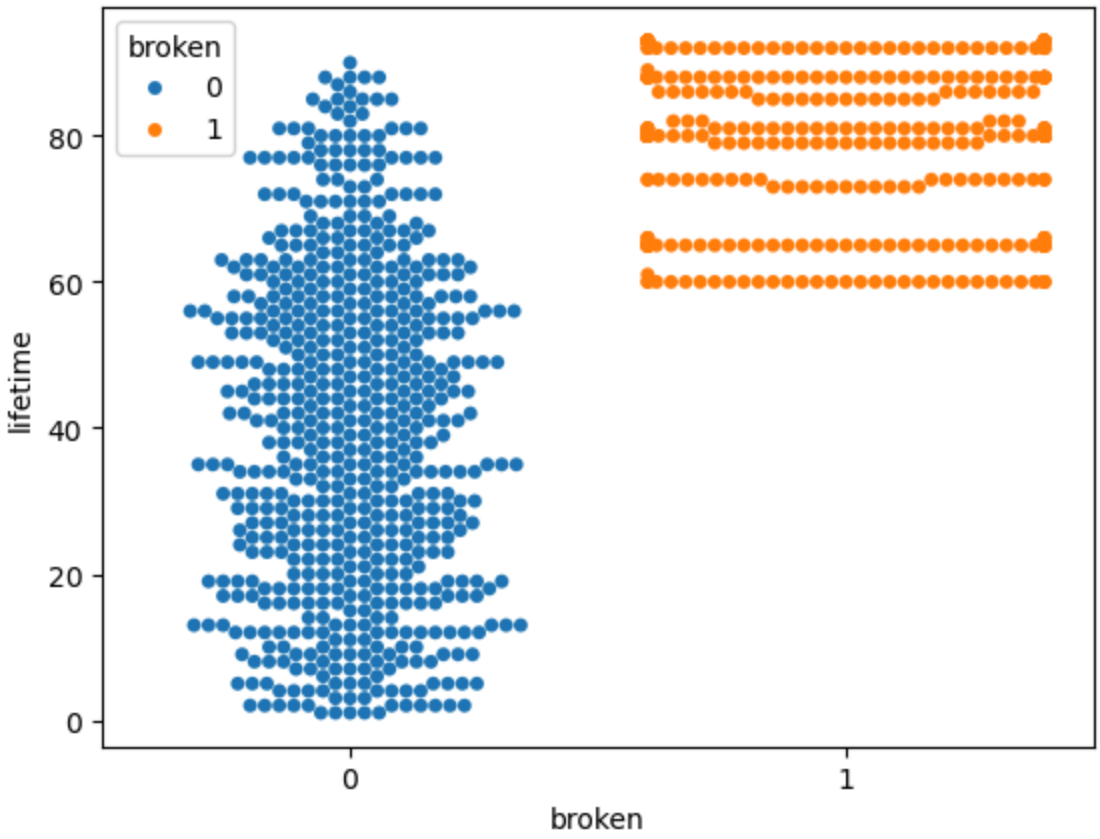
	lifetime	broken	pressureInd	moistureInd	temperatureInd	team	prov
count	1000.000000	1000.000000	1000.000000	1000.000000	1000.000000	1000	1
unique	NaN	NaN	NaN	NaN	NaN	3	
top	NaN	NaN	NaN	NaN	NaN	TeamB	Provi
freq	NaN	NaN	NaN	NaN	NaN	356	
mean	55.195000	0.397000	98.599338	99.376723	100.628541	NaN	I
std	26.472737	0.489521	19.964052	9.988726	19.633060	NaN	I
min	1.000000	0.000000	33.481917	58.547301	42.279598	NaN	I
25%	34.000000	0.000000	85.558076	92.771764	87.676913	NaN	I
50%	60.000000	0.000000	97.216997	99.433959	100.592277	NaN	I
75%	80.000000	1.000000	112.253190	106.120762	113.662885	NaN	I
max	93.000000	1.000000	173.282541	128.595038	172.544140	NaN	I

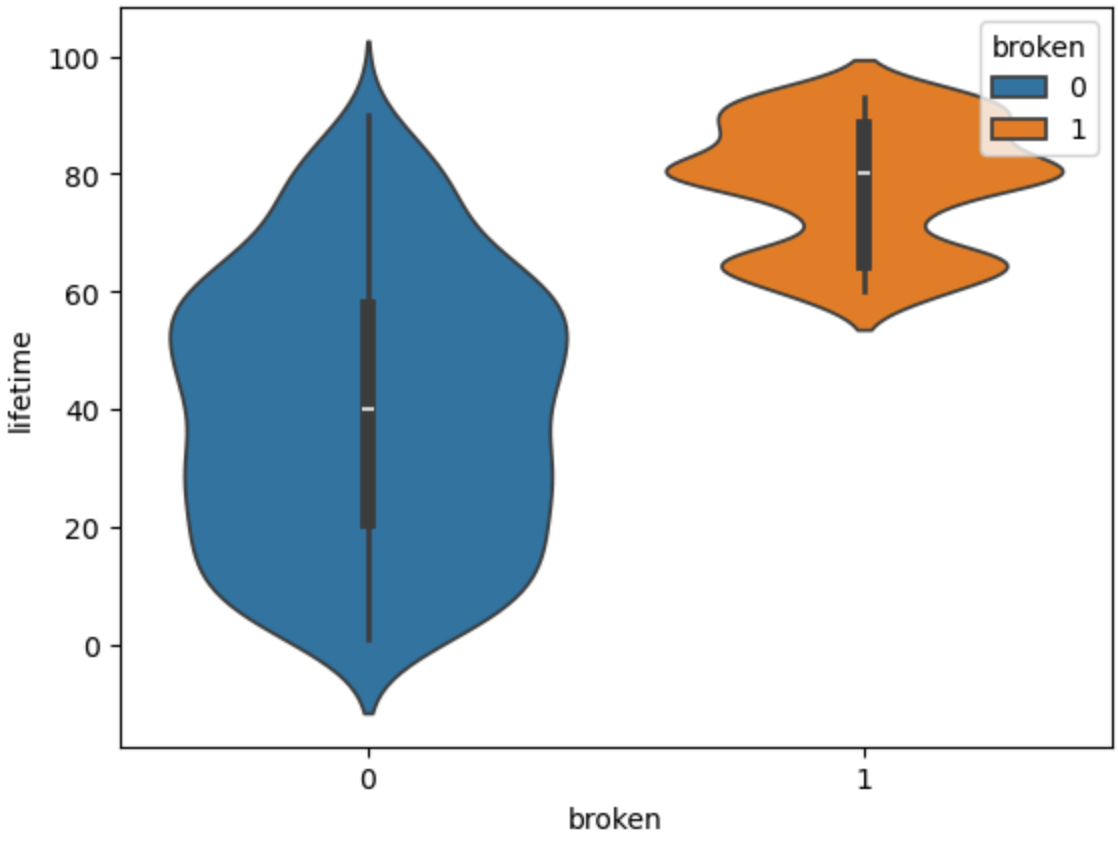
In [61]:
```
#Data Visualization or EDA
import warnings
warnings.filterwarnings('ignore')
```

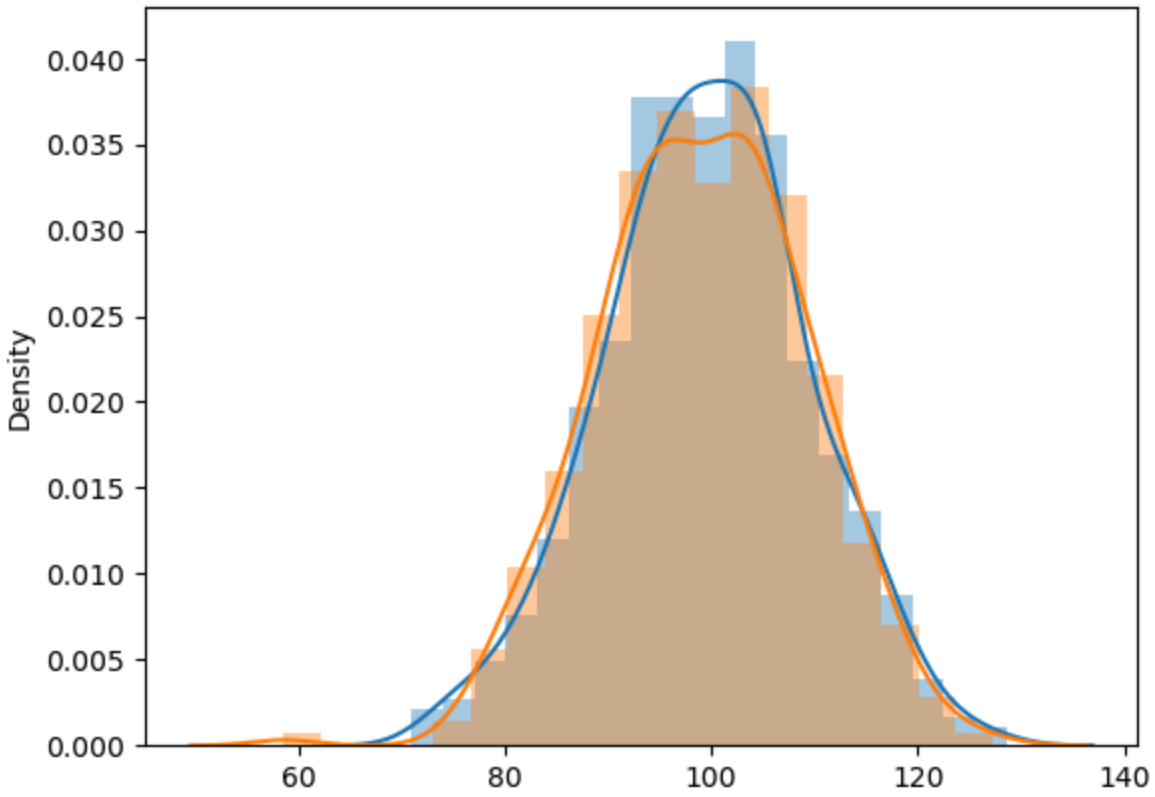
In [63]:
```
for i in ['lifetime','moistureInd','pressureInd','temperatureInd']:
    #distplot
    sns.distplot(x=main[i][main.broken==0])
    sns.distplot(x=main[i][main.broken==1])
    plt.show()

    #boxplot
    sns.boxplot(x=main.broken,y=main[i],hue=main.broken)
    plt.show()

    #swarmplot
    sns.swarmplot(x=main.broken,y=main[i],hue=main.broken)
    plt.show()

    #violinplot
    sns.violinplot(x=main.broken,y=main[i],hue=main.broken)
    plt.show()
```

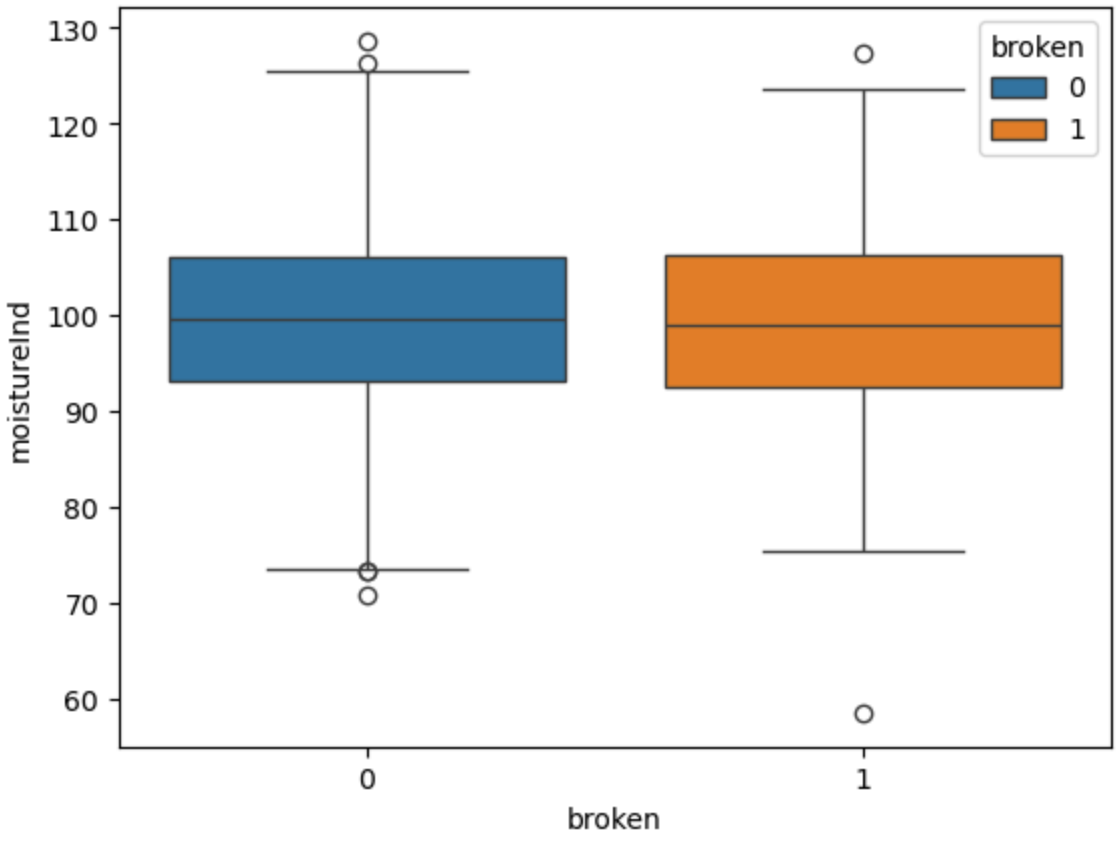

0.05
0.04
0.03
0.02
0.01
0.00
Density
−20
0
20
40
60
80
100

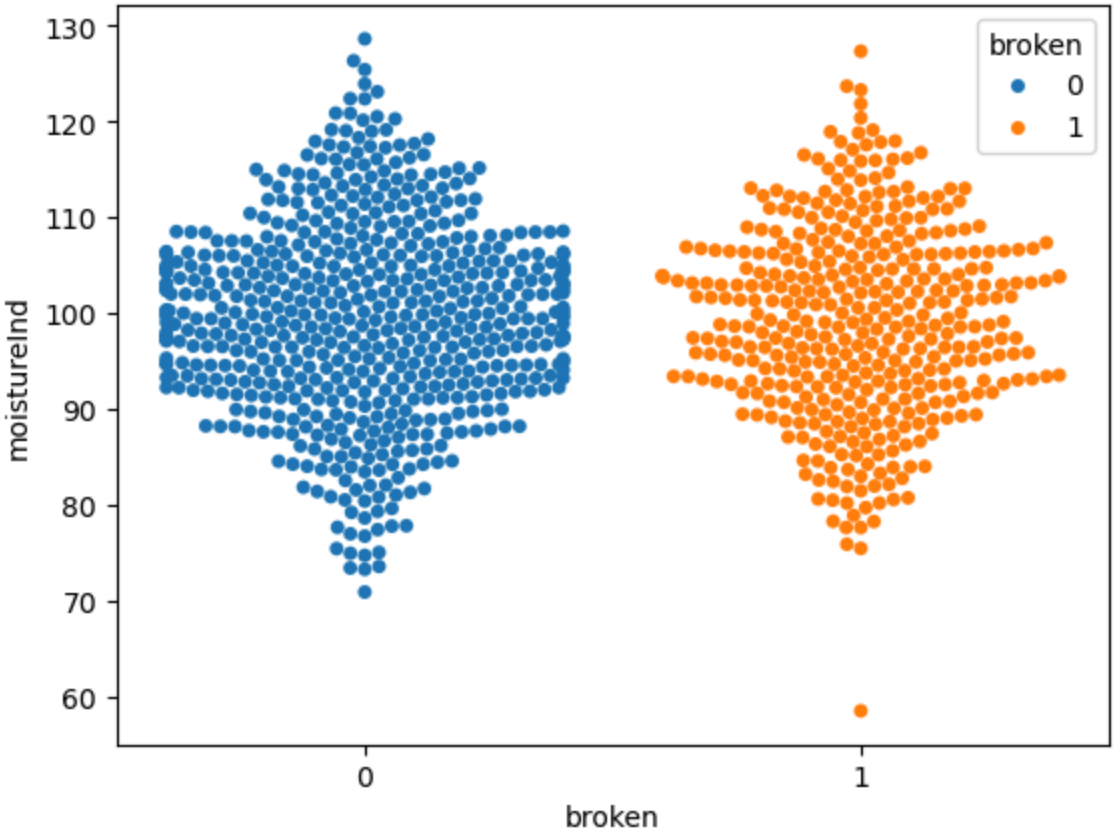

broken
0
1
80
60
40
20
0
lifetime
0
1
broken

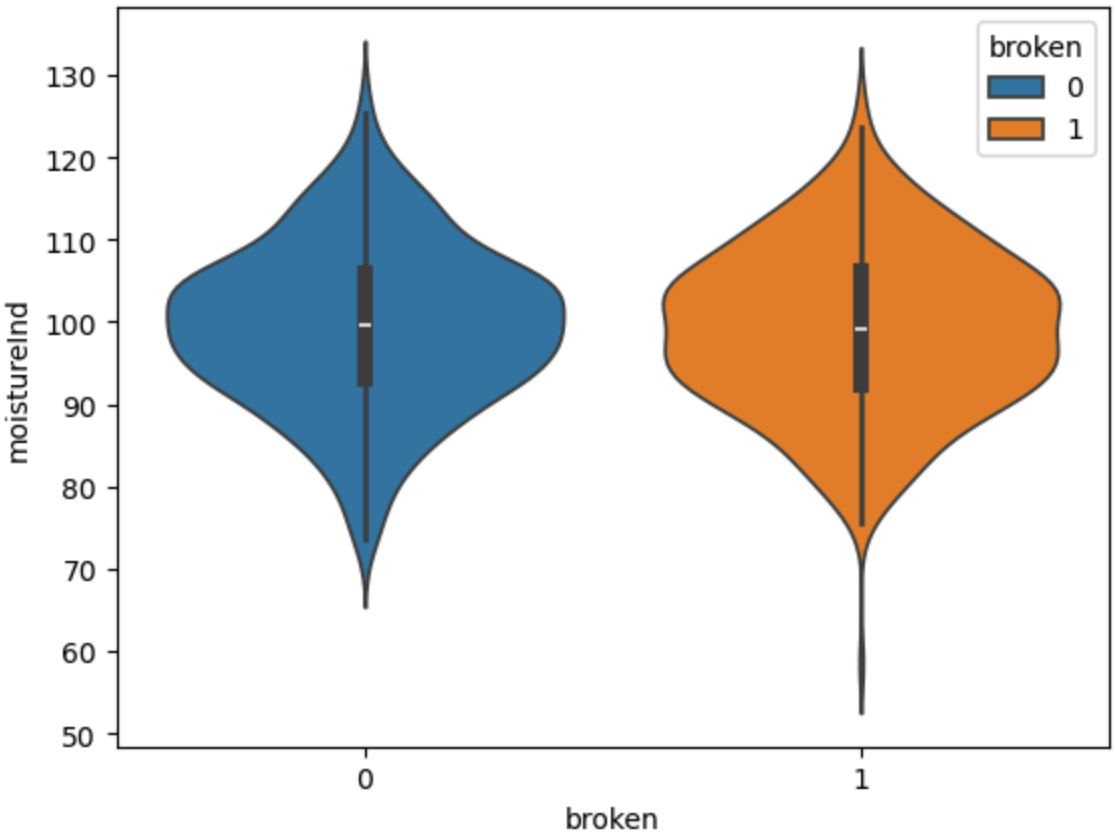

broken
0
1
lifetime
0
20
40
60
80
0
1
broken

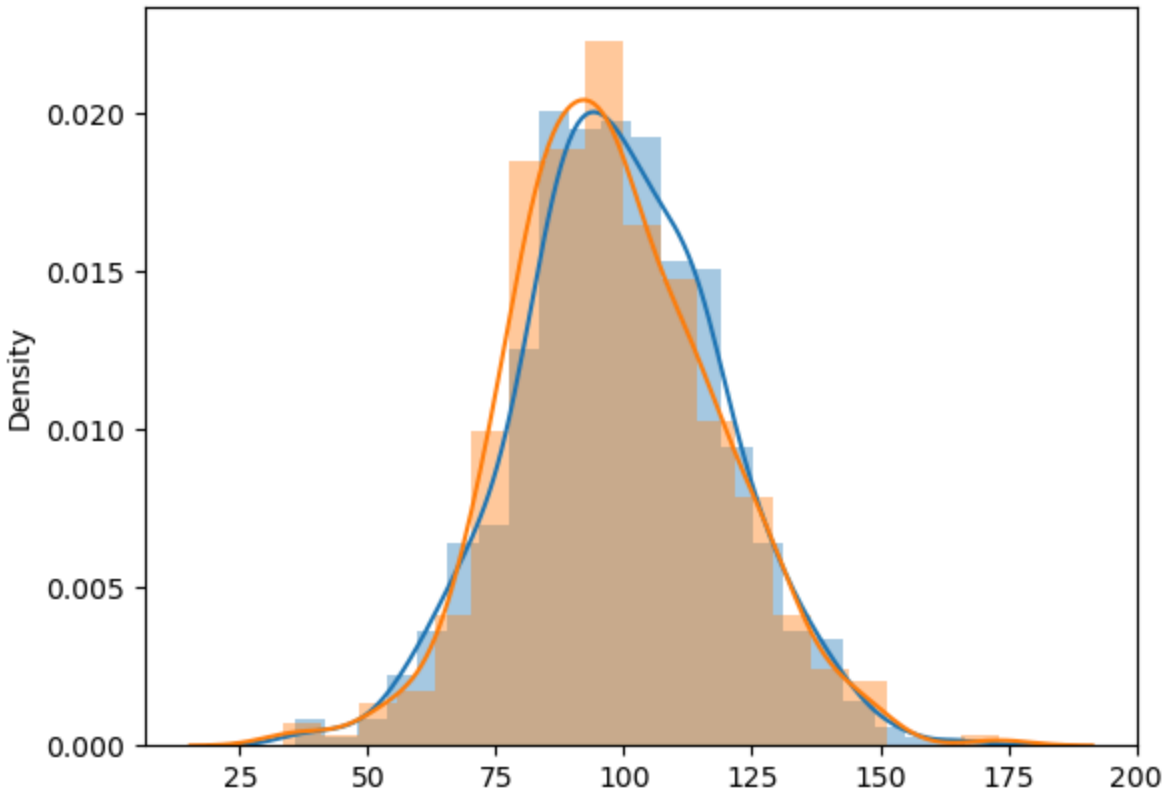

broken
0
1
lifetime
0
20
40
60
80
100
0
1
broken

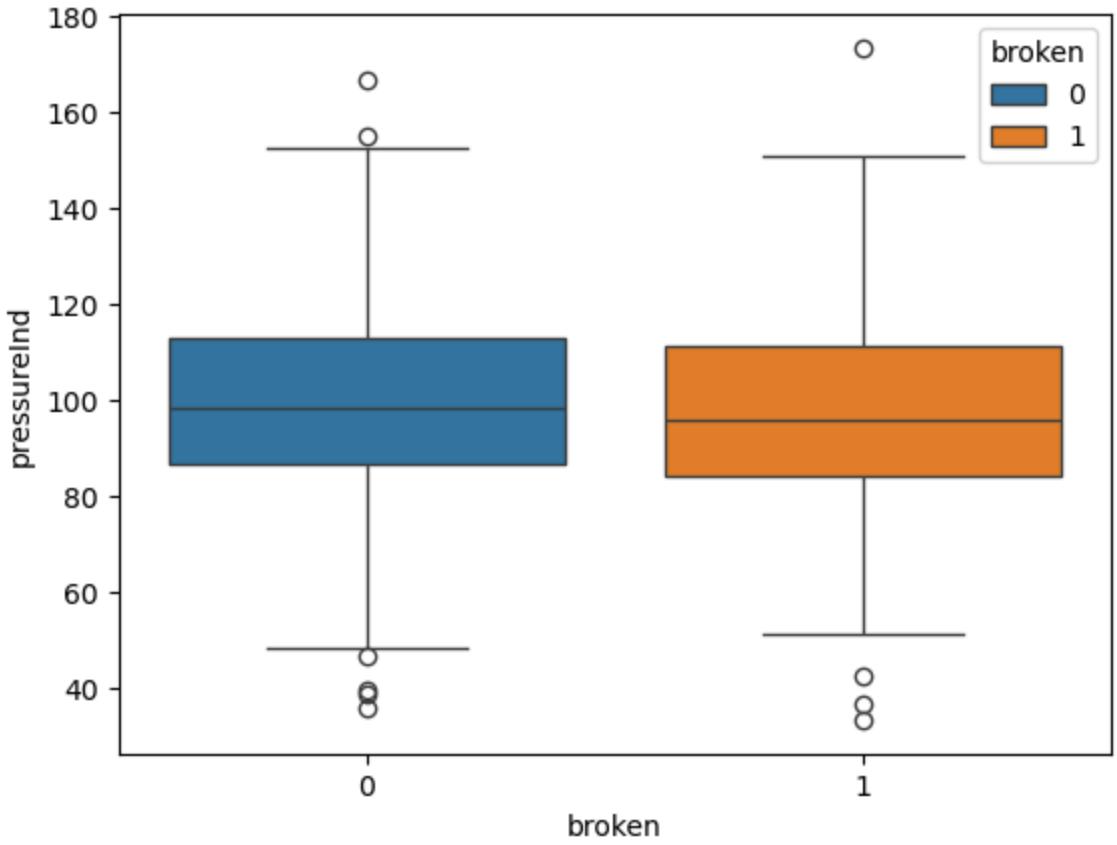

0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
Density
60
80
100
120
140

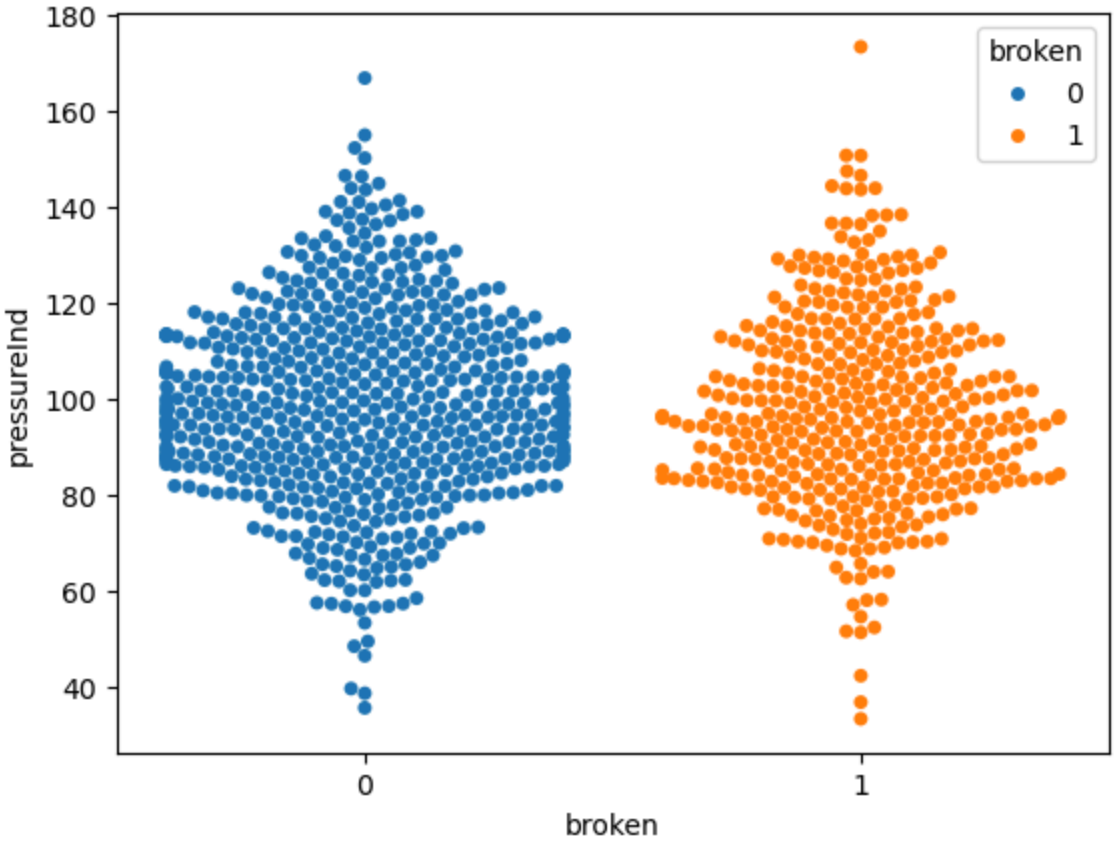

130
120
110
100
90
80
70
60
moistureInd
broken
0
1
0
1
broken

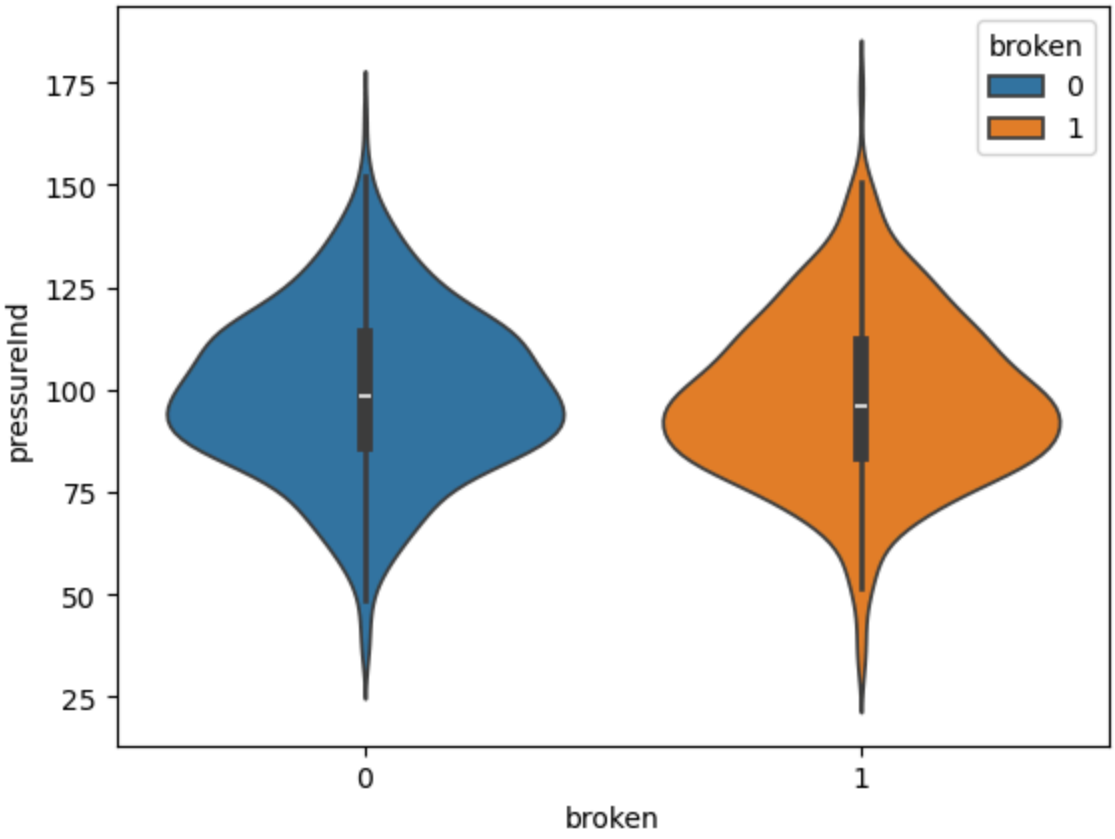

broken
0
1
moistureInd
130
120
110
100
90
80
70
60
0
1
broken

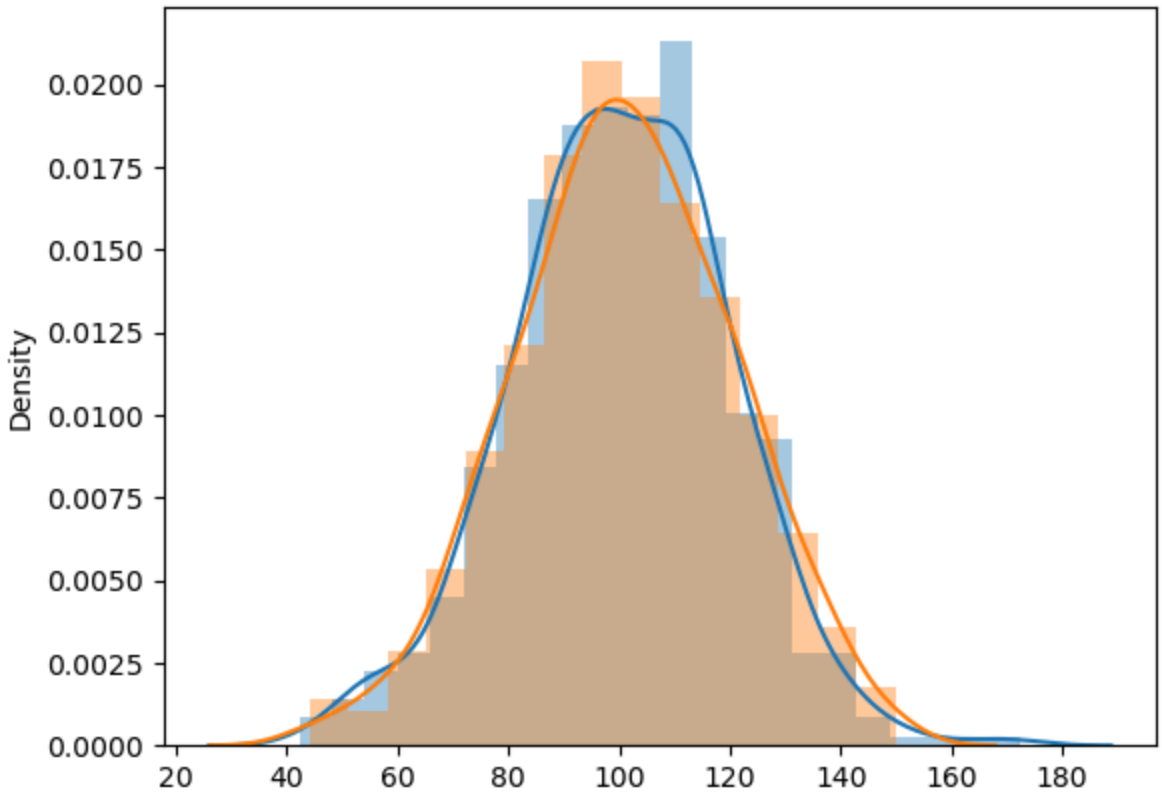

broken
0
1
moistureInd
130
120
110
100
90
80
70
60
50
0
1
broken

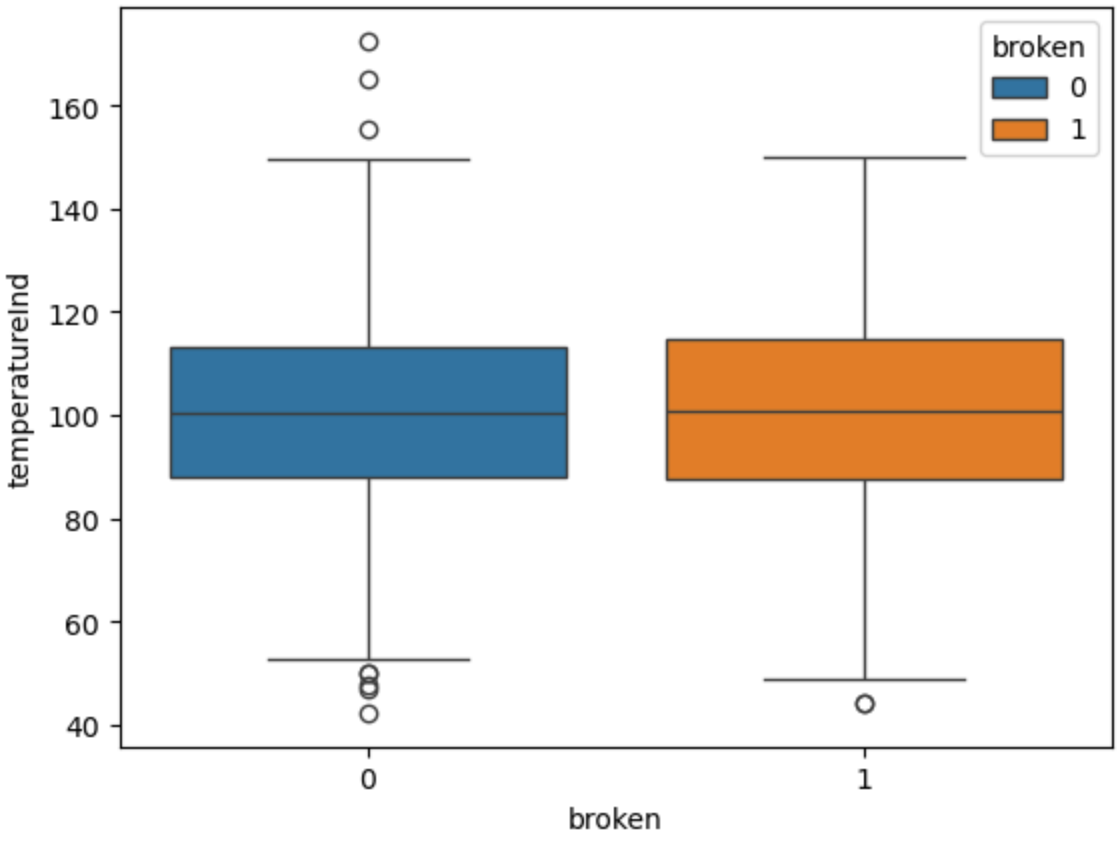

Density
0.020
0.015
0.010
0.005
0.000
25
50
75
100
125
150
175
200

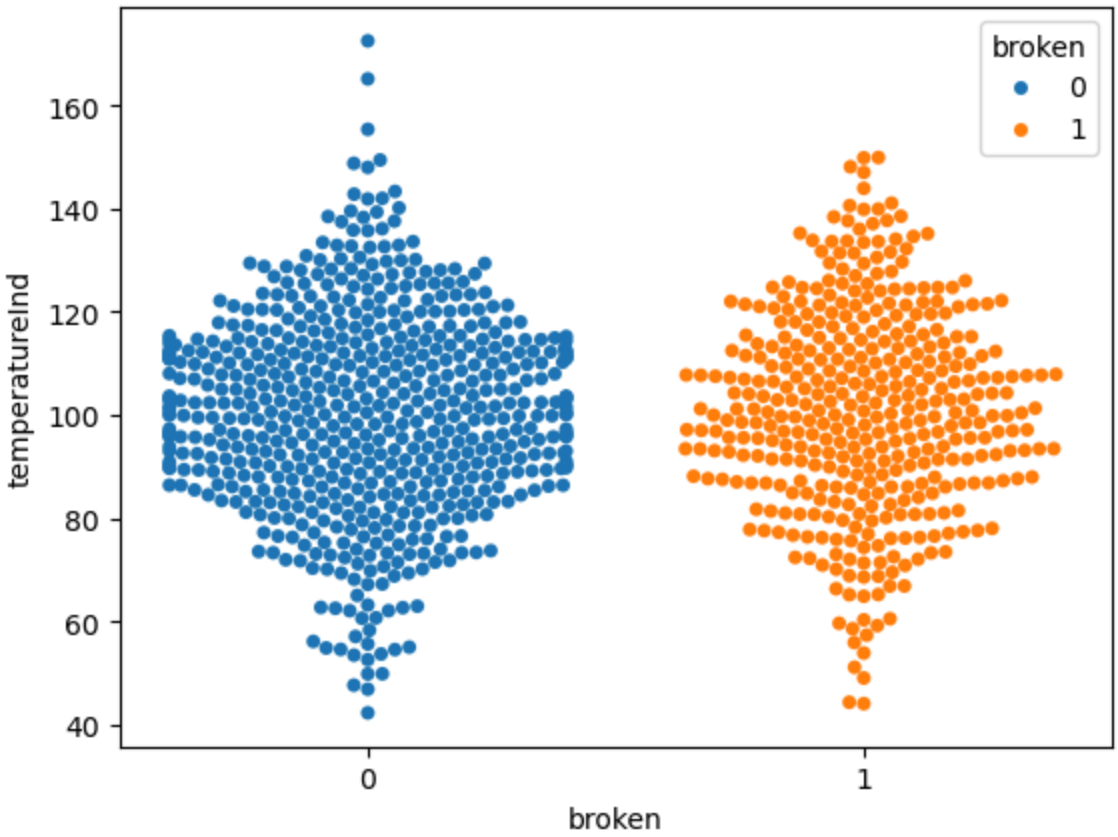

broken
0
1
pressureInd
180
160
140
120
100
80
60
40
0
1
broken

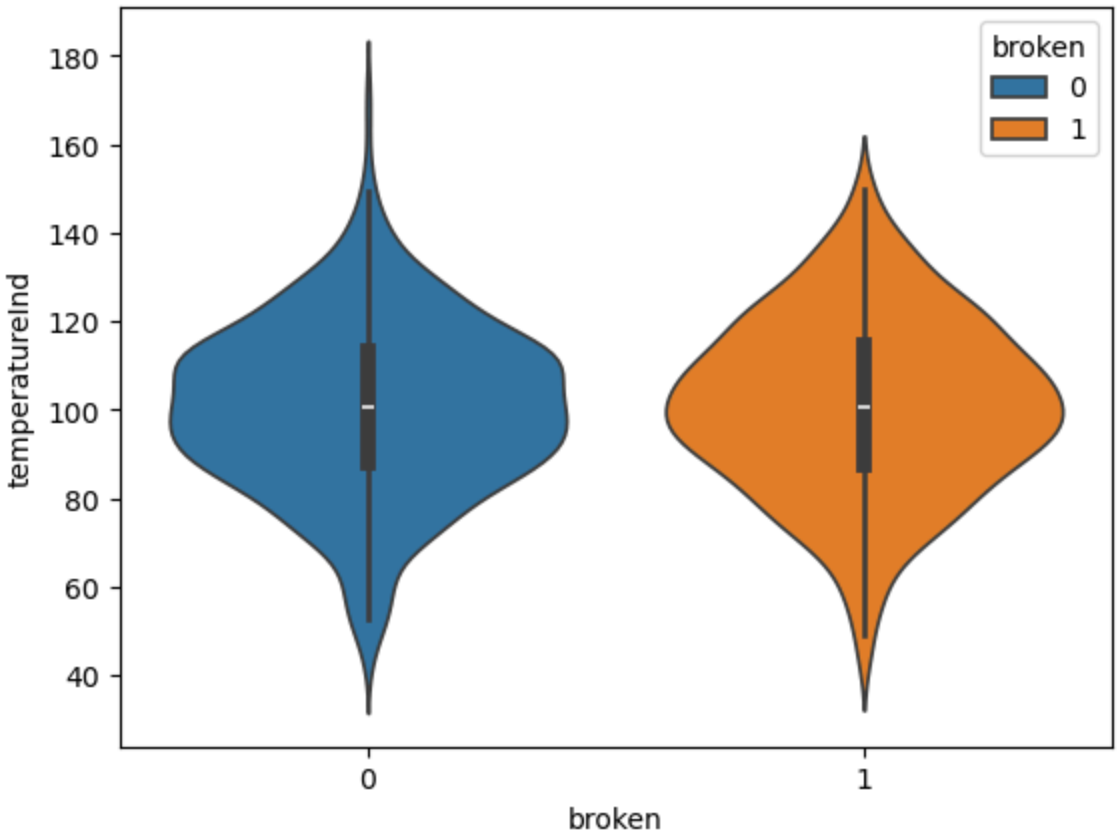

broken
0
1
pressureInd
180
160
140
120
100
80
60
40
0
1
broken


broken
0
1
pressureInd
175
150
125
100
75
50
25
0
1
broken

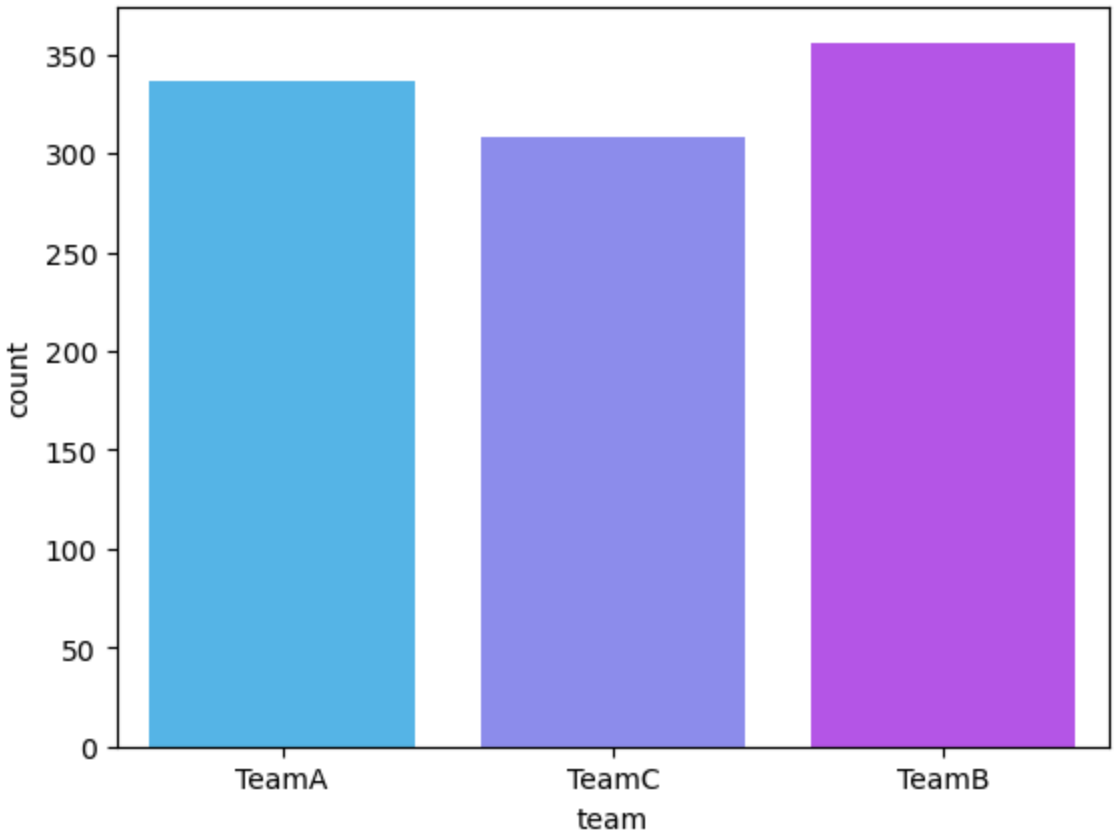

Density
0.0200
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
20
40
60
80
100
120
140
160
180


broken
0
1
temperatureInd
160
140
120
100
80
60
40
0
1
broken

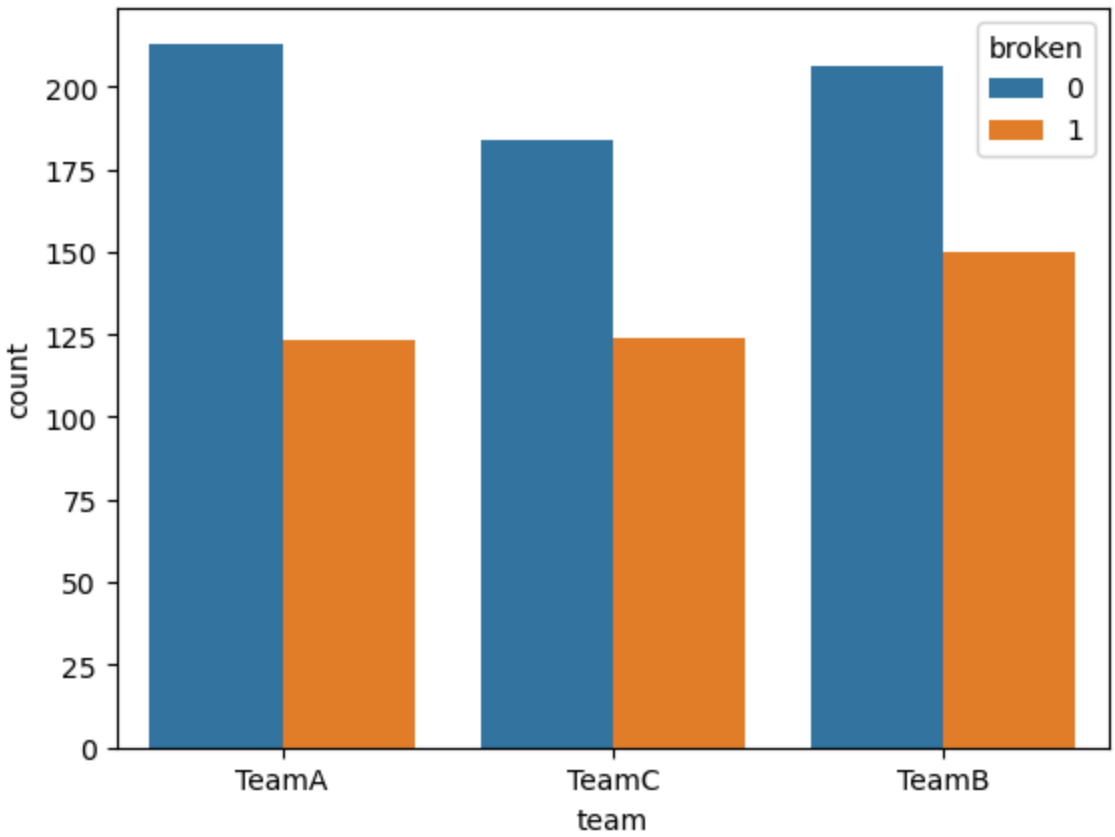




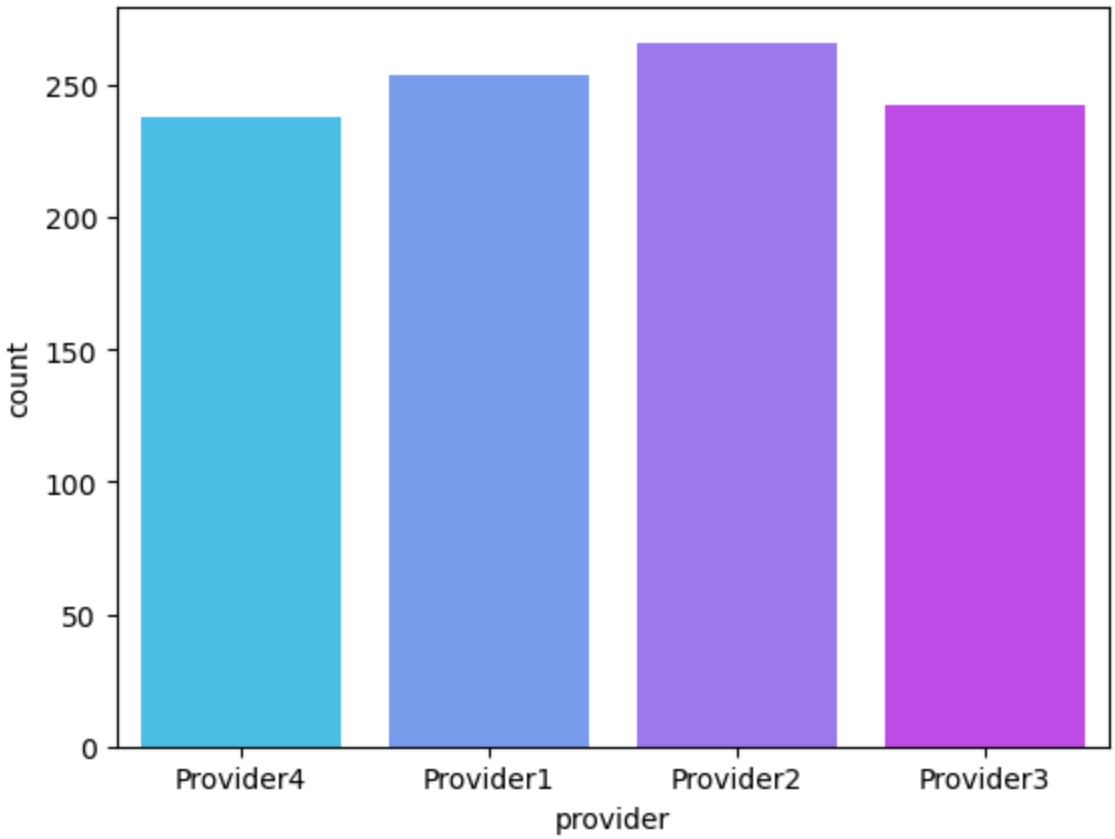
In [64]:
```
sns.countplot(x=main.team,palette='cool')
plt.show()
```



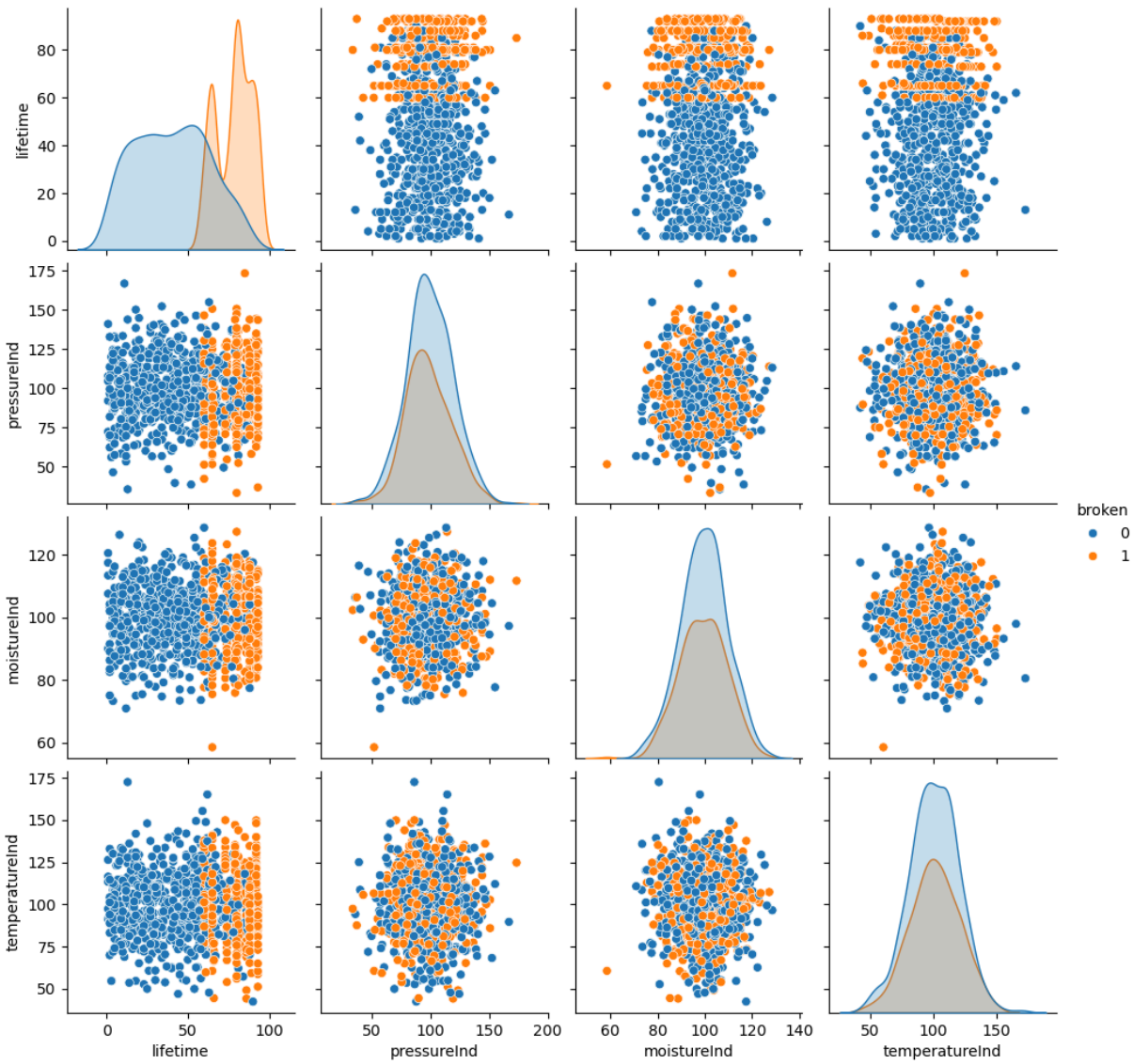
In [65]:
```
sns.countplot(x=main.team,hue=main.broken)
plt.show()
```



In [66]:
```
sns.countplot(x=main.provider,palette='cool')
plt.show()
```



In [67]:
```
sns.pairplot(main,hue='broken')
plt.show()
```


lifetime
pressureInd
moistureInd
temperatureInd
broken
0
1

In [ ]: