```
import warnings
warnings.filterwarnings('ignore')

# Import the numpy and pandas package

import numpy as np
import pandas as pd

# Data Visualisation
import matplotlib.pyplot as plt
import seaborn as sns


advertising = pd.DataFrame(pd.read_csv("/content/advertising.csv"))
advertising.head()
```

	AC	Fan	Cooler	Sales
0	323.0	56.7	45.7	23.5
1	65.5	34.6	87.7	76.7
2	45.6	87.8	98.6	65.7
3	23.6	123.5	34.6	87.6
4	98.6	67.0	87.0	56.7

```
advertising.shape
```

```
(9, 4)
```

```
advertising.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9 entries, 0 to 8
Data columns (total 4 columns):
 #   Column  Non-Null Count  Dtype  
---  ------  --------------  -----  
 0   AC      9 non-null      float64
 1   Fan     9 non-null      float64
 2   Cooler  9 non-null      float64
 3   Sales   9 non-null      float64
dtypes: float64(4)
memory usage: 416.0 bytes
```

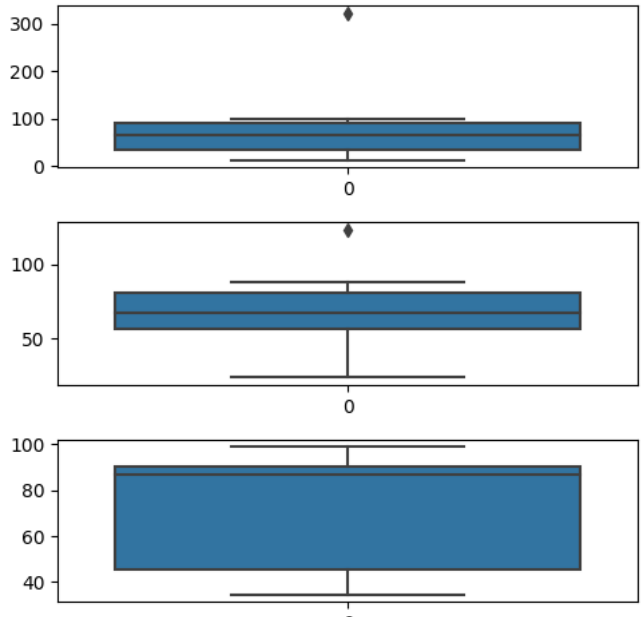
```
advertising.describe()
```

	AC	Fan	Cooler	Sales
count	9.000000	9.000000	9.000000	9.000000
mean	84.422222	67.633333	69.655556	66.055556
std	94.038274	29.759158	27.703073	22.453013
min	12.400000	23.500000	34.600000	23.500000
25%	34.600000	56.700000	45.700000	56.700000
50%	65.500000	67.000000	87.000000	65.700000
75%	90.800000	80.800000	90.000000	76.700000
max	323.000000	123.500000	98.700000	97.700000

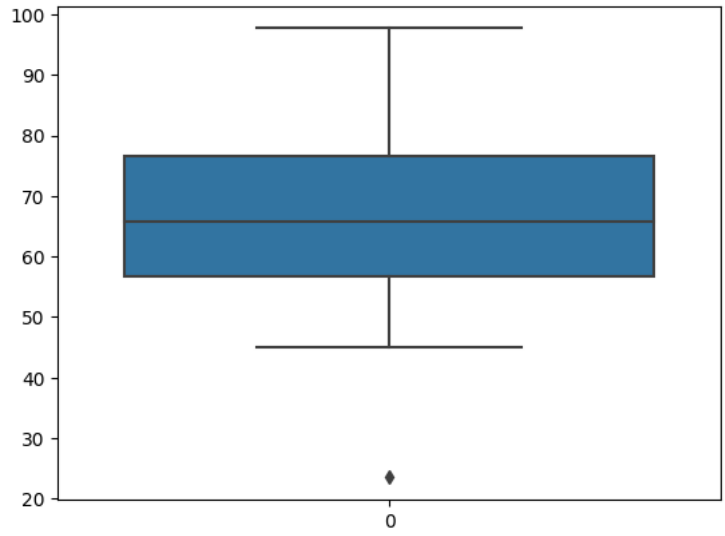
```
advertising.isnull().sum()*100/advertising.shape[0]
```

```
AC        0.0
Fan       0.0
Cooler    0.0
Sales     0.0
dtype: float64
```

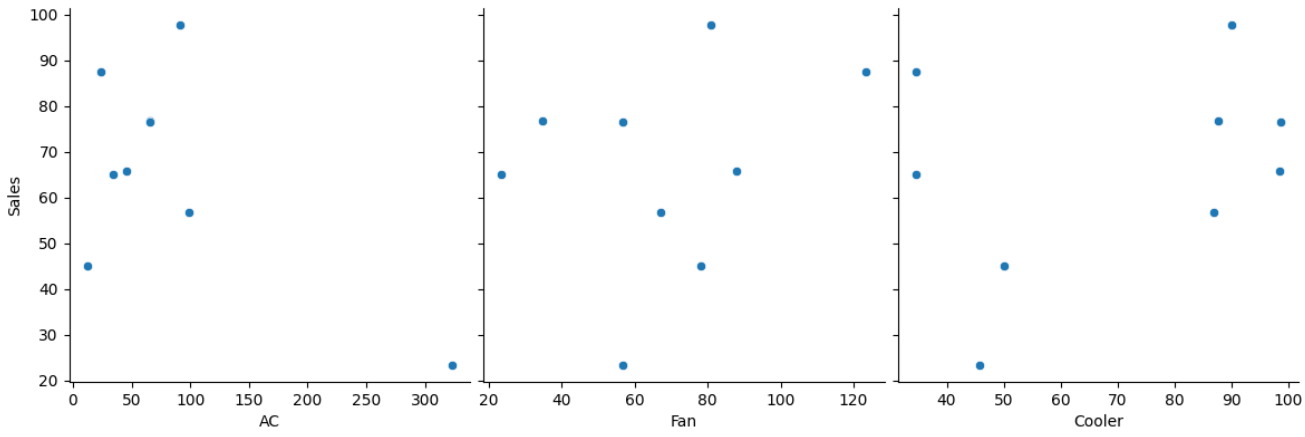
```
fig, axs = plt.subplots(3, figsize = (5,5))
plt1 = sns.boxplot(advertising['AC'], ax = axs[0])
plt2 = sns.boxplot(advertising['Fan'], ax = axs[1])
plt3 = sns.boxplot(advertising['Cooler'], ax = axs[2])
plt.tight_layout()
```



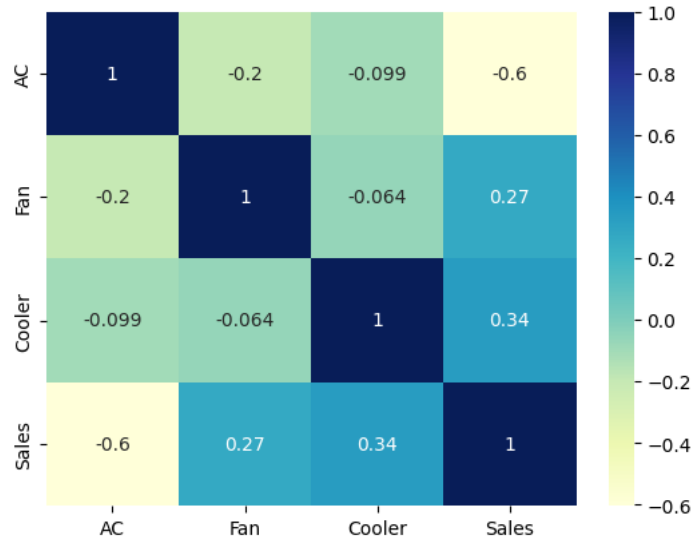

```
sns.boxplot(advertising['Sales'])
plt.show()
```




```
sns.pairplot(advertising, x_vars=['AC', 'Fan', 'Cooler'], y_vars='Sales', height=4, aspect=1, kind='scatter')
plt.show()
```




```
sns.heatmap(advertising.corr(), cmap="YlGnBu", annot = True)
plt.show()
```




```
X = advertising['AC']
y = advertising['Sales']
```

```
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, test_size = 0.3, random_state = 100)
```

```
X_train.head()
```

```
4     98.6
2     45.6
7     65.7
3     23.6
0    323.0
Name: AC, dtype: float64
```

```
y_train.head()
```

```
4    56.7
2    65.7
7    76.6
3    87.6
0    23.5
Name: Sales, dtype: float64
```

```
import statsmodels.api as sm
```

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

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

```
lr.params
```

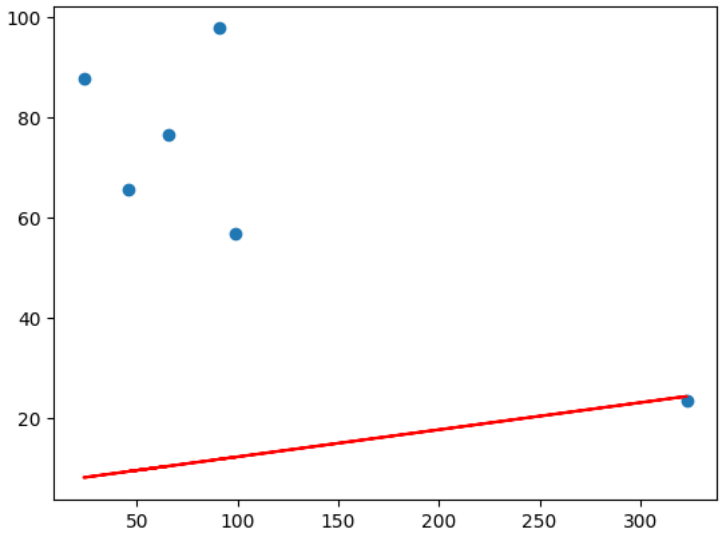
```
const    89.477127
AC       -0.199386
dtype: float64
```

```
print(lr.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                  Sales   R-squared:                       0.684
Model:                            OLS   Adj. R-squared:                  0.605
Method:                 Least Squares   F-statistic:                     8.657
Date:                Mon, 08 May 2023   Prob (F-statistic):             0.0423
Time:                        07:19:35   Log-Likelihood:                -24.124
No. Observations:                   6   AIC:                             52.25
Df Residuals:                       4   BIC:                             51.83
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const         89.4771      9.946      8.996      0.001      61.863     117.091
AC            -0.1994      0.068     -2.942      0.042      -0.388      -0.011
==============================================================================
Omnibus:                        nan   Durbin-Watson:                   0.943
Prob(Omnibus):                  nan   Jarque-Bera (JB):                0.771
Skew:                         0.872   Prob(JB):                        0.680
```

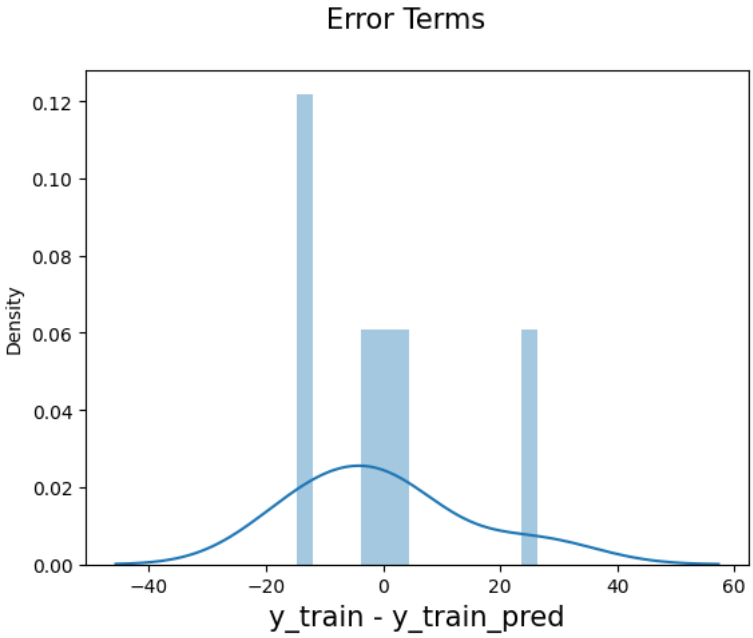
```
Kurtosis:                       2.804   Cond. No.                         216.
==============================================================================

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

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

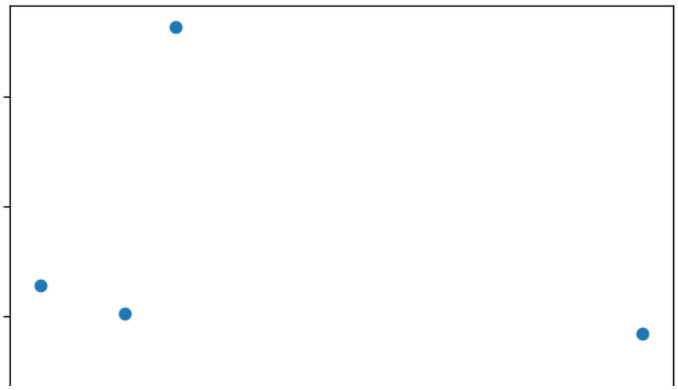



```
y_train_pred = lr.predict(X_train_sm)
res = (y_train - y_train_pred)
```

```
fig = plt.figure()
sns.distplot(res, bins = 15)
fig.suptitle('Error Terms', fontsize = 15)
plt.xlabel('y_train - y_train_pred', fontsize = 15)
plt.show()
```




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




```
X_test_sm = sm.add_constant(X_test)

y_pred = lr.predict(X_test_sm)
```

```
y_pred.head()
```

```
1    76.417323
6    82.578361
5    87.004737
dtype: float64
```

```
from sklearn.metrics import mean_squared_error
from sklearn.metrics import r2_score
```

```
np.sqrt(mean_squared_error(y_test, y_pred))
```

```
26.289900329034683
```

```
r_squared = r2_score(y_test, y_pred)
r_squared
```

```
-3.0345767449280707
```

```
plt.scatter(X_test, y_test)
plt.plot(X_test, 6.948 + 0.054 * X_test, 'r')
plt.show()
```