In [1]:
```
import numpy as np
import pandas as pd

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

In [3]:
```
data=pd.read_csv("advertising.csv")
data.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]:
```
data.tail()
```

Out[4]:

	TV	Radio	Newspaper	Sales
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

In [6]:
```
data.shape
```

Out[6]:
```
(200, 4)
```

In [7]:
```
data.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 [8]:
```
data.describe()
```

Out[8]:

	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 [9]:
```
data.isnull().sum()*100/data.shape[0]
```

Out[9]:
```
TV           0.0
Radio        0.0
Newspaper    0.0
Sales        0.0
dtype: float64
```

In [10]:
```
# Outlier Analysis
fig, axs = plt.subplots(3, figsize = (5,5))
plt1 = sns.boxplot(data['TV'], ax = axs[0])
plt2 = sns.boxplot(data['Newspaper'], ax = axs[1])
plt3 = sns.boxplot(data['Radio'], ax = axs[2])
plt.tight_layout()
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variabl
e as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variabl
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  warnings.warn(
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variabl
e as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```
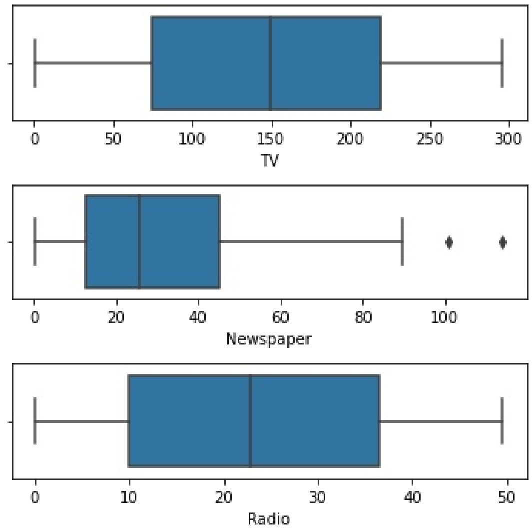
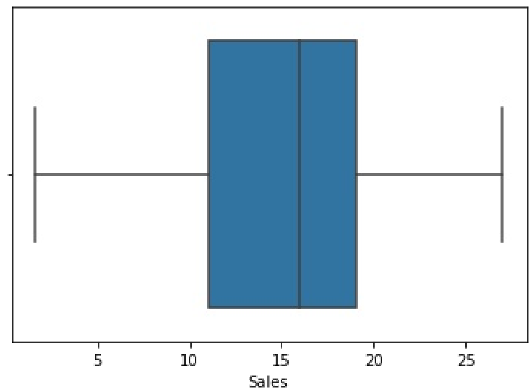
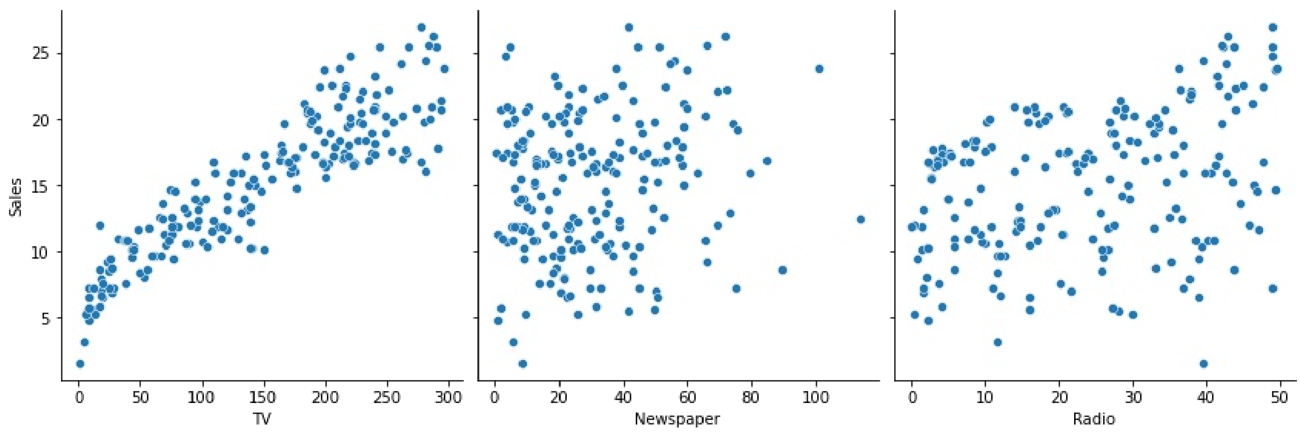



In [11]:
```
sns.boxplot(data['Sales'])
plt.show()
```

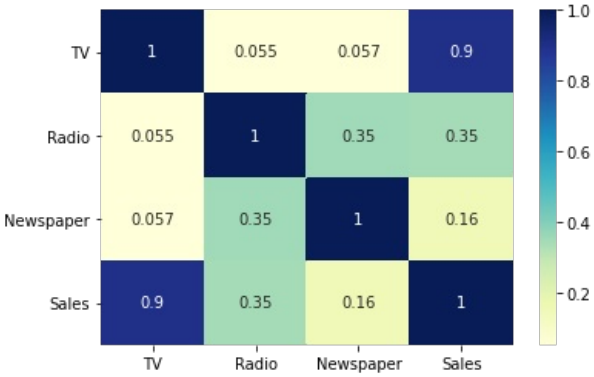
```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variabl
e as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```



In [12]:
```
#scatter plot.
sns.pairplot(data, x_vars=['TV', 'Newspaper', 'Radio'], y_vars='Sales', height=4, aspect=1, kind='scatter')
plt.show()
```



In [13]:
```
#correlation
sns.heatmap(data.corr(), cmap="YlGnBu", annot = True)
plt.show()
```



In [15]:
```
#simple Linear Regression
X = data['TV']
y = data['Sales']
```

In [16]:
```
#Train-Test Split
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
```

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

Out[17]:
```
74     213.4
3      151.5
185    205.0
26     142.9
90     134.3
Name: TV, dtype: float64
```

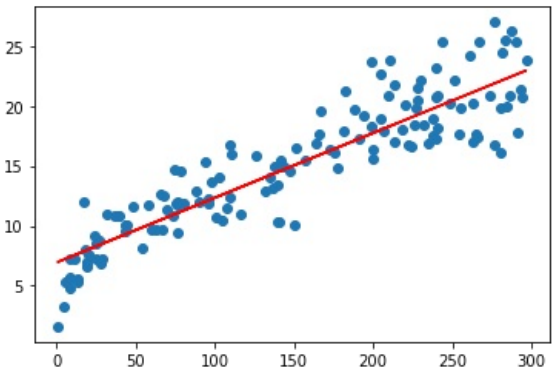
In [18]:
```
y_train.head()
```

Out[18]:
```
74     17.0
3      16.5
185    22.6
26     15.0
90     14.0
Name: Sales, dtype: float64
```

In [19]:
```
import statsmodels.api as sm
```

In [20]:
```
X_train_sm = sm.add_constant(X_train)
lr = sm.OLS(y_train, X_train_sm).fit()
```

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

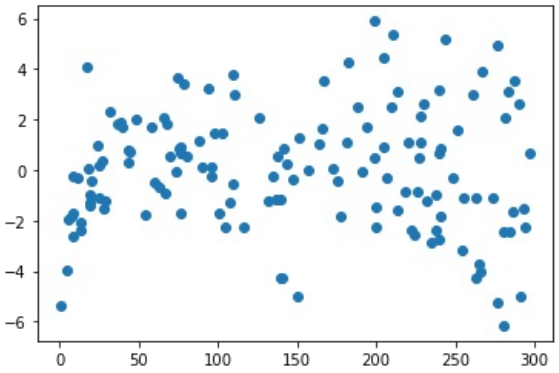


In [22]:
```
#Model Evaluation
y_train_pred = lr.predict(X_train_sm)
res = (y_train - y_train_pred)
```

In [2]:
```
fig = plt.figure()
sns.distplot(res, bins = 15)
fig.suptitle('Error Terms', fontsize = 15)                  # Plot heading
plt.xlabel('y_train - y_train_pred', fontsize = 15)         # X-label
plt.show()
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[2], line 1
----> 1 fig = plt.figure()
      2 sns.distplot(res, bins = 15)
      3 fig.suptitle('Error Terms', fontsize = 15)                  # Plot heading

NameError: name 'plt' is not defined
```

In [24]:
```
plt.scatter(X_train,res)
plt.show()
```



In [25]:
```
#Prediction
X_test_sm = sm.add_constant(X_test)
y_pred = lr.predict(X_test_sm)
```

In [26]:
```
y_pred.head()
```

Out[26]:
```
126     7.374140
104    19.941482
99     14.323269
92     18.823294
111    20.132392
dtype: float64
```

In [27]:
```
from sklearn.metrics import mean_squared_error
from sklearn.metrics import r2_score
```

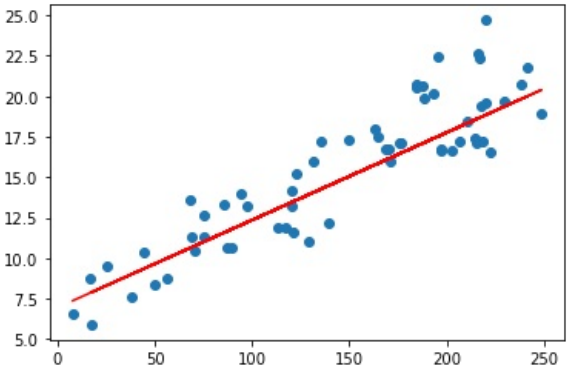
In [28]:
```
np.sqrt(mean_squared_error(y_test, y_pred))
```

Out[28]:
```
2.019296008966233
```

In [29]:
```
r_squared = r2_score(y_test, y_pred)
r_squared
```

Out[29]:
```
0.7921031601245658
```

In [30]:
```
plt.scatter(X_test, y_test)
plt.plot(X_test, 6.948 + 0.054 * X_test, 'r')
plt.show()
```



In [ ]: