Simple Linear Regression

In this book we will analyse the tv sales dataset using simple linear regression.

In this Notebook we will predict the sale of TV based on thier Advertisement.

Understanding the data

As we are performing Simple LR so feature must be one and predicted feature is also one.

We import data using pandas library.

```
import pandas as pd
import numpy as np
df=pd.read_csv('Advertising.csv')
df.head()
```

	Unnamed: 0	TV	Radio	Newspaper	Sales
0	1	230.1	37.8	69.2	22.1
1	2	44.5	39.3	45.1	10.4
2	3	17.2	45.9	69.3	9.3
3	4	151.5	41.3	58.5	18.5
4	5	180.8	10.8	58.4	12.9

As we need only one feature so we will remove other features

```
df=df.loc[:,['TV','Sales']]
```

```
df.head()     # we can see one dependent variable and one independent variable
```

	TV	Sales
0	230.1	22.1
1	44.5	10.4
2	17.2	9.3
3	151.5	18.5
4	180.8	12.9

```
df.tail()
```

	TV	Sales
195	38.2	7.6
196	94.2	9.7
197	177.0	12.8
198	283.6	25.5
199	232.1	13.4

```
df.isnull().sum()
```

```
TV       0
Sales    0
dtype: int64
```

```
df.shape
```

```
(200, 2)
```

```
df.duplicated().sum()
```

```
0
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 2 columns):
 #   Column  Non-Null Count  Dtype  
---  ------  --------------  -----  
 0   TV      200 non-null    float64
 1   Sales   200 non-null    float64
dtypes: float64(2)
memory usage: 3.2 KB
```

```
df.describe()
```

	TV	Sales
count	200.000000	200.000000
mean	147.042500	14.022500
std	85.854236	5.217457
min	0.700000	1.600000
25%	74.375000	10.375000
50%	149.750000	12.900000
75%	218.825000	17.400000
max	296.400000	27.000000

```
print('Check outlier for he TV feature')
Q1=74.37 #from df. describe
Q2=149.75  #from df.describe
Q3=218.82
IQR= Q3-Q1
IQR
upper_limit= Q3+1.5*(IQR)
print('Upper limit', upper_limit)
lower_limit= Q1-1.5*(IQR)
print('lower_limit',lower_limit)
print('max',df['TV'].max())
print('min',df['TV'].min())

print('''As we can conclude that out data max and mini values lies betweeen upper and lower limit
Hence we can say there is no outlier in our data''')
```

```
Check outlier for he TV feature
Upper limit 435.495
lower_limit -142.30499999999998
max 296.4
min 0.7
As we can conclude that out data max and mini values lies betweeen upper and lower limit
Hence we can say there is no outlier in our data
```

```
print('Check outlier for he Sales feature')
Q1=np.percentile(df['Sales'], 25)
Q2=np.percentile(df['Sales'], 50)
Q3=np.percentile(df['Sales'], 75)
IQR= Q3-Q1
print('Q1=',Q1,'Q2=',Q2,'Q3=',Q3)
print('IQR',IQR)

upper_limit= Q3+1.5*(IQR)
print('Upper limit', upper_limit)
lower_limit= Q1-1.5*(IQR)
print('lower_limit',lower_limit)
print('max',df['Sales'].max())
print('min',df['Sales'].min())

print('''As we can conclude that out data max and mini values lies betweeen upper and lower limit
Hence we can say there is no outlier in our data''')
```

```
Check outlier for he Sales feature
Q1= 10.375 Q2= 12.9 Q3= 17.4
IQR 7.024999999999999
Upper limit 27.937499999999996
lower_limit -0.16249999999999787
max 27.0
min 1.6
```

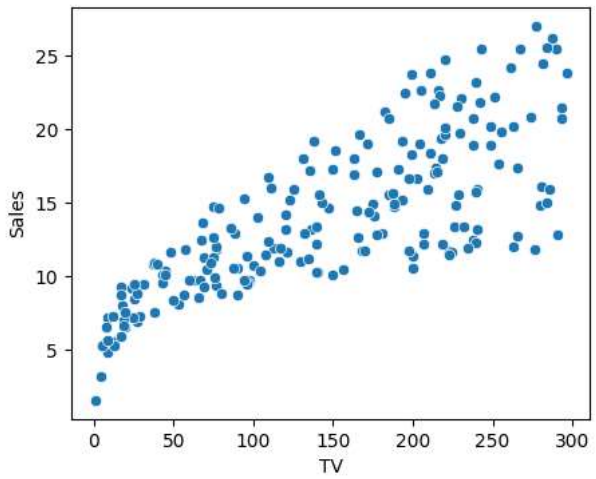
```
As we can conclude that out data max and mini values lies betweeen upper and lower limit
Hence we can say there is no outlier in our data
```

Visualization

```
import matplotlib.pyplot as plt
import seaborn as sns
```

```
plt.figure(figsize=(5,4))
sns.scatterplot(data=df,x= 'TV', y ='Sales',markers= '*')
```

```
<Axes: xlabel='TV', ylabel='Sales'>
```




```
from sklearn.model_selection import train_test_split
from sklearn.metrics import r2_score,accuracy_score,mean_absolute_error
from sklearn.linear_model import LinearRegression
```

```
df['tv_sqrt']=np.sqrt(df['TV'])
df['sales_sqrt']=np.sqrt(df['Sales'])
```

```
x=df.loc[:,'tv_sqrt']
y=df.loc[:,'sales_sqrt']
```

```
x.ndim,y.ndim
```

```
(1, 1)
```

```
x_train,x_test,y_train,y_test= train_test_split(x,y,random_state=42, test_size=0.33)
```

```
#Reshaping
x_train=x_train[:, np.newaxis]
x_test=x_test[:,np.newaxis]
y_train=y_train[:, np.newaxis]
y_test=y_test[:,np.newaxis]
```

```
<ipython-input-128-57bf3918e6db>:2: FutureWarning: Support for multi-dimensional indexing (e.g. `obj[:, None]`) is deprecated and w
  x_train=x_train[:, np.newaxis]
<ipython-input-128-57bf3918e6db>:3: FutureWarning: Support for multi-dimensional indexing (e.g. `obj[:, None]`) is deprecated and w
  x_test=x_test[:,np.newaxis]
<ipython-input-128-57bf3918e6db>:4: FutureWarning: Support for multi-dimensional indexing (e.g. `obj[:, None]`) is deprecated and w
  y_train=y_train[:, np.newaxis]
<ipython-input-128-57bf3918e6db>:5: FutureWarning: Support for multi-dimensional indexing (e.g. `obj[:, None]`) is deprecated and w
  y_test=y_test[:,np.newaxis]
```

```
x_train.ndim,y_train.ndim,x_test.ndim,y_test.ndim
```

```
(2, 2, 2, 2)
```

```
# from sklearn.preprocessing import PolynomialFeatures
# poly=PolynomialFeatures()
# x_train_poly=poly.fit_transform(x_train)
# x_test_poly=poly.fit(x_test)
```

```
print(lr.coef_)
print(lr.intercept_)
```

```
[[0.1466855]]
[2.01379003]
```

```
lr= LinearRegression()
lr
```

```
LinearRegression
LinearRegression()
```

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

```
LinearRegression
LinearRegression()
```

```
y_pred=lr.predict(x_test)
```

```
from sklearn.metrics import mean_squared_error
mse = mean_squared_error(y_test, y_pred)
mse
```

```
0.15384150295670243
```

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

```
0.6715412444611746
```

```
plt.scatter(y_test,y_pred)
plt.show()
```