

```
In [2]: import pandas as pd
import statsmodels.api as sm

df = pd.read_csv("/Users/manishkumar/Downloads/Advertising.csv")
```

```
In [3]: #checking for nan values
df.isnull().sum()
```

```
Out[3]: TV          0
radio          0
newspaper      0
sales          0
dtype: int64
```

```
In [4]: (df.sales==0).sum(),(df.TV==0).sum(),(df.newspaper==0).sum(),(df.ra
```

```
Out[4]: (0, 0, 0, 0)
```

```
In [5]: #python regression for TV v/s sales
cols=["TV"]
X=df[cols]
y=df.sales
est = sm.OLS(y, X).fit()
est.summary()
```

Out [5]: OLS Regression Results

Dep. Variable:	sales	R-squared (uncentered):	0.906
Model:	OLS	Adj. R-squared (uncentered):	0.905
Method:	Least Squares	F-statistic:	954.6
Date:	Mon, 22 Nov 2021	Prob (F-statistic):	1.22e-52
Time:	12:05:02	Log-Likelihood:	-296.69
No. Observations:	100	AIC:	595.4
Df Residuals:	99	BIC:	598.0
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P> t	[0.025	0.975]
TV	0.0863	0.003	30.897	0.000	0.081	0.092

Omnibus:	13.711	Durbin-Watson:	1.810
Prob(Omnibus):	0.001	Jarque-Bera (JB):	14.950
Skew:	-0.918	Prob(JB):	0.000567
Kurtosis:	3.465	Cond. No.	1.00

Notes:

[1] R^2 is computed without centering (uncentered) since the model does not contain a constant.

[2] Standard Errors assume that the covariance matrix of the errors is correctly specified.

```
In [6]: #python regression for newspaper v/s sales
cols1=["newspaper"]
X1=df[cols1]
y1=df.sales
est1 = sm.OLS(y1, X1).fit()
est1.summary()
```

Out [6]: OLS Regression Results

Dep. Variable:	sales	R-squared (uncentered):	0.665
Model:	OLS	Adj. R-squared (uncentered):	0.662
Method:	Least Squares	F-statistic:	196.7
Date:	Mon, 22 Nov 2021	Prob (F-statistic):	2.95e-25
Time:	12:05:14	Log-Likelihood:	-360.23
No. Observations:	100	AIC:	722.5
Df Residuals:	99	BIC:	725.1
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P> t	[0.025	0.975]
newspaper	0.3175	0.023	14.024	0.000	0.273	0.362

Omnibus:	14.530	Durbin-Watson:	1.529
Prob(Omnibus):	0.001	Jarque-Bera (JB):	18.865
Skew:	-0.731	Prob(JB):	8.01e-05
Kurtosis:	4.546	Cond. No.	1.00

Notes:

[1] R^2 is computed without centering (uncentered) since the model does not contain a constant.

[2] Standard Errors assume that the covariance matrix of the errors is correctly specified.

```
In [7]: #python regression for radio v/s sales
cols2=["radio"]
X2=df[cols2]
y2=df.sales
est2 = sm.OLS(y2, X2).fit()
est2.summary()
```

Out [7]: OLS Regression Results

Dep. Variable:	sales	R-squared (uncentered):	0.837
Model:	OLS	Adj. R-squared (uncentered):	0.835
Method:	Least Squares	F-statistic:	508.0
Date:	Mon, 22 Nov 2021	Prob (F-statistic):	9.05e-41
Time:	12:05:25	Log-Likelihood:	-324.27
No. Observations:	100	AIC:	650.5
Df Residuals:	99	BIC:	653.1
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P> t	[0.025	0.975]
radio	0.4890	0.022	22.539	0.000	0.446	0.532

Omnibus:	16.699	Durbin-Watson:	1.642
Prob(Omnibus):	0.000	Jarque-Bera (JB):	19.137
Skew:	-1.014	Prob(JB):	6.99e-05
Kurtosis:	3.694	Cond. No.	1.00

Notes:

[1] R^2 is computed without centering (uncentered) since the model does not contain a constant.

[2] Standard Errors assume that the covariance matrix of the errors is correctly specified.

```
In [8]: #python multiple regression
colsall=["TV", "radio", "newspaper"]
X3=df[colsall]
y3=df.sales
est3 = sm.OLS(y3, X3).fit()
est3.summary()
```

Out [8]: OLS Regression Results

Dep. Variable:	sales	R-squared (uncentered):	0.984
Model:	OLS	Adj. R-squared (uncentered):	0.983
Method:	Least Squares	F-statistic:	1962.
Date:	Mon, 22 Nov 2021	Prob (F-statistic):	1.19e-86
Time:	12:05:34	Log-Likelihood:	-208.84
No. Observations:	100	AIC:	423.7
Df Residuals:	97	BIC:	431.5
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P> t	[0.025	0.975]
TV	0.0548	0.002	29.210	0.000	0.051	0.059
radio	0.2225	0.015	14.729	0.000	0.193	0.252
newspaper	0.0131	0.010	1.337	0.184	-0.006	0.032

Omnibus:	0.455	Durbin-Watson:	2.349
Prob(Omnibus):	0.797	Jarque-Bera (JB):	0.130
Skew:	0.035	Prob(JB):	0.937
Kurtosis:	3.162	Cond. No.	14.7

Notes:

[1] R² is computed without centering (uncentered) since the model does not contain a constant.

[2] Standard Errors assume that the covariance matrix of the errors is correctly specified.

In []:

In []:

In []:

In []:

In []: