```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import scipy.stats as stats
import statsmodels.api as sm

# importing linear regression function
import sklearn.linear_model as lm

# function to calculate r-squared, MAE, RMSE
from sklearn.metrics import r2_score , mean_absolute_error, mean_squared_error
```

```
/usr/local/lib/python3.7/dist-packages/statsmodels/tools/_testing.py:19: FutureWarning: pandas.util.testing is deprecat
  import pandas.util.testing as tm
```

```
import io
import sys
from google.colab import files
```

```
uploaded = files.upload()
```

Choose Files Grade_Set_1…ication.csv

- **Grade_Set_1_Classification.csv**(application/vnd.ms-excel) - 87 bytes, last modified: 5/10/2021 - 100% done

```
Saving Grade_Set_1_Classification.csv to Grade_Set_1_Classification (1).csv
```

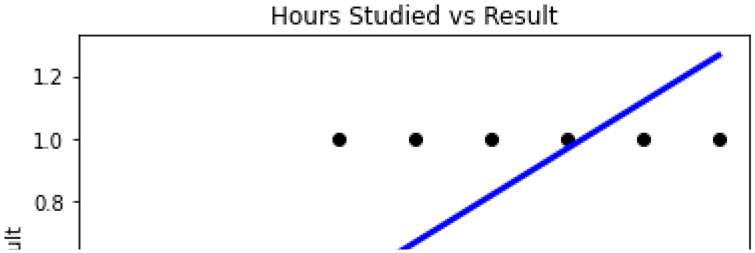
```
df = pd.read_csv(io.BytesIO(uploaded['Grade_Set_1_Classification.csv']))
print(df)
```

```
   Unnamed: 0  Hours_Studied  Result
0           0              2       0
1           1              3       0
2           2              4       0
3           3              5       1
4           4              6       1
```

```
     5           5              7       1
     6           6              8       1
     7           7              9       1
     8           8             10       1
```

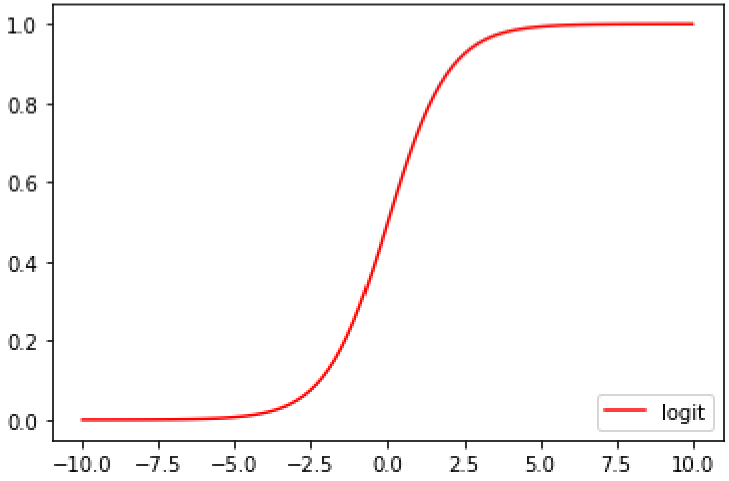
```
x= df.Hours_Studied[:, np.newaxis] # independent variable
y= df.Result                       # dependent variable

# Create linear regression object
lr = lm.LinearRegression()

# Train the model using the training sets
lr.fit(x, y)

# plotting fitted line
plt.scatter(x, y,  color='black')
plt.plot(x, lr.predict(x), color='blue', linewidth=3)
plt.title('Hours Studied vs Result')
plt.ylabel('Result')
plt.xlabel('Hours_Studied')

# add predict value to the data frame
df['Result_Pred'] = lr.predict(x)

# Using built-in function
print ("R Squared : ", r2_score(df.Result, df.Result_Pred))
print ("Mean Absolute Error: ", mean_absolute_error(df.Result, df.Result_Pred))
print ("Root Mean Squared Error: ", np.sqrt(mean_squared_error(df.Result, df.Result_Pred)))
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: FutureWarning: Sup
  """Entry point for launching an IPython kernel.
R Squared :  0.675
Mean Absolute Error:  0.2296296296296296
Root Mean Squared Error:  0.26874192494328497
```



```
# plot sigmoid function
x = np.linspace(-10, 10, 100)
y = 1.0 / (1.0 + np.exp(-x))

plt.plot(x, y, 'r-', label='logit')
plt.legend(loc='lower right')
```

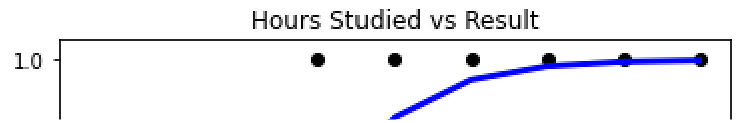
```
<matplotlib.legend.Legend at 0x7f49950c8d90>
```



```
from sklearn.linear_model import LogisticRegression

# manually add intercept
df['intercept'] = 1
```

```
independent_variables = ['Hours_Studied', 'intercept']

x = df[independent_variables]       # independent variable
y = df['Result']                      # dependent variable

# instantiate a logistic regression model, and fit with X and y
model = LogisticRegression()
model = model.fit(x, y)

# check the accuracy on the training set
model.score(x, y)

# predict_proba will return array containing proability of y = 0 and y = 1
print(model.predict_proba(x)[:,1])

# predict will give convert the probability(y=1) values > .5 to 1 else 0
print(model.predict(x))

# plotting fitted line
plt.scatter(df.Hours_Studied, y,  color='black')
plt.yticks([0.0, 0.5, 1.0])
plt.plot(df.Hours_Studied, model.predict_proba(x)[:,1], color='blue', linewidth=3)
plt.title('Hours Studied vs Result')
plt.ylabel('Result')
plt.xlabel('Hours_Studied')
plt.show()
```

```
[0.05368062 0.15313611 0.36565616 0.64757973 0.85417548 0.94916743
 0.98347736 0.99475738 0.99834945]
[0 0 0 1 1 1 1 1 1]
```



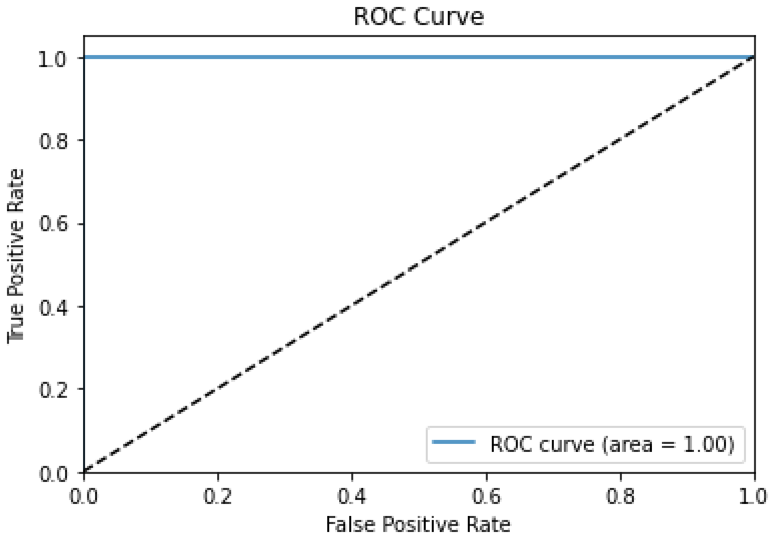
Hours Studied vs Result

```
from sklearn import metrics

# generate evaluation metrics
print("Accuracy :", metrics.accuracy_score(y, model.predict(x)))
print("AUC :", metrics.roc_auc_score(y, model.predict_proba(x)[:,1]))

print("Confusion matrix :",metrics.confusion_matrix(y, model.predict(x)))
print("classification report :", metrics.classification_report(y, model.predict(x)))
```

```
Accuracy : 1.0
AUC : 1.0
Confusion matrix : [[3 0]
 [0 6]]
classification report :               precision    recall  f1-score   support

           0       1.00      1.00      1.00         3
           1       1.00      1.00      1.00         6

    accuracy                           1.00         9
   macro avg       1.00      1.00      1.00         9
weighted avg       1.00      1.00      1.00         9
```

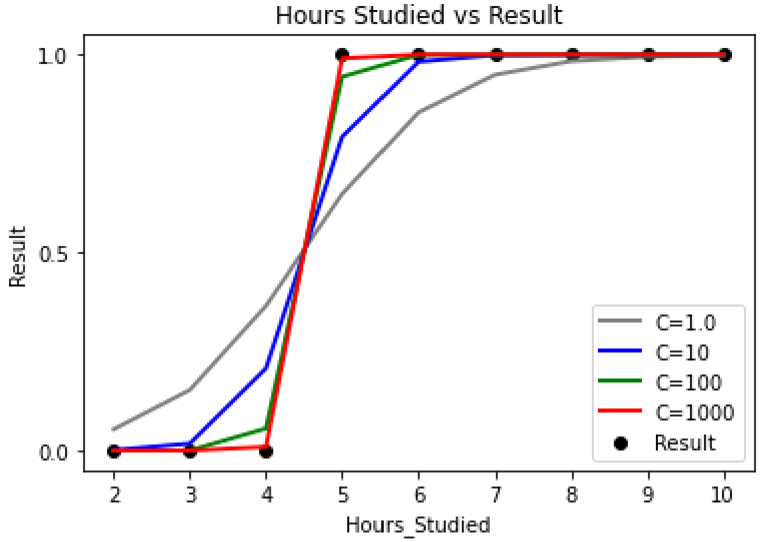
```
# Determine the false positive and true positive rates
fpr, tpr, _ = metrics.roc_curve(y, model.predict_proba(x)[:,1])

# Calculate the AUC
roc_auc = metrics.auc(fpr, tpr)
print('ROC AUC: %0.2f' % roc_auc)

# Plot of a ROC curve for a specific class
plt.figure()
plt.plot(fpr, tpr, label='ROC curve (area = %0.2f)' % roc_auc)
plt.plot([0, 1], [0, 1], 'k--')
plt.xlim([0.0, 1.0])
plt.ylim([0.0, 1.05])
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('ROC Curve')
plt.legend(loc="lower right")
plt.show()
```

```
     ROC AUC: 1.00
```



```
# instantiate a logistic regression model with default c value, and fit with X and y
model = LogisticRegression()
model = model.fit(x, y)

# check the accuracy on the training set
print ("C = 1 (default), Accuracy :", metrics.accuracy_score(y, model.predict(x)))

# instantiate a logistic regression model with c = 10, and fit with X and y
model1 = LogisticRegression(C=10)
model1 = model1.fit(x, y)

# check the accuracy on the training set
print ("C = 10, Accuracy :", metrics.accuracy_score(y, model1.predict(x)))
print ("C = 10, Accuracy :", metrics.accuracy_score(y, model1.predict(x)))

# instantiate a logistic regression model with c = 100, and fit with X and y
model2 = LogisticRegression(C=100)
model2 = model2.fit(x, y)

# check the accuracy on the training set
print ("C = 100, Accuracy :", metrics.accuracy_score(y, model2.predict(x)))

# instantiate a logistic regression model with c = 1000, and fit with X and y
model3 = LogisticRegression(C=1000)
model3 = model3.fit(x, y)

# check the accuracy on the training set
print("C = 1000, Accuracy :", metrics.accuracy_score(y, model3.predict(x)))


# plotting fitted line
plt.scatter(df.Hours_Studied, y,  color='black', label='Result')
plt.yticks([0.0, 0.5, 1.0])
plt.plot(df.Hours_Studied, model.predict_proba(x)[:,1], color='gray', linewidth=2, label='C=1.0')
plt.plot(df.Hours_Studied, model1.predict_proba(x)[:,1], color='blue', linewidth=2,label='C=10')
plt.plot(df.Hours_Studied, model2.predict_proba(x)[:,1], color='green', linewidth=2,label='C=100')
plt.plot(df.Hours_Studied, model3.predict_proba(x)[:,1], color='red', linewidth=2,label='C=1000')
plt.legend(loc='lower right') # legend location
plt.title('Hours Studied vs Result')
plt.ylabel('Result')
plt.xlabel('Hours_Studied')
plt.show()
```

```
C = 1 (default), Accuracy : 1.0
C = 10, Accuracy : 1.0
C = 100, Accuracy : 1.0
C = 1000, Accuracy : 1.0
```



✓ 0s completed at 15:36