Untitled

September 13, 2023

[ ]:
```
#QUESTION 1
```

[5]:
```
import numpy as np
import pandas as pd
import math
x1=[2.781084,
1.465489,
3.396562,
1.38807,
3.064072,
7.627531,
5.332441,
6.922597,
8.675419,
7.673756]
x2=[2.550537,
2.362125,
4.400294,
1.85022,
3.005306,
2.759262,
2.088627,
1.771064,
-0.24207,
3.508563]
y=[0,
0,
0,
0,
1,
1,
1,
1]
df=pd.DataFrame({'x1':x1,'x2':x2,'y':y})
df
```

[5]:

	x1	x2	y
0	2.781084	2.550537	0
1	1.465489	2.362125	0
2	3.396562	4.400294	0
3	1.388070	1.850220	0
4	3.064072	3.005306	0
5	7.627531	2.759262	1
6	5.332441	2.088627	1
7	6.922597	1.771064	1
8	8.675419	-0.242070	1
9	7.673756	3.508563	1

[8]:
```
from sklearn.linear_model import LogisticRegression
X = df[['x1', 'x2']]
Y = df['y']
model = LogisticRegression()
model.fit(X, Y)
b0 = model.intercept_[0]
b1, b2 = model.coef_[0]
print(f'Intercept (B0): {B0}')
print(f'Coefficient for X1 (B1): {B1}')
print(f'Coefficient for X2 (B2): {B2}')
```

```
Intercept (B0): -4.551633521124653
Coefficient for X1 (B1): 1.183834155636202
Coefficient for X2 (B2): -0.35803502860018704
```

[70]:
```
prediction=[0,0,0,0,0,0,0,0,0,0]
pred=[0]*10
loss=[0]*10
for i in range (10):
    prediction[i] = 1 / (1 + math.exp((-(b0 + b1*x1[i] + b2*x2[i]))))
    if (prediction[i]>=0.5):
        pred[i]=1
    else:
        pred[i]=0
    log_loss = -np.mean(y[i] * np.log(prediction[i]) + (1 - y[i]) * np.log(1 -␣
 ↪prediction[i]))
    loss[i]=y[i] * np.log(prediction[i]) + (1 - y[i]) * np.log(1 -␣
 ↪prediction[i])
```

[71]:
```
y1=Y.to_numpy()
log_loss
```

[71]: 0.0370599036730744

[72]:
```
from sklearn.metrics import classification_report, confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y1, pred))
print("\nClassification Report:")
print(classification_report(y1, pred))
```

```
Confusion Matrix:
[[5 0]
 [0 5]]

Classification Report:
              precision    recall  f1-score   support

           0       1.00      1.00      1.00         5
           1       1.00      1.00      1.00         5

    accuracy                           1.00        10
   macro avg       1.00      1.00      1.00        10
weighted avg       1.00      1.00      1.00        10
```

[73]:
```
loss
```

[73]:
```
[-0.10786343710322566,
 -0.02534533690103821,
 -0.11485292988795857,
 -0.027743977869036908,
 -0.1268940124592168,
 -0.030039470330351387,
 -0.3097046132086544,
 -0.04814023426500874,
 -0.003007045497936586,
 -0.0370599036730744]
```

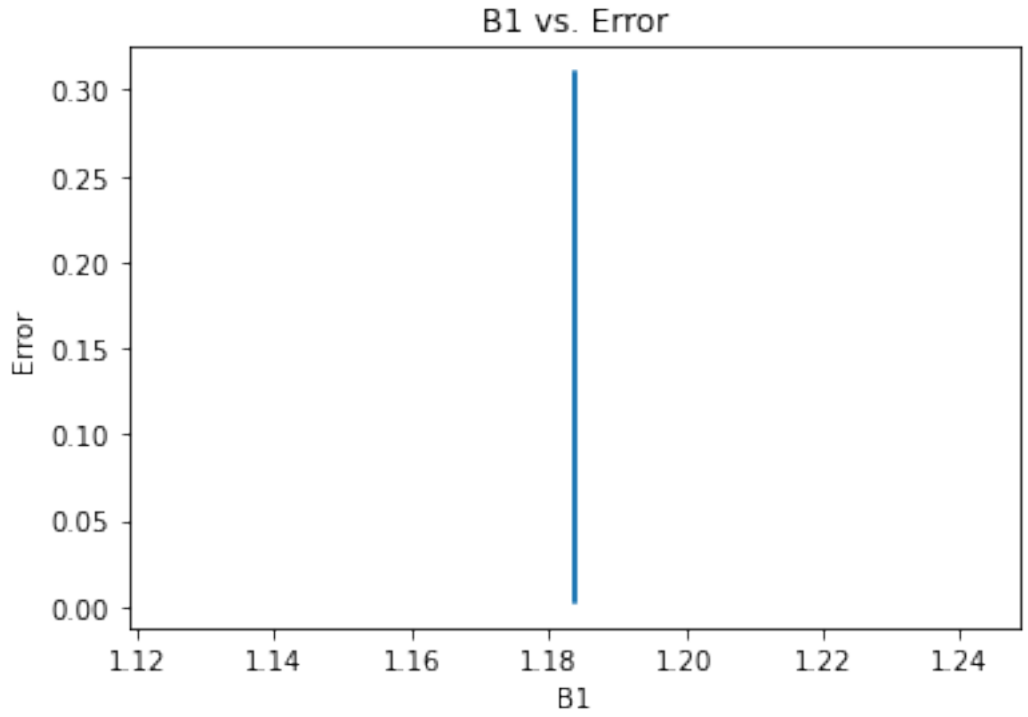
[74]:
```
beta = [x / 10 for x in range(1, 11)]
```

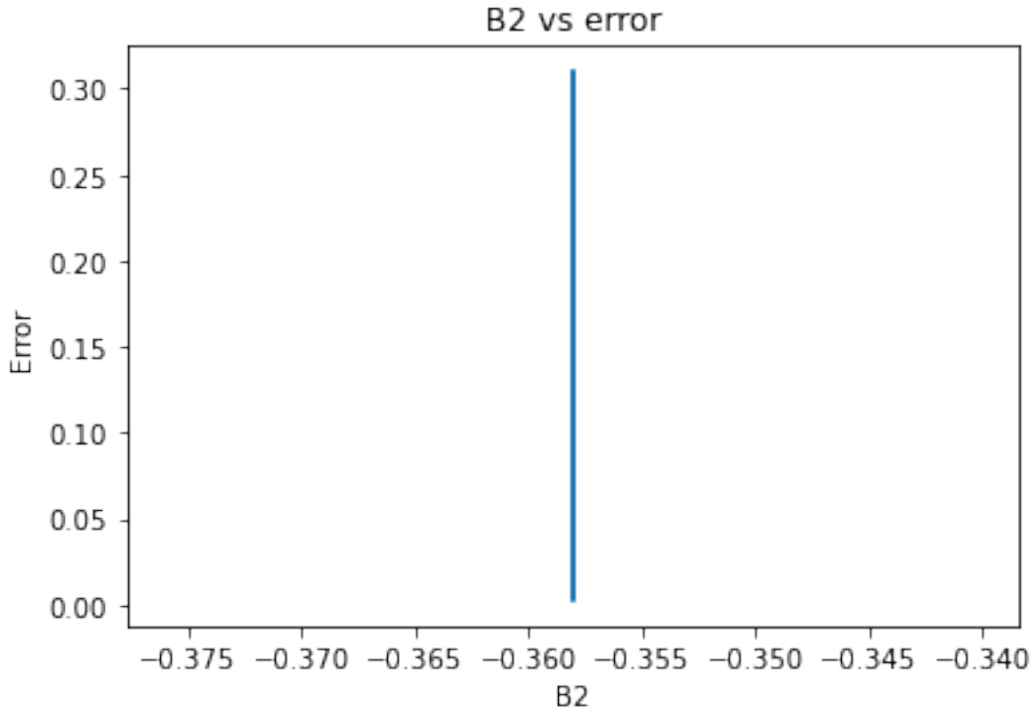
[75]:
```
prediction
```

[75]:
```
[0.1022498125742718,
 0.02502684032438537,
 0.10850275313408725,
 0.027362648385509735,
 0.11917297565982612,
 0.970407230498633,
 0.7336636387683158,
 0.9530001344329782,
 0.9969974711350023,
```

0.9636184093379092]

[84]:
```
parameters_and_errors = []
for i in range(len(df)):
    instance = df.iloc[i]
    X1_value = instance['x1']
    X2_value = instance['x2']
    Y_value = instance['y']
    predictions = prediction[i]
    error = - (Y_value * np.log(predictions) + (1 - Y_value) * np.log(1 -␣
 ↪predictions))
    parameters_and_errors.append((X1_value, X2_value, B0, B1, B2, predictions,␣
 ↪error))

# For example, to plot B1 vs. Error
B1_values = [item[3] for item in parameters_and_errors]
errors = [item[6] for item in parameters_and_errors]
B2_values = [item[4]for item in parameters_and_errors]
plt.plot(B1_values, errors)
plt.xlabel('B1')
plt.ylabel('Error')
plt.title('B1 vs. Error')
plt.show()
plt.plot(B2_values, errors)
plt.xlabel('B2')
plt.ylabel('Error')
plt.title('B2 vs error')
plt.show()
```


B1 vs. Error
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Error
1.12
1.14
1.16
1.18
1.20
1.22
1.24
B1

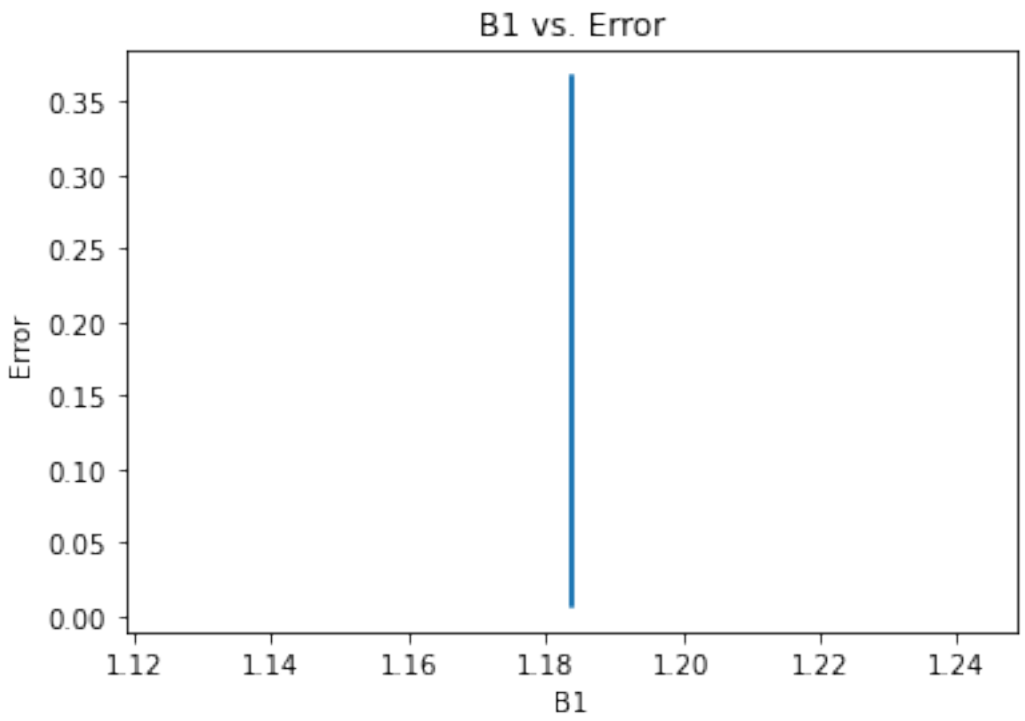

B2 vs error
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Error
−0.375
−0.370
−0.365
−0.360
−0.355
−0.350
−0.345
−0.340
B2

[ ]:
```
#QUESTION 2
```

[95]:
```
from sklearn.linear_model import LogisticRegression
X = df['x1'].to_numpy().reshape(-1,1)
Y = df['y'].to_numpy()

model = LogisticRegression()
model.fit(X, Y)
b0 = model.intercept_[0]
b1= model.coef_[0]
print(f'Intercept (B0): {B0}')
print(f'Coefficient for X1 (B1): {B1}')
prediction=[0,0,0,0,0,0,0,0,0,0]
pred=[0]*10
loss=[0]*10
for i in range (10):
    prediction[i] = 1 / (1 + math.exp((-(b0 + b1*x1[i] ))))
    if (prediction[i]>=0.5):
        pred[i]=1
    else:
        pred[i]=0
    log_loss = -np.mean(y[i] * np.log(prediction[i]) + (1 - y[i]) * np.log(1 -␣
 ↪prediction[i]))
    loss[i]=y[i] * np.log(prediction[i]) + (1 - y[i]) * np.log(1 -␣
 ↪prediction[i])
print('prediction\n',prediction)
print('pred\n',pred)
print('loss\n',log_loss)
print("Confusion Matrix:")
print(confusion_matrix(Y, pred))
print("\nClassification Report:")
print(classification_report(Y, pred))
parameters_and_errors = []
for i in range(len(df)):
    instance = df.iloc[i]
    X1_value = instance['x1']
    Y_value = instance['y']
    predictions = prediction[i]
    error = - (Y_value * np.log(predictions) + (1 - Y_value) * np.log(1 -␣
 ↪predictions))
    parameters_and_errors.append((X1_value, X2_value, B0, B1, B2, predictions,␣
 ↪error))

# For example, to plot B1 vs. Error
B1_values = [item[3] for item in parameters_and_errors]
errors = [item[6] for item in parameters_and_errors]
plt.plot(B1_values, errors)
```

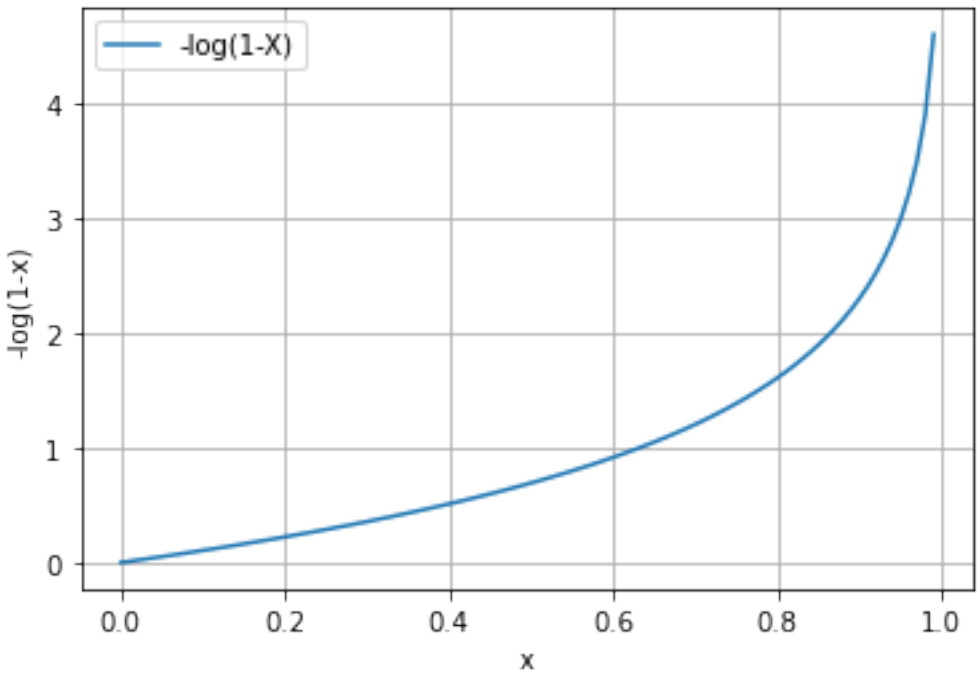
```
plt.xlabel('B1')
plt.ylabel('Error')
plt.title('B1 vs. Error')
plt.show()
```

```
Intercept (B0): -4.551633521124653
Coefficient for X1 (B1): 1.183834155636202
prediction
 [0.09011843087420256, 0.019369574767893347, 0.17394784416907869,
0.01764723237807845, 0.12288607383137673, 0.974100253490875, 0.6930840238300584,
0.9406635985967389, 0.9926923584787827, 0.9754917334436186]
pred
 [0, 0, 0, 0, 0, 1, 1, 1, 1, 1]
loss
 0.02481359312851262
Confusion Matrix:
[[5 0]
 [0 5]]

Classification Report:
              precision    recall  f1-score   support

           0       1.00      1.00      1.00         5
           1       1.00      1.00      1.00         5

    accuracy                           1.00        10
   macro avg       1.00      1.00      1.00        10
weighted avg       1.00      1.00      1.00        10
```



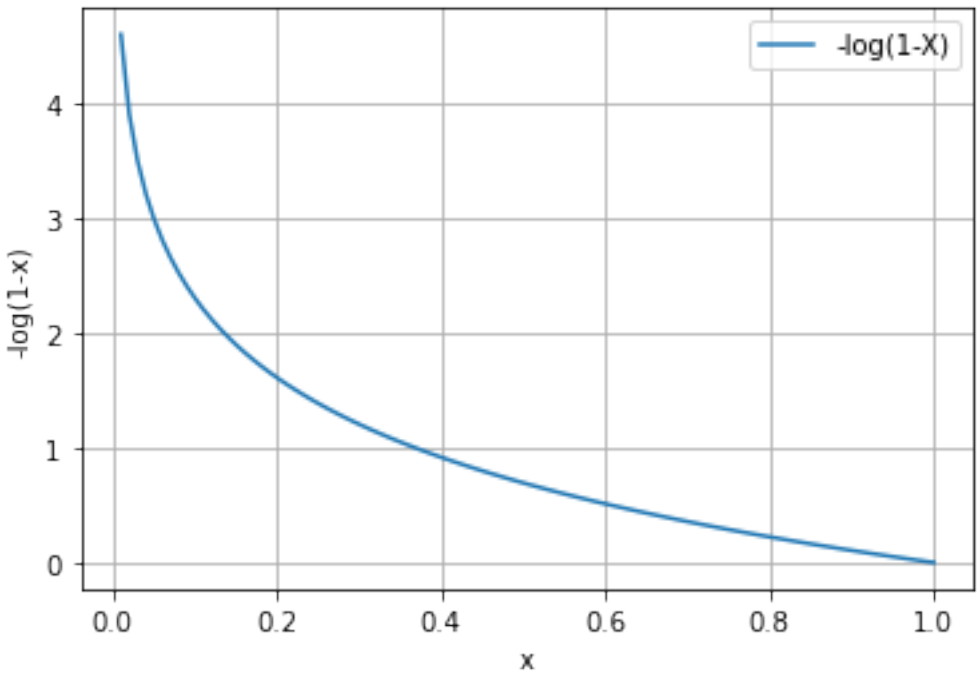
[99]:
```
xab= np.linspace(0,1,100)
yab = -np.log(1-xab)
plt.plot(xab,yab,label="-log(1-X)")
plt.xlabel("x")
plt.ylabel("-log(1-x)")
plt.legend()
plt.grid()
plt.show()
```

```
/tmp/ipykernel_4334/2533538379.py:2: RuntimeWarning: divide by zero encountered
in log
  yab = -np.log(1-xab) #Plotting a vertical line at x=0:
```



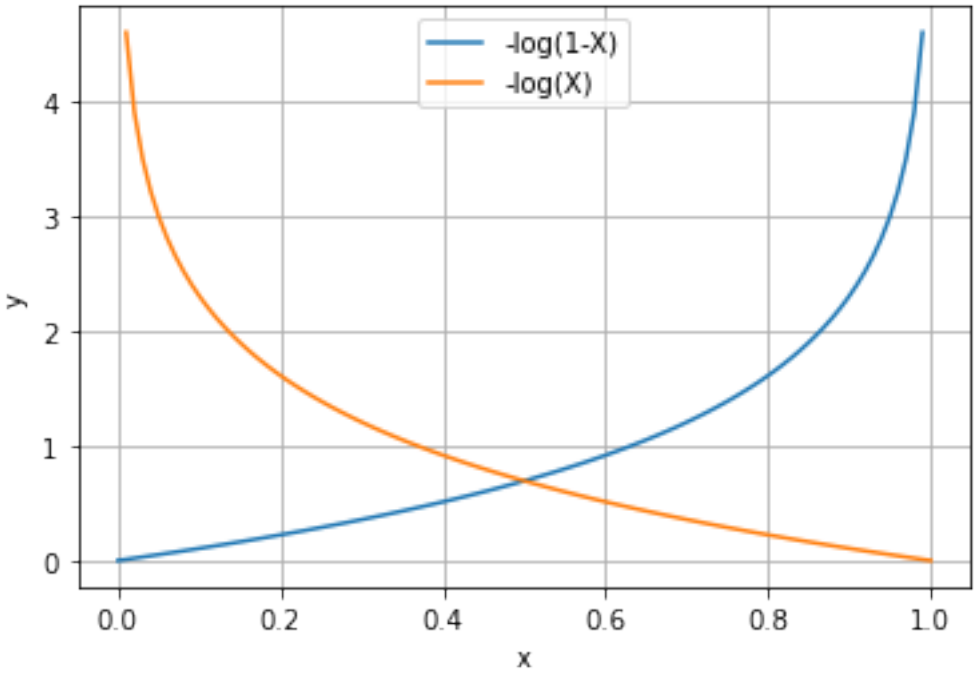
[100]:
```
xab= np.linspace(0,1,100)
yab = -np.log(xab)
plt.plot(xab,yab,label="-log(X)")
plt.xlabel("x")
plt.ylabel("-log(1-x)")
plt.legend()
plt.grid()
plt.show()
```

```
/tmp/ipykernel_4334/1519483183.py:2: RuntimeWarning: divide by zero encountered
in log
  yab = -np.log(xab) #Plotting a vertical line at x=0:
```



[101]:
```
xab= np.linspace(0,1,100)
yab = -np.log(1-xab)
zab= -np.log(xab)
plt.plot(xab,yab,label="-log(1-X)")
plt.plot(xab,zab,label="-log(X)")
plt.xlabel("x")
plt.ylabel("y")
plt.legend()
plt.grid()
plt.show()
```

```
/tmp/ipykernel_4334/2108430089.py:2: RuntimeWarning: divide by zero encountered
in log
  yab = -np.log(1-xab)
/tmp/ipykernel_4334/2108430089.py:3: RuntimeWarning: divide by zero encountered
in log
  zab= -np.log(xab)
```


-log(1-X)
-log(X)
y
x
0
1
2
3
4
0.0
0.2
0.4
0.6
0.8
1.0

[ ]:
```
#
```