

ROC- AUC Curve

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ROC – AUC Curve

- **Main idea**: Receiver Operating Curve (ROC) shows the performance of the classification model at different threshold settings.
- ROC is a probability curve and AUC represents the degree or measure of separability.
- It tells how much the model is capable of distinguishing between classes.
- Higher the AUC, the better the model is at predicting 0 classes as 0 and 1 classes as 1.
- It is consider that Higher the AUC, the better the model is at distinguishing between patients with the disease and no disease.
- The ROC curve is plotted with True Positive Rate (TPR) against the False Positive Rate (FPR) where TPR is on the y-axis and FPR is on the x-axis.

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- The **TPR** and **FPR** is given by-

$$TPR = \frac{T_p}{T_p + F_n}$$

$$FPR = \frac{F_p}{T_n + F_p}$$

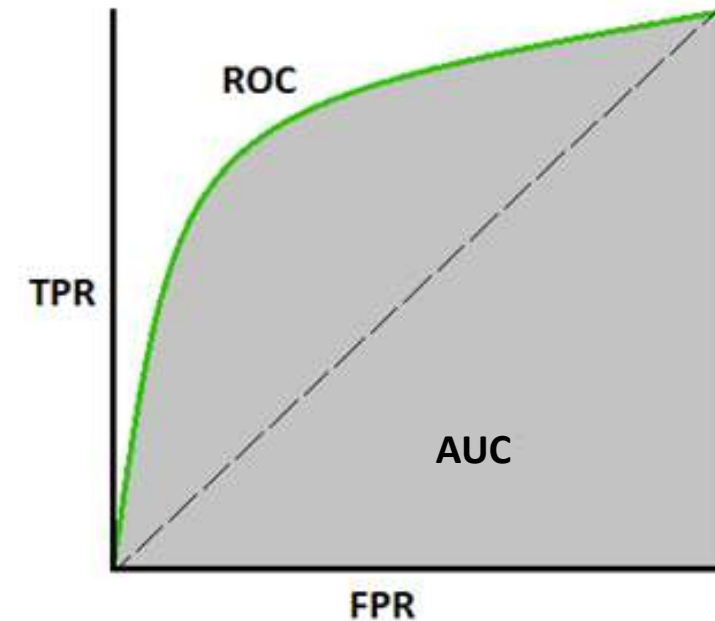


Fig. 1. ROC-AUC Curve.

Image courtesy: My Photoshopped Collection

- It is considered that more the AUC, better the model in classifying positive class as positive and negative as negative.

Example Problem-

- **Suppose**, a classification model yields the classification probability as shown in Table 1.

Step 1 - Let us set the different Threshold as $\alpha = [0, 0.2, 0.4, 0.8, 1]$

Step 2 - Taking first threshold as $\alpha = [0]$, we will get-

Step 3 - $TPR = \frac{4}{4+0} = 1$

& $FPR = \frac{2}{2+0} = 1$

Therefore TPR, FPR at $\alpha = [0]$ is (1,1)

Output	Class. Prob. (Y)	At $\alpha = [0]$ Y_1
1	0.8	1
0	0.96	1
1	0.4	1
1	0.3	1
0	0.2	1
1	0.7	1

Table 2. Predicted Output at $\alpha = [0]$

Output	Class. Prob. (Y)
1	0.8
0	0.96
1	0.4
1	0.3
0	0.2
1	0.7

Table 1. Actual Output vs Classification yielded Prob.

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Step 4 - Repeating all the steps from **Step 1** to **Step 3** at $\alpha = [0.2]$, we will get-

$$\text{TPR} = \frac{4}{4+0} = 1$$

$$\& \text{FPR} = \frac{1}{1+1} = 0.5$$

Therefore TPR, FPR at $\alpha = [0.2]$ is (1 , 0.5)

Step 5 - Again repeating all the steps from **Step 1** to **Step 3** at $\alpha = [0.4]$, we will get-

$$\text{TPR} = \frac{2}{2+2} = 0.5$$

$$\& \text{FPR} = \frac{1}{1+1} = 0.5$$

Therefore TPR, FPR at $\alpha = [0.4]$ is (0.5 , 0.5)

Output	Class. Prob. (Y)	At $\alpha = [0.2]$ Y_1
1	0.8	1
0	0.96	1
1	0.4	1
1	0.3	1
0	0.2	0
1	0.7	1

Table 3. Predicted Output at $\alpha = [0.2]$

Output	Class. Prob. (Y)	At $\alpha = [0.4]$ Y_1
1	0.8	1
0	0.96	1
1	0.4	0
1	0.3	0
0	0.2	0
1	0.7	1

Table 4. Predicted Output at $\alpha = [0.4]$

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Step 6 - Repeating all the steps from **Step 1** to **Step 3** at $\alpha = [0.8]$, we will get-

$$\text{TPR} = \frac{0}{0+4} = 0$$

$$\& \text{FPR} = \frac{1}{1+1} = 0.5$$

Therefore TPR, FPR at $\alpha = [0.8]$ is (0 , 0.5)

Step 7 - Again repeating all the steps from **Step 1** to **Step 3** at $\alpha = [1]$, we will get-

$$\text{TPR} = \frac{0}{0+4} = 0$$

$$\& \text{FPR} = \frac{0}{0+2} = 0$$

Therefore TPR, FPR at $\alpha = [1]$ is (0 , 0)

Output	Class. Prob. (Y)	At $\alpha = [0.8]$ Y_1
1	0.8	0
0	0.96	1
1	0.4	0
1	0.3	0
0	0.2	0
1	0.7	0

Table 5. Predicted Output at $\alpha = [0.8]$

Output	Class. Prob. (Y)	At $\alpha = [1]$ Y_1
1	0.8	0
0	0.96	0
1	0.4	0
1	0.3	0
0	0.2	0
1	0.7	0

Table 6. Predicted Output at $\alpha = [1]$

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Step 8 – Finally, plotting the **ROC** curve at different threshold setting we will get-

Threshold	TPR	FPR
0	1	1
0.2	1	0.5
0.4	0.5	0.5
0.8	0	0.5
1	0	0

Table 7. TPR, FPR values at different threshold settings.

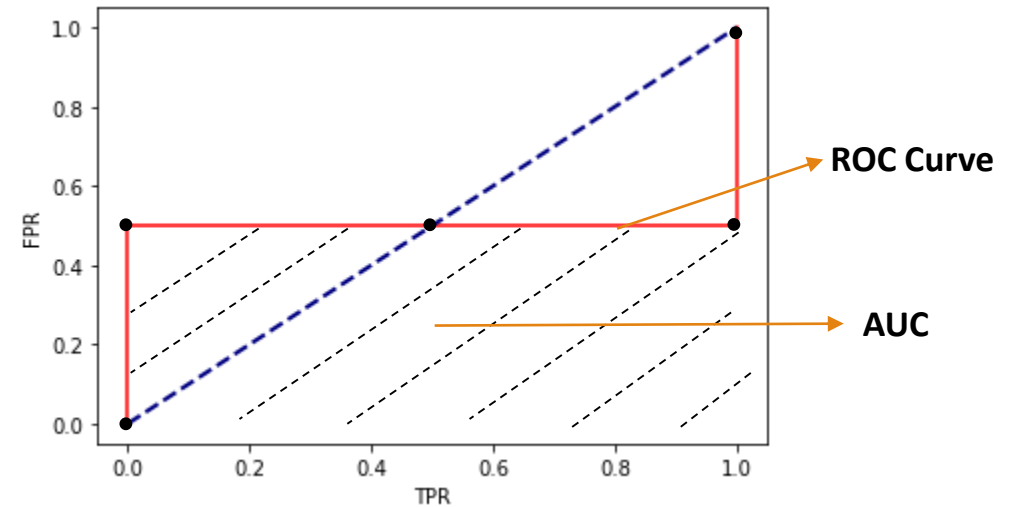


Fig. 2. ROC-AUC Curve.

Thank You