Examples to plot ROC Curve

1. The university has developed a biometric system for the students to mark their attendance using their faces. The biometric system will help the university to predict regular and irregular students. The probability of correct prediction for each student is provided in Table 1. Draw a Receiver Operating Characteristics (ROC) curve for the biometrics system thus defined.

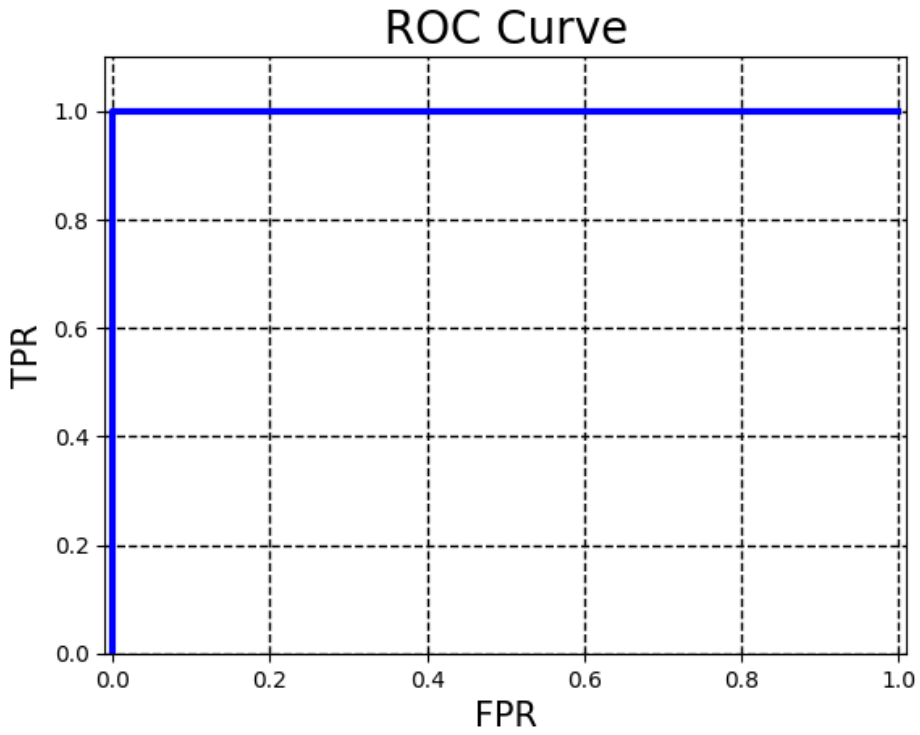
Table 1

Student's Roll Number	*Student's Status based on Ground Truth Attendance*	*Probability of Correct Prediction*
1	Regular	0.85
2	Irregular	0.12
3	Irregular	0.34
4	Regular	0.92
5	Regular	0.78
6	Irregular	0.45
7	Regular	0.67
8	Irregular	0.28
9	Irregular	0.19
10	Regular	0.88

Answer: (The table can be created using excel file provided)

$$FPR = \frac{FP}{Total\ Number\ of\ FP}\ and\ TPR = \frac{TP}{Total\ Number\ of\ TP}$$

Student's Roll Number	*Student's Status based on Ground Truth Attendance*	*Probability of Correct Prediction*	*TP*	*FP*	*FPR*	*TPR*
1	Regular	0.85	3	0	0	0.6
2	Irregular	0.12	5	5	1	1
3	Irregular	0.34	5	2	0.4	1
4	Regular	0.92	1	0	0	0.2
5	Regular	0.78	4	0	0	0.8
6	Irregular	0.45	5	1	0.2	1
7	Regular	0.67	5	0	0	1
8	Irregular	0.28	5	3	0.6	1
9	Irregular	0.19	5	4	0.8	1
10	Regular	0.88	2	0	0	0.4



2. The Institute of National Repute has developed a biometric system for scientists to enter the laboratory using a combination of fingerprint and iris. The biometric system will help the Institute to validate the legitimate user for laboratory entry. The probability of correct prediction for each scientist is provided in the following Table 2. Draw a Receiver Operating Characteristics (ROC) curve for the biometrics system thus defined.

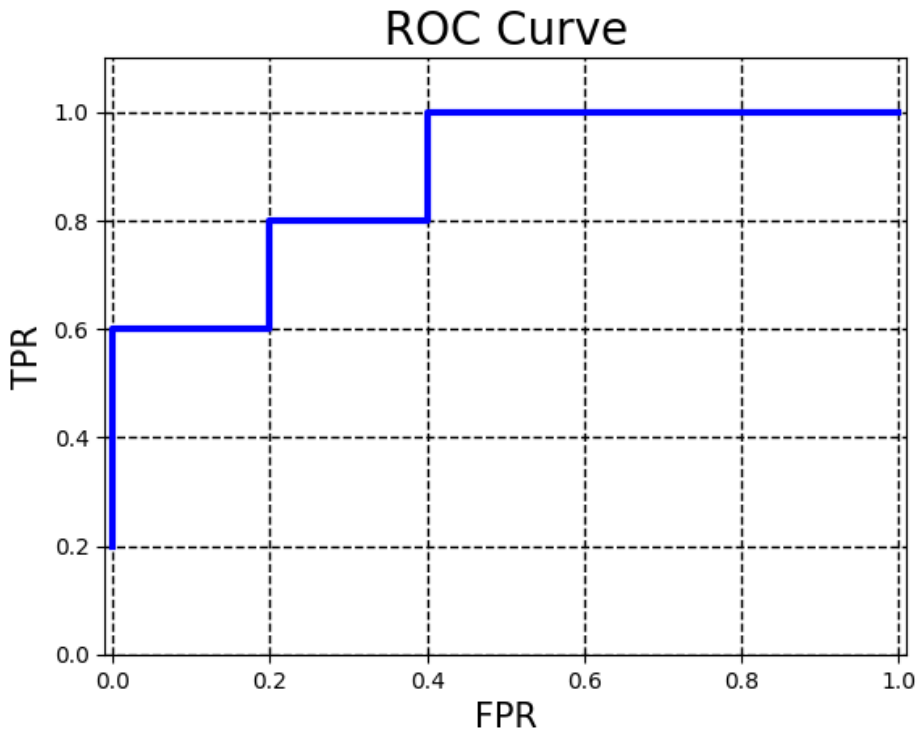
Table 2

Scientist's Employment ID	*Class of the Scientist*	*Probability of Correct Prediction*
1	dummy	0.78
2	legitimate	0.95
3	legitimate	0.65
4	dummy	0.23
5	dummy	0.56
6	legitimate	0.99
7	dummy	0.33
8	legitimate	0.88
9	legitimate	0.43
10	dummy	0.10

Answer: (The table can be created using excel file provided)

$$FPR = \frac{FP}{Total\ Number\ of\ FP}\ and\ TPR = \frac{TP}{Total\ Number\ of\ TP}$$

Scientist's Employment ID	*Class of the Scientist*	*Probability of Correct Prediction*	*TP*	*FP*	*FPR*	*TPR*
1	dummy	0.78	3	1	0.2	0.6
2	legitimate	0.95	2	0	0	0.4
3	legitimate	0.65	4	1	0.2	0.8
4	dummy	0.23	5	4	0.8	1
5	dummy	0.56	4	2	0.4	0.8
6	legitimate	0.99	1	0	0	0.2
7	dummy	0.33	5	3	0.6	1
8	legitimate	0.88	3	0	0	0.6
9	legitimate	0.43	5	2	0.4	1
10	dummy	0.1	5	5	1	1



Examples to plot CMC Curve

3. The university wishes to identify regular students in the academic sessions for the biometric system explained in Q.1. Thus, the biometric system is tested by presenting 500 probe samples. The number of genuine matches out of 500 probe samples is noted for each of the top 10 rank metrics. The resulting genuine rank histogram is given in Table 3 below. Plot the Cumulative Match Characteristics (CMC) curve for the biometric system.

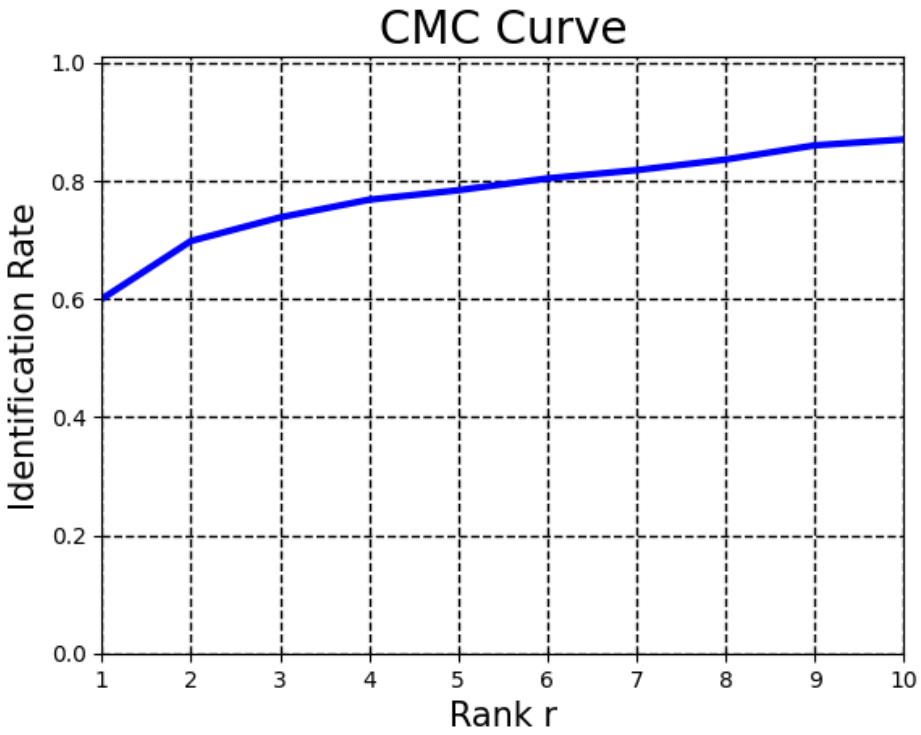
Table 3

Rank of the Genuine Match	*Rank Count of Genuine Matches*
R1	300
R2	49
R3	20
R4	15
R5	8
R6	10
R7	7
R8	9
R9	12
R10	5

Answer: (The table can be created using excel file provided)

$$Identification\ Rate = \frac{\sum_{r=1}^{10} Rank\ Count(r)}{Total\ Number\ of\ Probes}$$

Total Number of Probes	*500*	
Rank of the Genuine Match	*Rank Count*	*Identification Rate*
R1	300	0.6
R2	49	0.698
R3	20	0.738
R4	15	0.768
R5	8	0.784
R6	10	0.804
R7	7	0.818
R8	9	0.836
R9	12	0.86
R10	5	0.87



4. The Institute of National Repute wishes to identify legitimate scientists for the biometric system explained in Q.2. Thus, the biometric system is tested by presenting 700 probe samples. The number of genuine matches out of 700 probe samples is noted for each of the top 10 rank metrics. The resulting genuine rank histogram is given in Table 4 below. Plot the Cumulative match Characteristics (CMC) curve for the biometric system.

Table 4

Rank of the Genuine Match	*Rank Count of Genuine Matches*
R1	423
R2	123
R3	51
R4	33
R5	20
R6	23
R7	11
R8	7
R9	5
R10	2

Answer: (The table can be created using excel file provided)

$$Identification\ Rate = \frac{\sum_{r=1}^{10} Rank\ Count(r)}{Total\ Number\ of\ Probes}$$

Total Number of Queries	*700*	
Rank of the Genuine Match	*Rank Count*	*Identification Rate*
R1	423	0.604285714
R2	123	0.78
R3	51	0.852857143
R4	33	0.9
R5	20	0.928571429
R6	23	0.961428571
R7	11	0.977142857
R8	7	0.987142857
R9	5	0.994285714
R10	2	0.997142857