

1. Use the three-class confusion matrix below to answer questions a through f.

Computed Decision			
	Class 1	Class 2	Class 3
Class 1	42	2	1
Class 2	5	40	3
Class 3	0	3	4

- a. What percent of the instances were correctly classified? (0.5)

$$42+40+4 = 86$$

$$86/100 = 86\%$$

- b. According to Confusion matrix, how many Class 1/Class 2/Class 3 instances are there in the dataset?(0.5)

Class 1: 45

Class 2: 48

Class 3: 7

- c. How many instances were incorrectly classified with Class 1/Class2/Class 3? (0.5)

Class 1: 5

Class 2: 5

Class 3: 4

- d. Calculate Sensitivity, Specificity of class 1 . (1)

Computed Decision Class 1			
	Class 1	Class 2	Class 3
Class 1	42 (TP)	2(FN)	1(FN)
Class 2	5(FP)	40(TN)	3
Class 3	0(FP)	3	4(TN)

Computed Decision Class 2			
	Class 1	Class 2	Class 3
Class 1	42 (TN)	2(FP)	1

<b>Class 2</b>	5(FN)	40(TP)	3(FN)
<b>Class 3</b>	0	3(FP)	4(TN)

Computed Decision Class 3			
	<b>Class 1</b>	<b>Class 2</b>	<b>Class 3</b>
<b>Class 1</b>	42	2	1(FP)
<b>Class 2</b>	5	40	3(FP)
<b>Class 3</b>	0(FN)	3(FN)	4(TP)

Sensitivity(TPR)= recall=  $TP/(TP+FN)$

Class 1 :  $42/(42+2+1) = 42/45 = 0.93$

Class 2:  $40/(40+5+3) = 40/48 = 0.83$

Class 3:  $4/(4+3+0) = 4/7 = 0.57$

Specificity (TNR) =  $TN/(TN+FP)$

Class 1:  $(40+4)/(40+4)+(5+0) = 44/49 = 0.90$

Class 2:  $(42+4)/(46+2+3) = 46/51 = 0.90$

Class 3:  $(40+42)/(82+1+3) = 82/86 = 0.95$

**e. Calculate FPR and FNR of class 1. (1.5)**

$FPR = 1 - \text{Specificity} = FP/(FP+TN)$

Class 1 :  $1 - .90 = 0.1$

Class 2:  $1 - .90 = 0.1$

Class 3:  $1 - .95 = 0.05$

$FNR = FN/(FN+TP)$  or  $1 - TPR$

Class 1 :  $3/(3+42) = 3/45 = 0.067$

Class 2:  $8/(8+40) = 8/48 = 0.17$

Class 3:  $3/7 = 0.43$

**f. Calculate F1 score of class 1. (1)**

Precision =  $\# \text{ True positives} / \# \text{ predicted positive} = TP/(TP+FP)$

Class 1:  $42/(42+5) = 0.875$

Class 2:  $40/(40+5) = 0.89$

Class 3:  $4/(4+4) = 0.5$

$$F1 = 2 * (\text{precision} * \text{recall}) / (\text{precision} + \text{recall})$$

$$\text{Class 1: } 2 * (0.875 * 0.93) / (0.875 + 0.93) = 2 * (0.82 / 1.81) = 0.91$$

$$\text{Class 2: } 2 * (0.89 * 0.83) / (0.89 + 0.83) = 2 * (0.74 / 1.72) = 0.86$$

$$\text{Class 3: } 2 * (0.5 * 0.57) / (0.5 + 0.57) = 2 * (0.29 / 1.07) = 0.54$$