Definition :

to describe the performance of a classification model (or "classifier") on a set of test data for which the true values are known The confusion matrix shows the ways in which your classification model is confused when it makes predictions. It gives insight not only into the errors being made by your classifier but, more importantly, the types of errors that are being made

Structure :

A confusion matrix is a table with two dimensions ("Actual" and "Predicted"), and identical sets of "classes" in both dimensions. It compares the actual target values with those predicted by the machine learning model.

		Predicted	
Actual		Positive	Negative
Positive		True Positive (TP)	False Negative (FN)
Negative		False Positive (FP)	True Negative (TN)

four quadrants of the confusion matrix:

True Positive (TP): Correctly predicted positive class.
True Negative (TN): Correctly predicted negative class.
False Positive (FP): Incorrectly predicted positive class (Type I error).
False Negative (FN): Incorrectly predicted negative class (Type II error).

		Predicted	
Actual		**Spam**	**Not Spam**
Spam		TP = 40	FN = 10
Not Spam		FP = 5	TN = 45

Accuracy

the proportion of the total number of predictions that were correct

Formula:

(TP + TN) / (TP + TN + FP + FN)

E.g. Accuracy = (40 + 45) / (40 + 45 + 5 + 10) = 85 / 100 = 0.85

Precision

the proportion of positive identifications that were actually correct. It answers: "What proportion of predicted positives is actually positive?"

Formula:

Precision = TP / (TP + FP)

Precision = 40 / (40 + 5) = 40 / 45 ≈ 0.8889

Recall (Sensitivity or True Positive Rate)

the proportion of actual positives that were correctly identified. It answers: "What proportion of actual positives was correctly classified?"

Formula:

Recall = TP / (TP + FN)

Recall = 40 / (40 + 10) = 40 / 50 = 0.80

Specificity

the proportion of actual negatives that were correctly identified.

Formula:

Specificity = TN / (TN + FP)

Specificity = 45 / (45 + 5) = 45 / 50 = 0.90

F-1 Score

the harmonic mean of Precision and Recall. It provides a balance between Precision and Recall.

Formula;

F1 Score = 2 * (Precision * Recall) / (Precision + Recall)

F1 Score = 2 * (0.8889 * 0.80) / (0.8889 + 0.80) ≈ 0.8421

False Positive Rate (Fall-out)

proportion of actual negatives that were incorrectly classified as positives.

Formula:

False Positive Rate = FP / (FP + TN)

False Positive Rate = 5 / (5 + 45) = 5 / 50 = 0.10