**Answer**

**Q1**. Basic Confusion Matrix Construction

A binary classifier gave the following results:

50 samples were actually positive, and it predicted 45 as positive, 5 as negative.

Out of 50 actually negative samples, it predicted 10 as positive, 40 as negative.

👉 Construct the confusion matrix.

👉 Calculate:

Accuracy = TP + TN / TP + TN + FP + FN = 0.85%

Precision = TP / TP + FP = 0.8182%

Recall = TP / TP + FN = 0.9%

F1 Score = 2 \* (Precision \* Recall) / (Precision + Recall) = 0.8572%

**Q2**. Fill in the Blanks

A model produced the following confusion matrix:

Predicted Positive Predicted Negative

Actual Positive 70 30

Actual Negative 10 90 (Assumed)

Find the missing number. Then, calculate:

Accuracy = TP + TN / TP + TN + FP + FN = 0.80 %

Precision = TP / TP + FP = 0.875 %

Recall = TP / TP + FN = 0.70%

F1 Score = 2 \* (Precision \* Recall) / (Precision + Recall) = 0.778%

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**Q3**. Model Comparison

Two models A and B gave the following metrics:

Metric Model A Model B

TP 80 60

FP 20 10

FN 40 20

TN 60 90

👉 For model 1, calculate:

Accuracy = TP + TN / TP + TN + FP + FN = 0.7 %

Precision = TP / TP + FP = 0.8 %

Recall = TP / TP + FN = 0.6666%

F1 Score = 2 \* (Precision \* Recall) / (Precision + Recall) = 0.7272%

👉 For model 2, calculate:

Accuracy = TP + TN / TP + TN + FP + FN = 0.8333 %

Precision = TP / TP + FP = 0.8571%

Recall = TP / TP + FN = 0.75%

F1 Score = 2 \* (Precision \* Recall) / (Precision + Recall) = 0.7999 %

👉 Which model performs better in terms of F1 score?

Model B performs better in terms of F1 score.

**Q4.** Precision vs Recall Tradeoff

A medical test detects a disease. Out of 1000 people:

100 have the disease (actual positive)

Model detects 95 positives, out of which only 60 are correct

👉 Calculate:

TP = 60, FP = 35 , FN = 40, TN = 865

Accuracy = TP + TN / TP + TN + FP + FN = 0.925 %

Precision = TP / TP + FP = 0.632 %

Recall = TP / TP + FN = 0.60 %

F1 Score = 2 \* (Precision \* Recall) / (Precision + Recall) = 0.616 %

**Q5.** Imbalanced Dataset Challenge

A dataset contains 950 negatives and 50 positives.

A model predicts all as negative.

👉 Create the confusion matrix

Predicted Positive Predicted Negative

Actual Positive TP = 0 FN = 50

Actual Negative FP = 0 PN = 950

👉 Calculate all five metrics

TP = 0, FP = 0, FN = 50, TN = 950

Accuracy = TP + TN / TP + TN + FP + FN = 0.95 %

Precision = TP / TP + FP = 0 %

Recall = TP / TP + FN = 0 %

F1 Score = 2 \* (Precision \* Recall) / (Precision + Recall) = 0 %

👉 Interpret whether this is a good model or not. Why?

This is not a good model. Because it is biased toward the majority class (negatives), and it fails completely at detecting the minority class (positives).

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**Q6.** Improving Precision

A spam filter model flags 100 emails as spam.

Out of them, 80 are really spam.

The model misses 20 spam emails.

👉 Calculate:

TP = 80, FP = 20, FN = 20

Precision = 0.80

Recall = 0.80

F1 Score = 0.80

Now, recommend one method to improve precision.

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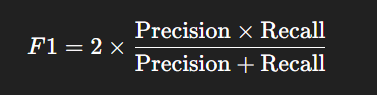
**Q7.** F1 Score Focus

A binary classification model has:

Precision = 0.75

Recall = 0.60

👉 Calculate the F1 Score using the formula:

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F1 Score = 0.667

**Q8.** Real-Life Example

A facial recognition system unlocks a phone only for the actual user. Out of 100 attempts:

30 were from the real user, and 25 were accepted.

70 were from others, and 10 were wrongly accepted.

👉 Find:

Confusion matrix (TP, FP, FN, TN)

Predicted Positive Predicted Negative

Actual Positive TP = 25 FN = 5

Actual Negative FP = 10 TN = 60

Precision = 0.714, Recall = 0.833, Accuracy = 0.85, F1 Score = 0.77

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**Q9.** Calculate from Percentages

Given the following:

Precision = 85%, Recall = 68%

👉 Compute the F1 Score

F1 Score = 0.755

👉 What does this score say about the balance of the model?

The F1 Score balances precision and recall, making it especially useful when both false positives and false negative matter.

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**Q10**. Multi-Step: Find the Missing

A model gives:

Precision = 0.80

TP = 64

FP = 16

FN = 36

👉 Calculate:

Recall = 0.64

F1 Score = 0.711

TN (assume total = 200 samples) = 84