📘 Assignment: Evaluation Metrics in Classification

Topic: Confusion Matrix, Accuracy, Precision, Recall, F1 Score

Level: Beginner to Intermediate

Objective: Understand how classification models are evaluated using various performance metrics.

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✅ Instructions:

1. Solve all questions showing step-by-step working.

2. Final answers must be in percentage or decimal up to 2 decimal places, where applicable.

3. Use a calculator where needed, but show all formulas.

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🔢 Questions

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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.

True Positive:-45

True Negative:-40

False Positive :-10

False Positive:- 5

👉 Calculate:

Accuracy:

Accuracy=TP+TN/(TP+TN+FP+FN)=45+40/(45+40+100+5)=85/100=0.85

Precision:

Precision=TP/(FP+TP)​=45/(45+10)=45​/55≈0.818

Recall:

Recall=TP/(FN+TP)​=45/(45+5)​=0.9

F1 Score:

2\*Precision\*Recall/ Precision+Recall=2\*0.818\*0.9/0.818+0.9=2\*0.7362/1.718=0.857

Q2. Fill in the Blanks

A model produced the following confusion matrix:

Predicted Positive Predicted Negative

Actual Positive 70 30

Actual Negative 10 \_\_\_

Find the missing number. Then, calculate:

Accuracy

Precision

Recall

F1 Score

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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 each model, calculate:

Accuracy

Precision

Recall

F1 Score

👉 Which model performs better in terms of F1 score?

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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, FP, FN, TN

Precision

Recall

Accuracy

F1 Score

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Q5. Imbalanced Dataset Challenge

A dataset contains 950 negatives and 50 positives.

A model predicts all as negative.

👉 Create the confusion matrix

👉 Calculate all five metrics

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

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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, FP, FN

Precision

Recall

F1 Score

Now, recommend one method to improve precision.

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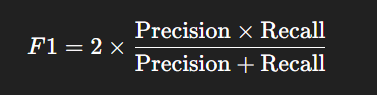
Q7. F1 Score Focus

A binary classification model has:

Precision = 0.75

Recall = 0.60

👉 Calculate the F1 Score using the formula:

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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)

Precision, Recall, Accuracy, F1 Score

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Q9. Calculate from Percentages

Given the following:

Precision = 85%, Recall = 68%

👉 Compute the F1 Score

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

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Q10. Multi-Step: Find the Missing

A model gives:

Precision = 0.80

TP = 64

FP = 16

FN = 36

👉 Calculate:

Recall

F1 Score

TN (assume total = 200 samples)