Confusion Matrix Metrics Practice Problems

(a) Binary confusion matrix

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

(b) Multiclass confusion matrix

		Actual Label: Class A	Actual Label: Class B	Actual Label: Class C
Predicted Label	Class A	1 TP_A (A as A)	2 $Error_{BA}$ (B as A)	3 $Error_{CA}$ (C as A)
Predicted Label	Class B	4 $Error_{AB}$ (A as B)	5 TP_B (B as B)	6 $Error_{CB}$ (C as B)
Predicted Label	Class C	7 $Error_{AC}$ (A as C)	8 $Error_{BC}$ (B as C)	9 TP_C (C as C)

Problem 1

A model predicts whether a user will subscribe to a newsletter.

n=100	Predicted No:	Predicted Yes:
Actual No 60	50	10
Actual Yes 40	5	35

Step 1 – Identify values:

TP = 45, TN = 40, FP = 10, FN = 5. Total = 100.

Step 2 – Metrics:

Precision = TP / (TP + FP) = 45 / 55 = 0.818

Recall = TP / (TP + FN) = 45 / 50 = 0.90

Accuracy = (TP + TN) / Total = 85 / 100 = 0.85

F1 = 2PR / (P + R) = 0.857

Problem 2

A bank predicts loan default.

n=165	**Predicted: NO**	**Predicted: YES**
Actual: NO	50	10
Actual: YES	5	100

Step 1 – Identify values:

TP = 60, TN = 90, FP = 30, FN = 20. Total = 200.

Step 2 – Metrics:

Precision = 60 / 90 = 0.667

Recall = 60 / 80 = 0.75

Accuracy = 150 / 200 = 0.75

F1 = 0.706

Problem 3

Fraud detection where fraud is rare.

	Pred No	**Pred Yes**
Actual No	950	30
Actual Yes	10	10

Step 1 – Identify values:

TP = 10, TN = 950, FP = 30, FN = 10.

Total = 1000.

Step 2 – Metrics:

Precision = 10 / 40 = 0.25

Recall = 10 / 20 = 0.50

Accuracy = 960 / 1000 = 0.96

F1 = 0.333

Problem 4

Medical screening test.

	Pred No	**Pred Yes**
Actual No	15	5
Actual Yes	35	45

Step 1 – Identify values:

TP = 45, TN = 15, FP = 5, FN = 35. Total = 100.

Step 2 – Metrics:

Precision = 45 / 50 = 0.90

Recall = 45 / 80 = 0.563

Accuracy = 60 / 100 = 0.60

F1 = 0.693

Problem 5

Marketing campaign response prediction.

Actual No / Pred No = 300

Actual No / Pred Yes = 120

Actual Yes / Pred No = 25

Actual Yes / Pred Yes = 55

Step 1 – Identify values:

TP = 55, TN = 300, FP = 120, FN = 25. Total = 500.

Step 2 – Metrics:

Precision = 55 / 175 = 0.314

Recall = 55 / 80 = 0.688

Accuracy = 355 / 500 = 0.71

F1 = 0.431