Deciding to Carry an Umbrella: A Confusion Matrix Analysis

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1 Problem Overview

Every morning, you check a weather app to decide whether to carry an umbrella, predicting if it will rain in the afternoon. We analyze this decision using a confusion matrix, which categorizes outcomes as True Positives (TP), True Negatives (TN), False Positives (FP), and False Negatives (FN).

1.1 Definitions

- Positive Class: It will rain (carry umbrella).
- Negative Class: It will not rain (don't carry umbrella).

2 Confusion Matrix Outcomes

The confusion matrix for this decision is:

	Actual Rain	Actual No Rain
Predicted Rain	True Positive (TP)	False Positive (FP)
Predicted No Rain	False Negative (FN)	True Negative (TN)

Table 1: Confusion Matrix for Umbrella Decision

- TP: Carry umbrella, it rains (stay dry).
- TN: Don't carry umbrella, no rain (travel light).
- FP: Carry umbrella, no rain (unnecessary hassle).
- FN: Don't carry umbrella, it rains (get wet).

3 Example: One Week of Decisions

Over a week, the outcomes were:

- Monday: Carried umbrella, it rained (TP = 1).
- Tuesday: Didn't carry, no rain (TN = 1).
- Wednesday: Carried umbrella, no rain (FP = 1).
- Thursday: Didn't carry, it rained (FN = 1).
- Friday: Didn't carry, no rain (TN = 1).

Total: TP = 1, TN = 2, FP = 1, FN = 1.

4 Metrics

- Accuracy: $\frac{\text{TP+TN}}{\text{TP+TN+FP+FN}} = \frac{1+2}{1+2+1+1} = \frac{3}{5} = 60\%$
- Precision: $\frac{\text{TP}}{\text{TP+FP}} = \frac{1}{1+1} = 50\%$
- Recall: $\frac{\text{TP}}{\text{TP+FN}} = \frac{1}{1+1} = 50\%$

5 Conclusion

The weather app was correct 60% of the time. Precision (50%) shows that half the time you carried an umbrella, it wasn't needed. Recall (50%) indicates you missed half the rainy days, risking getting wet. Adjusting the decision threshold (e.g., carrying an umbrella only for a high rain probability) could improve outcomes, balancing the inconvenience of carrying an umbrella against the risk of getting wet.