

## Sensitivity and Specificity in Machine Learning

**Sensitivity** and **Specificity** are essential metrics that evaluate a model's ability to classify positive and negative cases correctly.

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### ◆ Key Concepts

- **Sensitivity (Recall):** Measures correct identification of positives.

- **Formula:** Sensitivity = 
$$\frac{\text{True Positives (TP)}}{\text{TP} + \text{False Negatives (FN)}}$$

- **Specificity:** Measures correct identification of negatives.

- **Formula:** Specificity = 
$$\frac{\text{True Negatives (TN)}}{\text{TN} + \text{False Positives (FP)}}$$

### ◆ Confusion Matrix Breakdown

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

This matrix shows **true and false positives/negatives** to clarify prediction outcomes.

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### Key Insights

- **High Sensitivity** 🌟: Vital when identifying positives is crucial, like detecting diseases in medical screening.
- **High Specificity** 🌟: Useful in scenarios where minimizing false alarms is essential, like confirming the absence of a condition.

### Binary vs. Multi-Class Classification

- **Binary:** Sensitivity and specificity calculations are straightforward.
- **Multi-Class:** Each class requires individual sensitivity/specificity calculations, then averaging for overall evaluation.

### Real-World Applications

- Used beyond healthcare—common in finance, marketing, and fraud detection—these metrics guide decision-making in high-stakes predictions.

## ☠️ CONFUSION MATRIX EXAMPLE:

