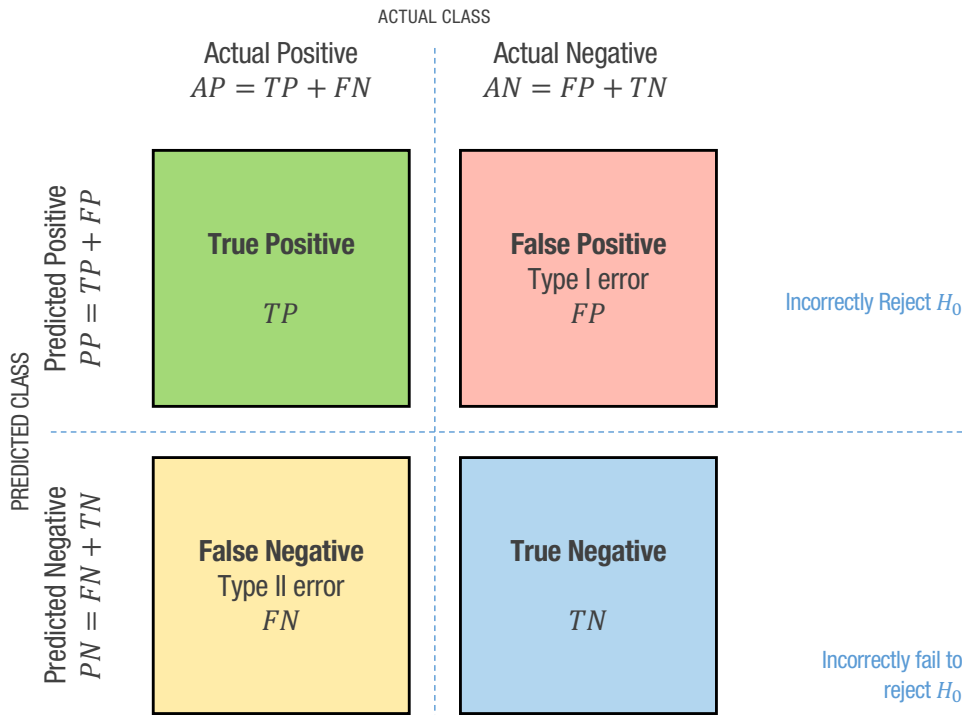


# Confusion Matrix Quick Reference

Total Population  
 $N$



TIP: Higher Precision indicates fewer false positives.

## Precision

also Positive Predictive Value (PPV)  
Proportion of predicted positives that were right

$$PPV = \frac{TP}{PP}$$

$$PPV = 1 - FDR \quad \updownarrow \quad FDR = 1 - PPV$$

## False Discovery Rate

How often model incorrectly discovered alternate hypothesis

$$FDR = \frac{FP}{PP}$$

## Negative Predictive Value

Proportion of predicted negatives that were right

$$NPV = \frac{TN}{PN}$$

$$NPV = 1 - FOR \quad \updownarrow \quad FOR = 1 - NPV$$

## False Omission Rate

How often model incorrectly omitted an alternate hypothesis

$$FOR = \frac{FN}{PN}$$

TIP: Higher Recall indicates fewer false negatives.

## Recall, Sensitivity

True Positive Rate (TPR)  
Coverage of actual positive sample

$$TPR = \frac{TP}{AP}$$

$$TPR = 1 - FNR \quad \updownarrow \quad FNR = 1 - TPR$$

## Miss Rate

False Negative Rate (FNR)  
Type II Error Rate ( $\beta$ )

$$FNR = \frac{FN}{AP}$$

## Fallout

False Positive Rate (FPR)  
Type I Error Rate ( $\alpha$ )

$$FPR = \frac{FP}{AN}$$

$$FPR = 1 - TNR \quad \updownarrow \quad TNR = 1 - FPR$$

## Specificity

True Negative Rate (TNR)  
Coverage of actual negative sample

$$TNR = \frac{TN}{AN}$$

## Accuracy

How much did the model get right overall?

$$ACC = \frac{TP + TN}{N}$$

$$ACC = 1 - ER \quad \updownarrow \quad ER = 1 - ACC$$

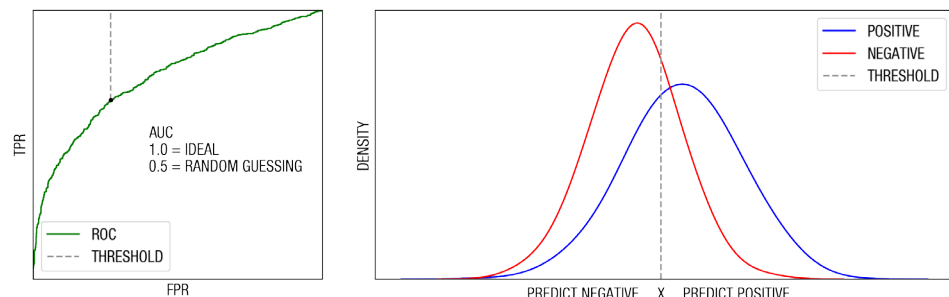
## Error Rate

How much did the model get wrong overall?

$$ER = \frac{FP + FN}{N}$$

## Receiver Operating Characteristic (ROC) Curve

Illustrate the tradeoff between model specificity and recall



## $F_1$ Score

Harmonic mean of precision and recall

$$F_1 = 2 \frac{\text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}$$

## $F_\beta$ Score

A generalization of  $F_1$  score such that recall is  $\beta$  times more important than precision

$$F_\beta = (1 + \beta^2) \frac{\text{Precision} \times \text{Recall}}{\beta^2 \times \text{Precision} + \text{Recall}}$$

smaller  $\beta \rightarrow$  emphasize precision, accept more FNs  
larger  $\beta \rightarrow$  emphasize recall, accept more FPs