DECISION PATTERNS

Classification Performance

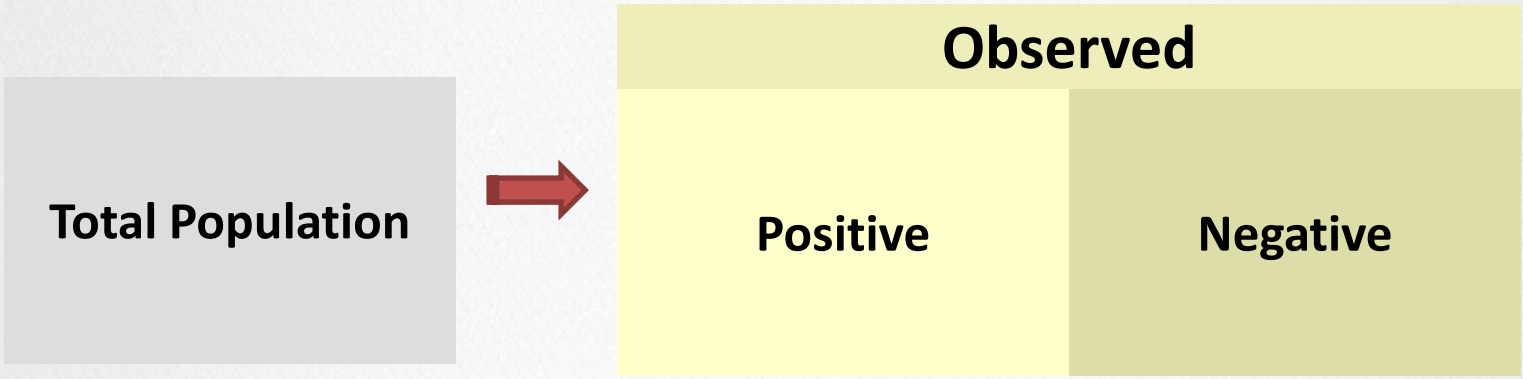
Practical Machine Learning (with R)

UC Berkeley

CLASSIFICATION PERFORMANCE

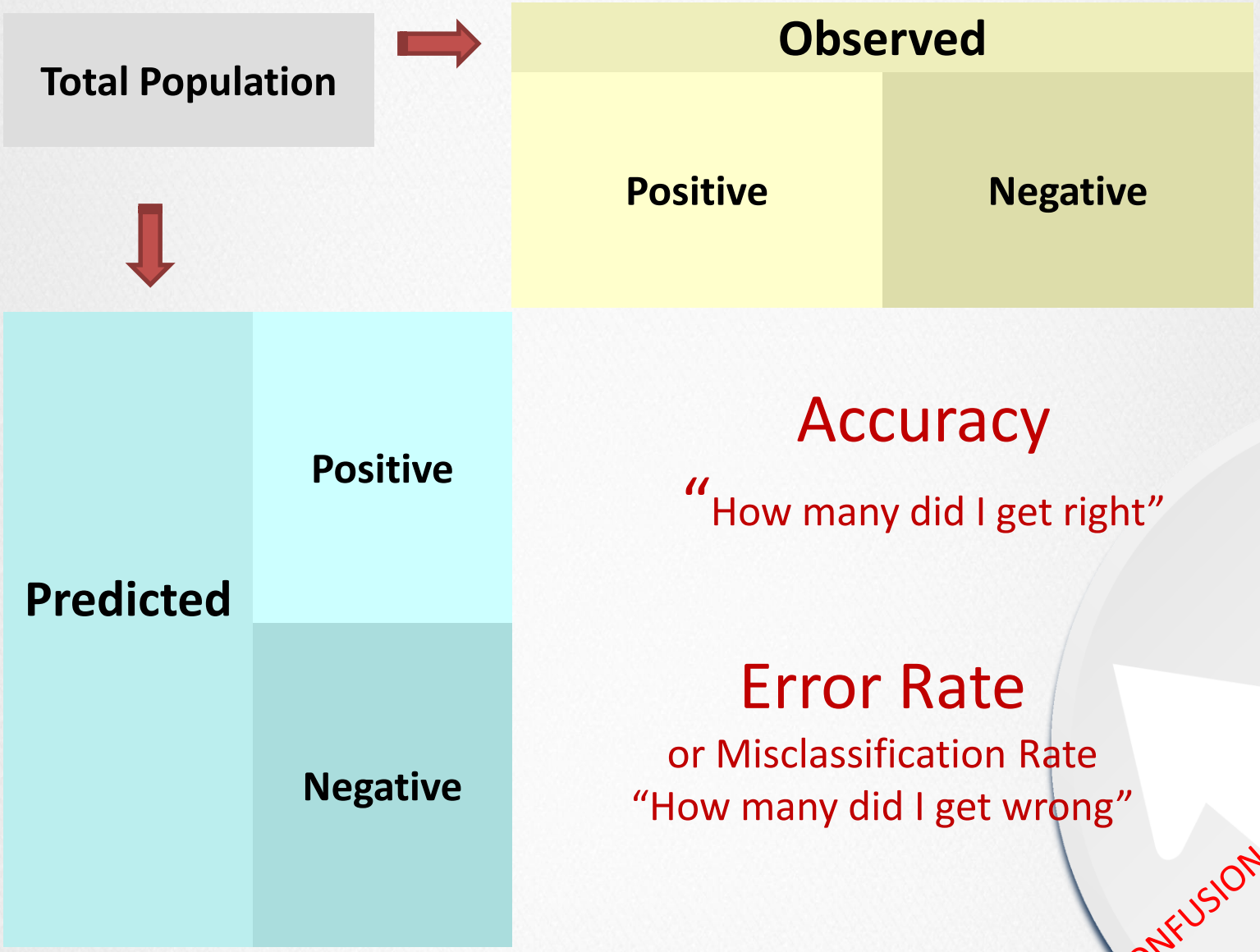
METRICS FOR BINOMIAL CLASSIFICATION

Total Population


Total Population
Observed
Positive
Negative

Total Population

Predicted	Positive
	Negative



Accuracy

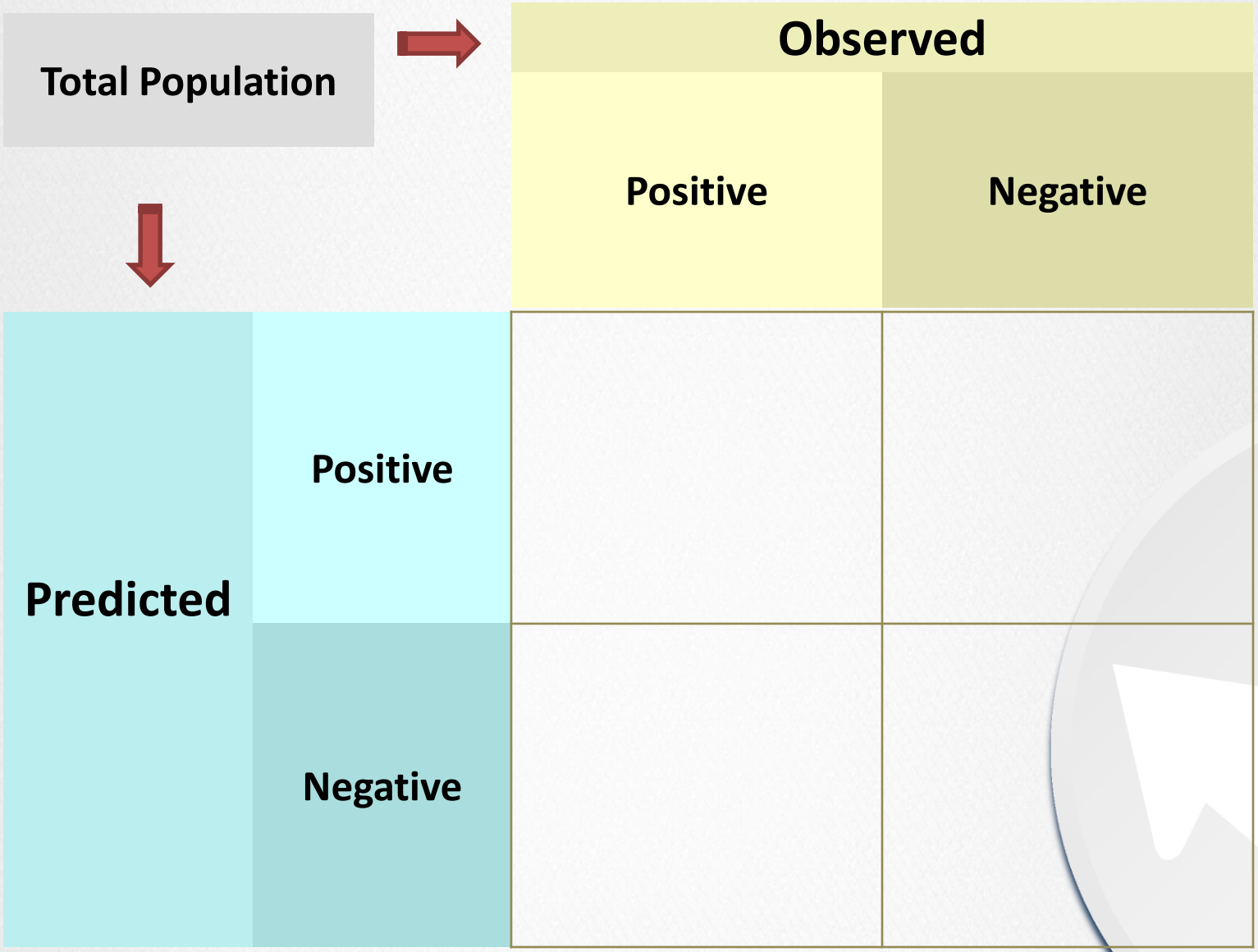
"How many did I get right"

Error Rate

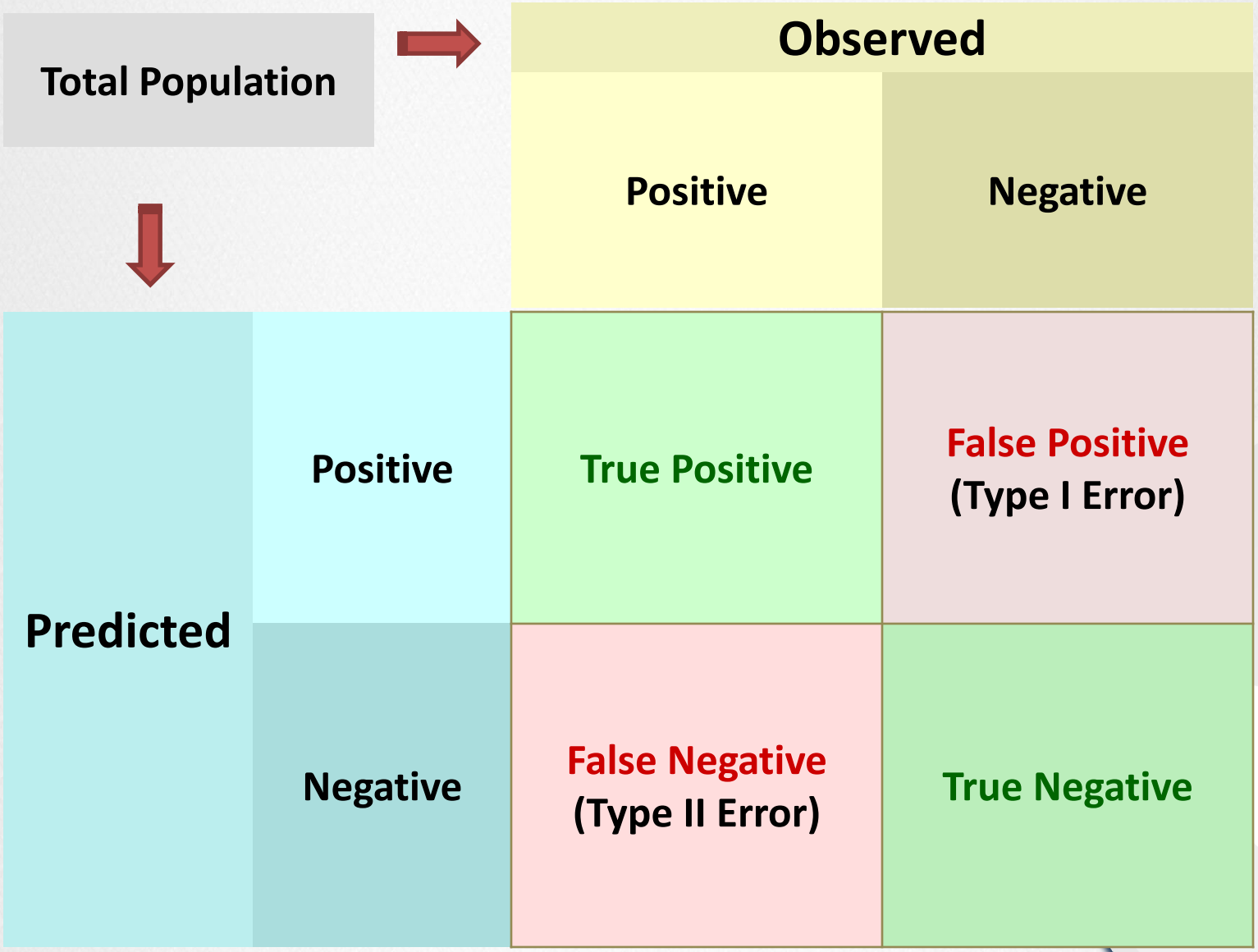
or Misclassification Rate

"How many did I get wrong"

CONFUSION MATRIX



- https://en.wikipedia.org/wiki/Sensitivity_and_specificity


Total Population
Observed
Positive
Negative
Predicted
Positive
Negative
True Positive
False Positive
(Type I Error)
False Negative
(Type II Error)
True Negative

Alternatives: Norm by Observed

Total Population		Observed: Positive	Observed: Negative
Predicted: Positive		True Positive Rate (TPR), **Sensitivity**, Recall $\frac{\text{True Positives}}{\textbf{Observed Positives}}$	False Positive Rate (FPR), Fall-Out $\frac{\text{False Positives}}{\textbf{Observed Negatives}}$
Predicted: Negative		False Neg. Rate (FNR), Miss rate $\frac{\text{False Negatives}}{\textbf{Observed Positives}}$	True Neg. Rate (TNR), **Specificity** (SPC) $\frac{\text{True Negatives}}{\textbf{Observed Negatives}}$

Alternatives: Norm by Predicted

Total Population		Observed: Positive	Observed: Negative
Predicted	Positive	Pos. Predictive Value (PPV), **Precision** $\frac{\text{True Positives}}{\textbf{Predicted Positives}}$	False Discovery Rate (FDR) $\frac{\text{False Positives}}{\textbf{Predicted Positives}}$
	Negative	False Omission Rate(FOR) $\frac{\text{False Negatives}}{\textbf{Predicted Negatives}}$	Negative Predictive Value (NPV) $\frac{\text{True Negatives}}{\textbf{Predicted Negatives}}$

- https://en.wikipedia.org/wiki/Sensitivity_and_specificity

More Fun …

https://en.wikipedia.org/wiki/Sensitivity_and_specificity

https://en.wikipedia.org/wiki/precision_and_recall

EXERCISE: CLASSIFICATION METRICS

Even More Complication …

- Not all errors need count "*equivocal zone*" or "*intermediate zone*"

- *Prevalent when the model has three choices, e.g. A or B or Nothing.*

MUTLI-NOMIAL CLASSIFICATION

Classification Performance

- `predict` methods can provide
  - Classes
  - Class probabilities

- Class probs → Classes?
  - Apply ***softmax*** function

$$\hat{p}_\ell^* = \frac{e^{\hat{y}_\ell}}{\sum_{l=1}^{C} e^{\hat{y}_l}}$$

- Probabilities often need post predict → calibrations (talk about this with deployment)

Classification Performance

- Accuracy … problems?
- Confusion Matrix
  - `table`
  - `caret::confusionMatrix`
- `Cohen's Kappa:` $\kappa = \frac{O-E}{1-E}$
  - Kappa values within (0.30-0.50)+ → good fit
- ROC Curves / Lift Charts

TERMS

- Kappa Statistic,
- S-Statistic, F-Statistic