Binary Classification Evaluation

- Binary Classification Prediction

$$\hat{y}_i = \mathbb{P}\left(y_i = 1 \mid x_i\right)$$

$$\hat{\tilde{y}}_i = \begin{cases} 1 & \text{if } \hat{y}_i > t \\ 0 & \text{otherwise} \end{cases}$$

- Binary Classification Evaluation: compare on a test data set
  - True data labels: $y_i \in \{0, 1\}$, $i = 1, \cdots, N_{\text{test}}$
  - Predicted data labels: $\hat{\tilde{y}}_i \in \{0, 1\}$, $i = 1, \cdots, N_{\text{test}}$

Binary Classification Evaluation Metrics

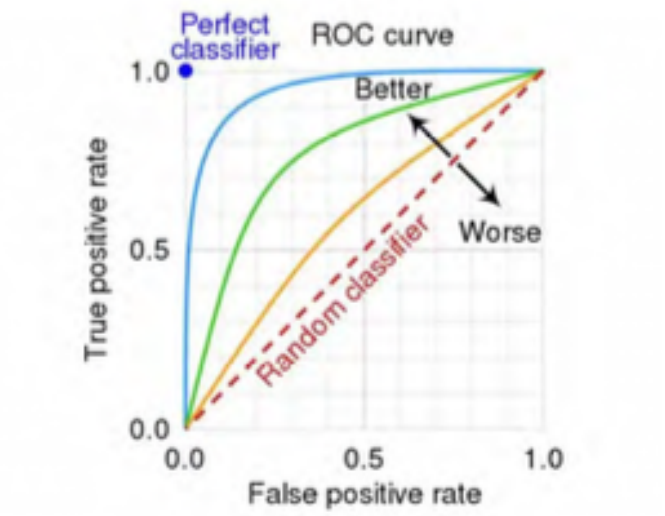
- Confusion Matrix

		Predicted	
		Positive $\left(\hat{\tilde{y}}_i = 1\right)$	Negative $\left(\hat{\tilde{y}}_i = 0\right)$
Actual	Positive $(y_i = 1)$	True Positive (TP)	False Negative (FN)
	Negative $(y_i = 0)$	False Positive (FP)	True Negative (TN)

- Accuracy: $\frac{TP+TN}{TP+FP+TN+FN}$
- Precision: $\frac{TP}{TP+FP}$
- Recall/True Positive Rate: $\frac{TP}{TP+FN}$
- F1 Score $= 2 \cdot \frac{Precision \cdot Recall}{Precision+Recall}$
- False Positive Rate: $\frac{FP}{FP+TN}$
- True negative rate/Specificity: $\frac{TN}{TN+FP}$

Binary Classification Evaluation Metrics

- Receiver Operating Characteristic (ROC) Curve
  - Plot TPR VS. FPR at various classification thresholds $t \in (0, 1)$
    - Shows the tradeoff between sensitivity and specificity



- Area Under the ROC Curve (AUC)
  - Measures the entire two-dimensional area underneath the entire ROC curve
  - Range: 0.5 (random guessing) to 1 (perfect classifier)

HW3

Logistic Regression in R and Python