Performance metrics

1. Metrics

2. Precision and recall

3. Receiver Operating Characteristic (ROC) curves

Outline

1. **Metrics**

2. Precision and recall

3. Receiver Operating Characteristic (ROC) curves

Metrics

It is extremely important to use **quantitative metrics** for evaluating a machine learning model

- Until now, we relied on the **cost function value** for regression and classification
- Other metrics can be used to **better evaluate** and understand the model
- **For classification**
  - ✓ Accuracy/Precision/Recall/F1-score, ,…
- **For regression**
  - ✓ Normalized RMSE, Normalized Mean Absolute Error (NMAE),…

Outline

1. Metrics

2. **Precision and recall**

3. Receiver Operating Characteristic (ROC) curves

Precision and recall

Suppose that $y = 1$ in presence of a **rare class** that we want to detect

Precision *(How much we are precise in the detection)*

Of all patients where we predicted $y = 1$, what fraction actually has the disease?

$$\frac{\text{True Positive}}{\text{\# Predicted Positive}} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}}$$

Recall *(How much we are good at detecting)*

Of all patients that actually have the disease, what fraction did we correctly detect as having the disease?

$$\frac{\text{True Positive}}{\text{\# Actual Positive}} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Negative}}$$

Confusion matrix

Predicted class	Actual class: 1 (p)	Actual class: 0 (n)
1 (Y)	True positive (TP)	False positive (FP)
0 (N)	False negative (FN)	True negative (TN)

F1-score

It is usually better to compare models by means of one number only. The F1 – score can be used to combine precision and recall

	Precision(P)	Recall (R)	Average	F_1 Score
Algorithm 1	0.5	0.4	0.45	0.444
Algorithm 2	0.7	0.1	0.4	0.175
Algorithm 3	0.02	1.0	0.51	0.0392

The best is Algorithm 1

Algorithm 3 predict always 1

Average says not correctly that Algorithm 3 is the best

$$\text{Average} = \frac{P + R}{2} \qquad F_1\text{score} = 2\frac{PR}{P + R}$$

- $P = 0$ or $R = 0 \Rightarrow F_1\text{score} = 0$
- $P = 1$ and $R = 1 \Rightarrow F_1\text{score} = 1$