Contents

Contents

Contents

Contents

Contents

Contents

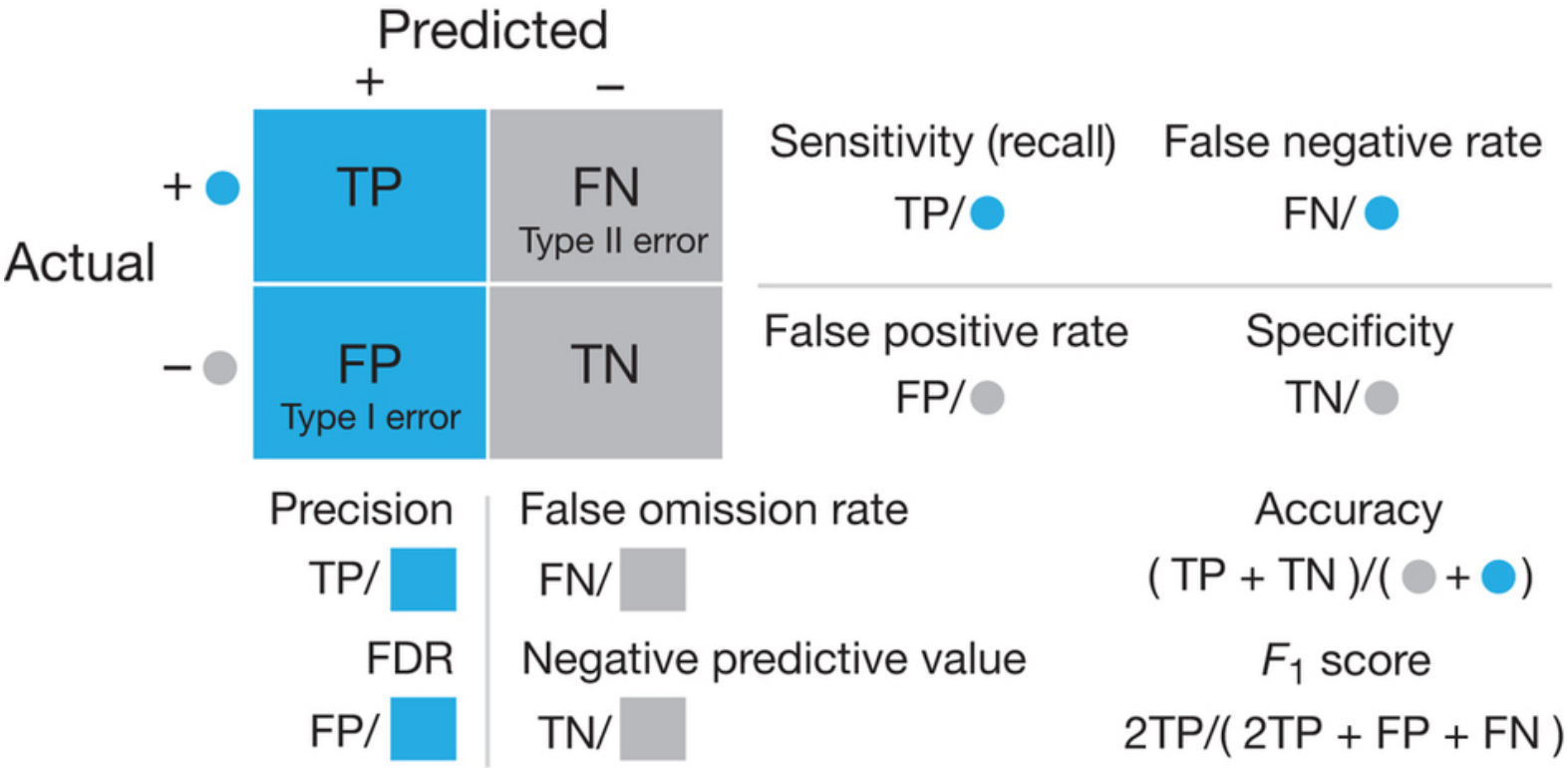
Contents

Outline

In fact, this is the same notation as in the linear models chapter, except that now Y_i is discrete and represent generally a class number, a qualitative variable $Y_i \in \{0, 1, ...K\}$, $Y_i \in \{$ spam, ham$\}$
$Y_i = h(X^i) = \beta_0 + \beta_1 X_{i,1} + \beta_2 X_{i,2} + ... + \beta_i X_{i,p}$
Moreover the prediction is a probability to be in the class k. In a two-class problem, you can decide Y_i is true if probability is > 0.5

Outline

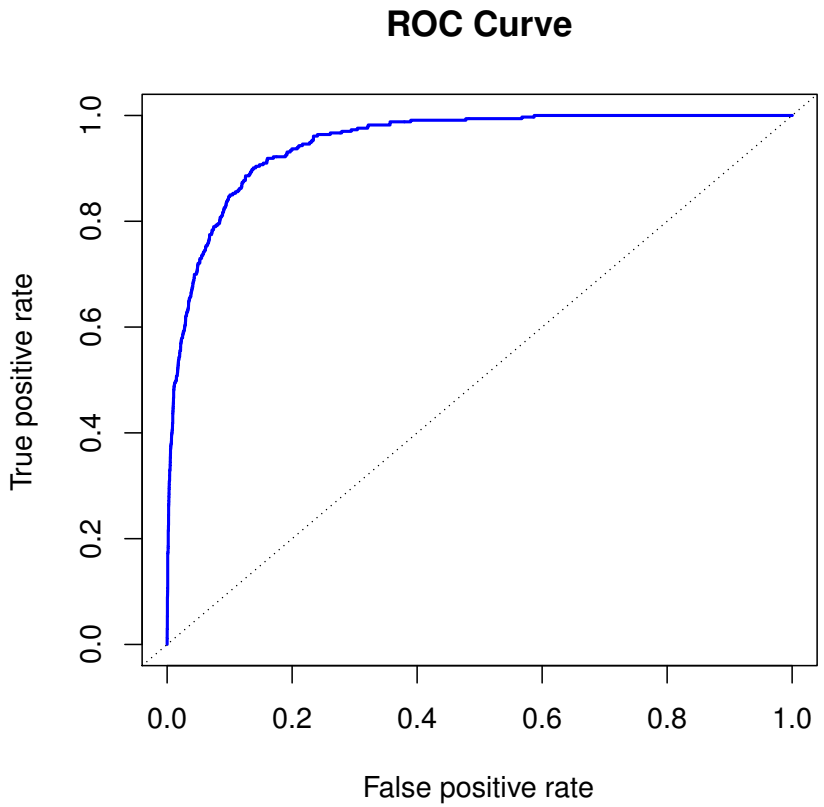
Vocabulary :



Beware : in the book Predicted is given horizontally

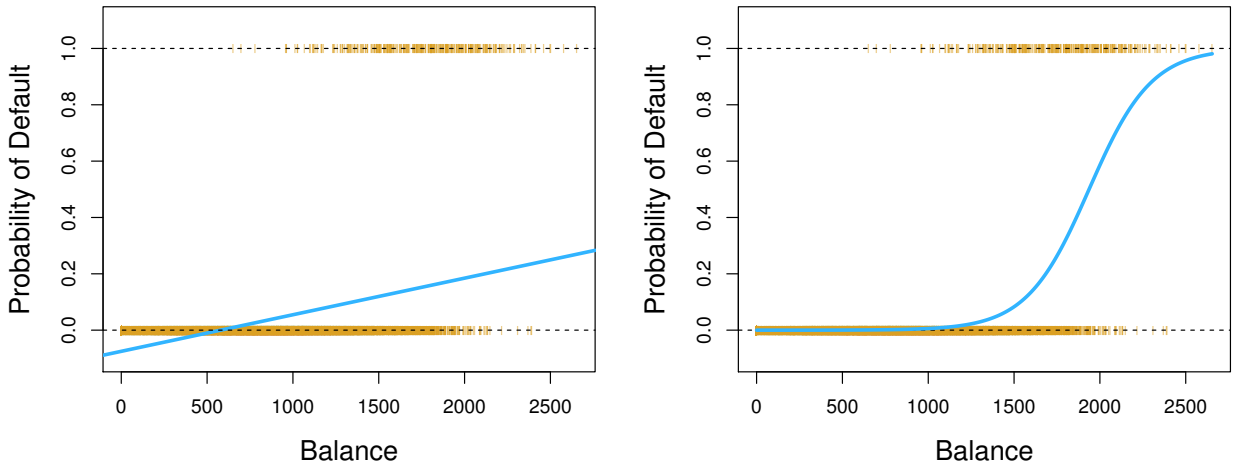
Outline

From communication theory Receiver Operator Curve :



The associated measure is the Area Under the Curve (**AUC**), need to be near 1.

Outline



- To avoid values outside $[0, 1]$, we use a specific function called **sigmoid** or **logistic function**
- $\text{sigmoid}(x) = \frac{1}{1+e^{-x}} = \frac{e^x}{e^x+1} \in [0, 1]$
- The Linear Regression is "filtered" by this function.

Outline

- After some manipulation the model is :
  $\ln(\frac{p(X)}{1-p(X)}) = \beta_0 + \beta_1 X_1$ where $p(X)$ is the probability that the response is 1
- Instead of using Least Square algorithm to adjust the β_i parameters, here we use a more statistical way, the Maximum Likelihood algorithm
- Obviously we can have multiple predictors :
  $\ln(\frac{p(X)}{1-p(X)}) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_i X_p$

Outline

- In order to make a prediction for an observation $X = x$, the K training observations that are closest to x are identified.
- Then X is assigned to the class to which the plurality of these observations belong. Hence KNN is a completely **non-parametric** approach : no assumptions are made about the shape of the decision boundary.
- There is also a KNN Regression algorithm (book)

Outline

- Prediction of probabilities ;
- Same minimization frameworks ;
- In general, all the algorithms have a Regression and a Classification behaviour.