

Lecture 16:

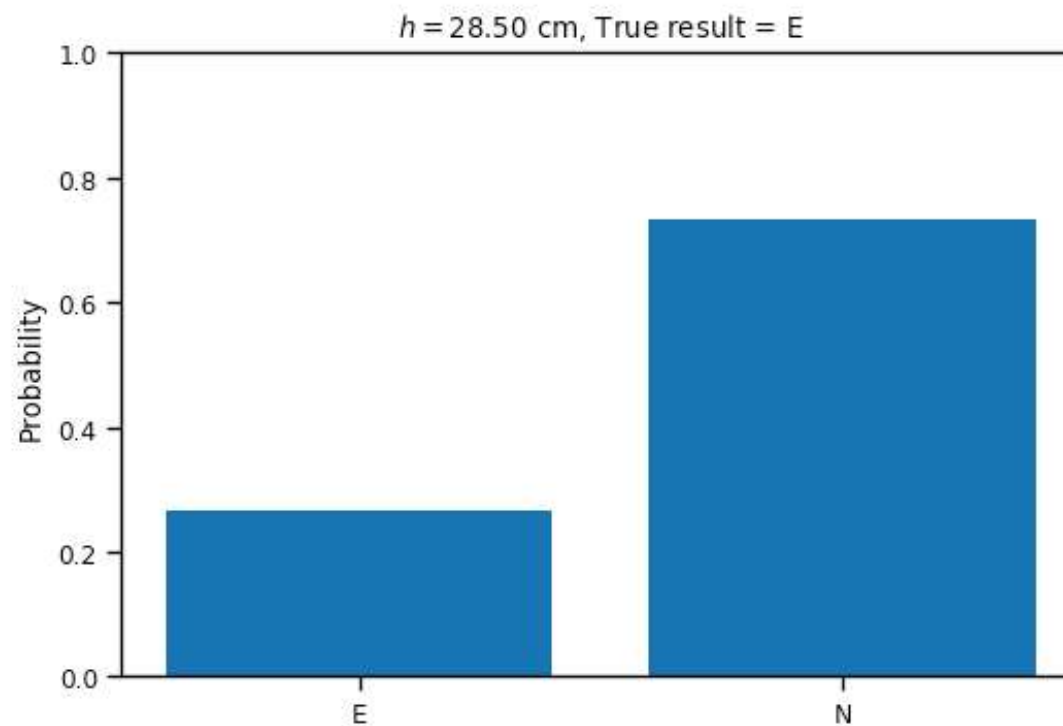
Classification

Professor Ilias Bilonis

Making decisions

picking one of the two labels

HMX Example



How do you pick a single label?

minimize the expected cost



Picking labels by minimizing the expected cost

$$p(y | x, w)$$

cost incurred when you choose \hat{y} but the true label is y

Pick label \hat{y} . Cost of choice $c(\hat{y}, y)$.

	True E	True N
Predict E	0	1
Predict N	100	0

← a table

$$\min_{\hat{y}} \mathbb{E}[c(\hat{y}, y) | x_{1:n}, y_{1:n}]$$

'expectation over y

$$= \min_{\hat{y}} \int c(\hat{y}, y) \underbrace{p(y | x, x_{1:n}, y_{1:n})}_{\text{posterior predictive}} dy$$

cost imbalance

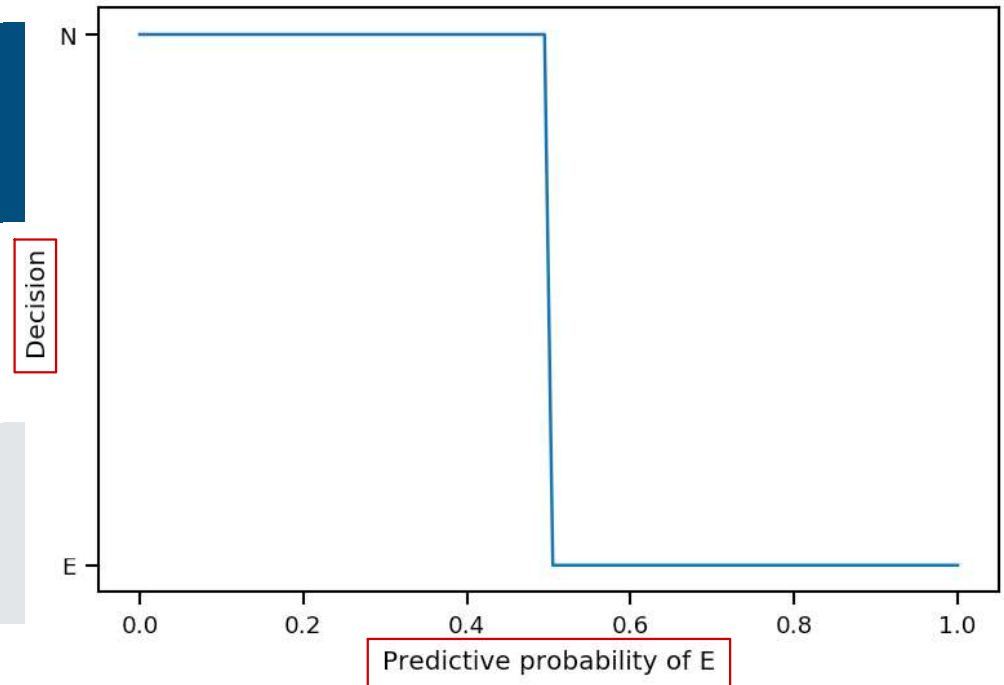
$$\approx \min_{\hat{y}} \int c(\hat{y}, y) p(y | x, w) dy$$

Best decision when risk-neutral.
 When risk-averse you need utility theory.
 Jitesh Panchal¹⁴ Decision Making.

The cost of making wrong predictions

	True result E	True result N
Predict E	0	1
Predict N	1	0

Balanced



The cost of making wrong predictions

	True result E	True result N
Predict E	0	1
Predict N	10	0

Imbalanced (with red arrows pointing to the counts 1 and 10)

