Risk in Decision Making

$P(\omega_1 | x) = 0.51$ (2 class w/ equal priors)

Classes: $\{\omega_1, \omega_2, \ldots, \omega_c\}$

actions: $\{\alpha_1, \alpha_2, \ldots, \alpha_l\}$

cost: $\{\lambda_1, \lambda_2, \ldots, \lambda_l\}$

* l does not need to equal c.

cost function: $\lambda(\alpha_i | \omega_j)$ → cost of taking action i given that the state-of-nature is ω_j

For evrery action there is a cost function.

→ healtny

→ disease → Type 1, Type 2] Treatment 1; → Type 3 } Treatment 2

$\omega_1 \to$ healthy

$\omega_2 \to T1$

$\omega_3 \to T2$

$\omega_4 \to T3$

$\alpha_1 \to$ nothing

$\alpha_2 \to$ Treatment 1

$\alpha_3 \to$ Treatment 2

Conditional Risk

$p(\ \ |\omega)p(\omega)$

$$R(\alpha_i | x) = \sum_{j=1}^{\overset{\#\text{ of classes}}{c}} \lambda(\alpha_i | \omega_j) \underbrace{P(\omega_j | x)}_{\text{posterior}}$$

$$\hat{y} = w^T x$$

$$\alpha^* = \arg\min_{\alpha_i} R(\alpha_i | x)$$

We need to build up a cost matrix

$$[\lambda] = \begin{array}{cc} & \text{Predicted} \\ \begin{array}{c} \omega_1 \\ \omega_2 \end{array} & \begin{bmatrix} \lambda_{11} & \lambda_{12} \\ \lambda_{21} & \lambda_{22} \end{bmatrix} \text{True} \\ & \omega_1 \qquad \omega_2 \end{array}$$

$$[\lambda] = \begin{array}{cc} \text{cancer} & \text{healthy} \\ \end{array}$$
$$\begin{bmatrix} 1/2 & 1000 \\ 10 & 0 \end{bmatrix} \begin{array}{c} \text{cancer} \\ \text{health} \end{array}$$