Stochsatic gradient descent for logistic regression smoothing

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1 The logistic regression model

We consider the logistic regression $y_i \in \{0, 1\}, x_i \in \mathbb{R}$ s.t. $p_i(\beta) = P(Y_i = 1|X_i = x_i)$ and

$$\log\left(\frac{p_i(\beta)}{1 - p_i(\beta)}\right) = f(x_i|\beta) = \big(\varphi_1(x_i), \ldots, \varphi_p(x_i)\big)^\top \beta$$

For some $\beta \in \mathbb{R}^p$ and fixed basis functions $\varphi_1(x_i), \ldots, \varphi_p(x_i) : \mathbb{R} \to \mathbb{R}$. We aim to minimize the penalized log-likelihood.

$$H(\beta) = -\frac{1}{N}\sum_{i=1}^{N}\big(y_i \log(p_i(\beta)) + (1 - y_i)\log(1 - p_i(\beta))\big) + \lambda||f''_\beta||_2^2$$

over $\beta \in \mathbb{R}^{\text{l}}$.

2 Horse data

The dataset contains a couple of missing values we need to handle appropriately.

Dead	Missing	Count
FALSE	FALSE	426
FALSE	TRUE	17
TRUE	FALSE	106
TRUE	TRUE	2