

## 1 Log-Likelihood

In Exercise 01, we showed that the log-likelihood can be written as

$$\nabla \ell(\beta) = \sum_i (y_i - m_i w_i(\beta)) x_i$$

The first term in the parenthesis is the actual value of the observation, the second term is the expected value given the current guess for the parameters  $\beta$

## 2 Unbiased Estimators

We want to show that  $ng_i(\beta)$  is an unbiased estimator of the gradient:

$$\begin{aligned} \mathbb{E}\{ng_i(\beta)\} &= n \mathbb{E}\{g_i(\beta)\} \\ &= n \left( \frac{1}{n} \sum_{i=1}^n g_i(\beta) \right) \\ &= \sum_{i=1}^n g_i(\beta) \\ &= \nabla \ell(\beta) \end{aligned}$$