- Posterior probabilities can be estimated from a set of n labeled samples and can be used with the Bayesian decision rule for classification.
- Suppose that a volume V around $\mathbf{x}$ includes k samples, k_i of which are labeled as belonging to class w_i.
- As estimate for the joint probability $p(\mathbf{x}, w_i)$ becomes

$$p_n(\mathbf{x}, w_i) = \frac{k_i/n}{V}$$

and gives an estimate for the posterior probability

$$P_n(w_i|\mathbf{x}) = \frac{p_n(\mathbf{x}, w_i)}{\sum_{j=1}^{c} p_n(\mathbf{x}, w_j)} = \frac{k_i}{k}.$$