Multiple bins

Generalizing the bin model to more than one hypothesis:

\[ h_1, h_2, \ldots, h_M \]

\[ \mu_1, \mu_2, \ldots, \mu_M \]

\[ \nu_1, \nu_2, \ldots, \nu_M \]
Notation for learning

Both $\mu$ and $\nu$ depend on which hypothesis $h$

$\nu$ is 'in sample' denoted by $E_{in}(h)$

$\mu$ is 'out of sample' denoted by $E_{out}(h)$

The Hoeffding inequality becomes:

$$\mathbb{P} \left[ \left| E_{in}(h) - E_{out}(h) \right| > \epsilon \right] \leq 2e^{-2\epsilon^2 N}$$
Notation with multiple bins

$h_1$  
$E_{\text{out}}(h_1)$  
$E_{\text{in}}(h_1)$

$h_2$  
$E_{\text{out}}(h_2)$  
$E_{\text{in}}(h_2)$

$h_M$  
$E_{\text{out}}(h_M)$  
$E_{\text{in}}(h_M)$