

$$EI_{y^*}(x) := \int_{-\infty}^{\infty} \max(y^* - y, 0) p_M(y|x) dy$$

becomes

$$\begin{aligned} EI_{y^*}(x) &= \int_{-\infty}^{y^*} \max(y^* - y, 0) p_M(y|x) dy \\ &= \int_{-\infty}^{y^*} \frac{p(x|y)p(y)}{p(x)} dy \\ &= \frac{\gamma y^* l(x) \int_{-\infty}^{y^*} p(y) dy}{yl(x) + (1 - \gamma)g(x)} \\ &\propto \left(\gamma + \frac{g(x)}{l(x)}(1 - \gamma)\right)^{-1} \end{aligned}$$

where

$$\gamma = p(y < y^*)$$

$$\begin{aligned} p(x|y) &= l(x) \text{ if } y < y^* \\ &= g(x) \text{ if } y \geq y^* \end{aligned}$$