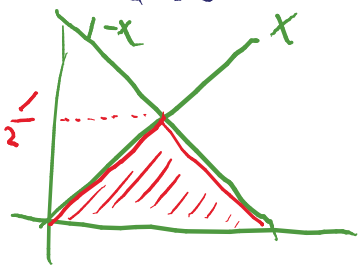
$$\mathbb{P}(Y=1) = \mathbb{E}\,\mathbb{E}[\mathbb{1}_{Y=1} \mid X] = \mathbb{E}\,\eta(X) = \int_0^1 x\,dx = \frac{1}{2}$$

$$\mathbb{P}(Y=0) = 1 - \mathbb{P}(Y=1) = \frac{1}{2}.$$

$$f(x \mid Y=1) = \frac{f(x)\,\mathbb{P}(Y=1 \mid X=x)}{\mathbb{P}(Y=1)} = \frac{1 \cdot x}{1/2} = 2x \quad \text{if } x \in [0,1]$$

Similarly, $f(x \mid Y=0) = 2(1-x)$ for $x \in [0,1]$ (0 otherwise)



$$R^* = \mathbb{E}[\min(\eta(X), 1-\eta(X))]$$

$$= \int_0^1 \min(x, 1-x)\,dx = \frac{1}{4}$$

$$R_{1\text{-NN}} = 2\int_0^1 x(1-x)\,dx = 2\left[\underbrace{\int_0^1 x\,dx}_{=\frac{1}{2}} - \underbrace{\int_0^1 x^2\,dx}_{=\frac{1}{3}}\right] = \frac{1}{3}$$

$$R_{3\text{-NN}} = \underbrace{\mathbb{E}[\eta(X)(1-\eta(X))]}_{=\frac{1}{6}} + 4\,\mathbb{E}[\eta(X)^2(1-\eta(X))^2] = \frac{1}{6} + \frac{2}{15} = 0.3$$

$$= \int_0^1 x^2\,dx - 2\int_0^1 x^3\,dx + \int_0^1 x^4\,dx = \frac{1}{3} - \frac{1}{2} + \frac{1}{5} = \frac{1}{30}$$