

## Homework 1

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### Problem 1

### Problem 2

By Bayes' Theorem, we can compute the posterior probability that coin 2 was chosen by:

$$\begin{aligned} P(c = 2|h = 1) &= \frac{P(h = 1|c = 2)P(c = 2)}{P(h = 1)} \\ &= \frac{P(h = 1|c = 2)P(c = 2)}{P(h = 1|c = 2)P(c = 2) + P(h = 1|c = 1)P(c = 1)} \\ &= \frac{0.8 \times 0.5}{0.8 \times 0.5 + 0.5 \times 0.5} \\ &= \frac{0.4}{0.65} \\ &\approx 0.615 \end{aligned}$$

### Problem 3

Given Equation 2.3 and the fact that  $x$  and  $y$  are independent, we can show that  $Pr(x|y = y^*) = Pr(x)$  by:

$$\begin{aligned} Pr(x|y = y^*) &= \frac{Pr(x, y = y^*)}{\int Pr(x, y = y^* * dx)} \\ &= \frac{Pr(x, y = y^*)}{Pr(y = y^*)} \\ &= \frac{Pr(x) \cdot Pr(y = y^*)}{Pr(y = y^*)} \\ &= Pr(x) \end{aligned}$$

### Problem 4

The expected value of one roll of this biased die is:

$$\begin{aligned}
\mathbb{E}(x) &= 1 \cdot \frac{1}{12} + 2 \cdot \frac{1}{12} + 3 \cdot \frac{1}{12} + 4 \cdot \frac{1}{12} + 5 \cdot \frac{1}{6} + 6 \cdot \frac{1}{12} \\
&= \frac{10}{12} + \frac{5}{6} + \frac{6}{2} \\
&= \frac{56}{12} \\
&= \frac{14}{3} \\
&\approx 4.67
\end{aligned}$$

The expected value of the sum of two rolls is:

$$\begin{aligned}
\mathbb{E}(2x) &= 2\mathbb{E}(x) \\
&= 2\frac{14}{3} \\
&= \frac{28}{3} \\
&\approx 9.34
\end{aligned}$$