

# AI1110 - ASSIGNMENT 5

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# Question

## Papoulis Chapter 2, Example 2.10

In a fair die experiment,  $S$  represents the set consisting of the faces  $f_1, f_2, f_3, f_4, f_5, f_6$ . Determine the conditional probability of the event  $\{f_2\}$ , assuming the event *even* occurred.

# Concepts

## Formulas

$$\Pr(E) = \frac{n(E)}{n(S)} \quad (2.0.1)$$

$$\Pr(E|F) = \frac{\Pr(E, F)}{\Pr(F)} \quad (2.0.2)$$

# Solution

Let  $X$  be a random variable which is used to denote the outcome of the dice. Then we have,  $X \in \{f_1, f_2, f_3, f_4, f_6\}$  where in  $f_k$ ,  $k$  denotes the outcome of the dice.

We must find the value of

$$\Pr(X = f_2 \mid X = f_2 \cdot f_4 \cdot f_6) \quad (2.0.3)$$

$$\Pr(X = k) = \begin{cases} \frac{1}{6}, & 1 \leq k \leq 6 \\ 0, & \text{otherwise} \end{cases} \quad (2.0.4)$$

$$\Pr(X = f_2 \mid X = f_2, f_4, f_6) = \frac{\Pr(X = f_2 \cdot f_2, f_4, f_6)}{\Pr(X = f_2, f_4, f_6)} \quad (2.0.5)$$

Since the events  $f_2, f_4, f_6$  are mutually exclusive, we have

$$\Pr(X = f_2, f_4, f_6) = \Pr(X = f_2) + \Pr(X = f_4) + \Pr(X = f_6) \quad (2.0.6)$$

$$\implies \Pr(X = f_2, f_4, f_6) = \frac{1}{6} + \frac{1}{6} + \frac{1}{6} \quad (2.0.7)$$

$$\implies \Pr(X = f_2, f_4, f_6) = \frac{3}{6} = \frac{1}{2} \quad (2.0.8)$$

We see that  $\{f_2\}$  is a subset of  $\{f_2, f_4, f_6\}$ .

We know that if

$$A \subset B \text{ then, } A \cdot B = A. \quad (2.0.9)$$

Therefore

$$\Pr(X = f_2 \cdot f_2, f_4, f_6) = \Pr(f_2) = \frac{1}{6} \quad (2.0.10)$$

Therefore, by substituting the results (2.0.9) and (2.0.11), in the equation (2.0.5), we have

$$\Pr(X = f_2 \mid X = f_2, f_4, f_6) = \frac{1/6}{1/2} \quad (2.0.11)$$

$$\implies \Pr(X = f_2 \mid X = f_2, f_4, f_6) = \frac{1}{6} \times \frac{2}{1} \quad (2.0.12)$$

$$\implies \Pr(X = f_2 \mid X = f_2, f_4, f_6) = \frac{1}{3} \quad (2.0.13)$$

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