Assignment 6

AI1110: Probability and Random Variables

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Example 9 Let a sample space be $S = \{\omega_1, \omega_2, \ldots, \omega_6\}$. Which of the following assignments of probabilities to each outcome are valid?

Solution. Let a random variable $X \in \mathcal{X}$ where $\mathcal{X} = \{1, 2, 3, 4, 5, 6\}$ denote each of the six outcomes respectively.

The necessary conditions for a given set of assignments of probabilities $\mathcal{P}$ to be valid are:

$$0 \le \Pr(X = i) \le 1, \ \forall i \in \mathcal{X} \tag{1}$$

$$\sum_{i \in \mathcal{X}} \Pr(X = i) = 1 \tag{2}$$

If either of these conditions fails, then the given assignment is invalid.

(a)

$$\mathcal{P} = \left\{\frac{1}{6}, \frac{1}{6}, \frac{1}{6}, \frac{1}{6}, \frac{1}{6}, \frac{1}{6}\right\} \tag{3}$$

Valid: Both conditions hold

(b)

$$\mathcal{P} = \{1, 0, 0, 0, 0, 0\} \tag{4}$$

Valid: Both conditions hold

(c)

$$\mathcal{P} = \left\{\frac{1}{8}, \frac{2}{3}, \frac{1}{3}, \frac{1}{3}, -\frac{1}{4}, -\frac{1}{3}\right\} \tag{5}$$

Invalid: Both conditions fail

$$\Pr(X = 5) < 0 \tag{6}$$

$$\Pr(X = 6) < 0 \tag{7}$$

$$\sum_{i \in \mathcal{X}} \Pr(X = i) = \frac{7}{8} \tag{8}$$

(d)

$$\mathcal{P} = \left\{\frac{1}{12}, \frac{1}{12}, \frac{1}{6}, \frac{1}{6}, \frac{1}{6}, \frac{3}{2}\right\} \tag{9}$$

Invalid: Both conditions fail

$$\Pr(X = 6) > 1 \tag{10}$$

$$\sum_{i \in \mathcal{X}} \Pr(X = i) = \frac{13}{6} \tag{11}$$

(e)

$$\mathcal{P} = \{0.1, 0.2, 0.3, 0.4, 0.5, 0.6\} \tag{12}$$

Invalid: Condition (2) fails

$$\sum_{i \in \mathcal{X}} \Pr(X = i) = 2.1 \tag{13}$$