Assignment 1

AI1110: Probability and Random Variables
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12.13.4.1 Question: State which of the following are not the probability distributions of a random variable. Give reasons for your answer.

1)

X	0	1	2
P(X)	0.4	0.4	0.2

2)

X	0	1	2	3	4
P(X)	0.1	0.5	0.2	-0.1	0.3

3)

Y	-1	0	1
P(Y)	0.6	0.1	0.2

4)

X	0	1	2	3	4
P(Z)	0.3	0.2	0.4	0.1	0.05

Solution: If the probability distribution of a random variable X is represented as:-

X	x_1	x_2	...	x_n
P(X)	p_1	p_2	...	p_n

then,

$$p_i > 0, \sum_{i=1}^{n}(p_i) = 1, i = 1, 2, 3...n. \tag{1}$$

Hence for all cases the sum of P(X) should be equal to one. The second condition is that probabilities of all events must be between 0 and 1, both inclusive. i.e.,

$$0 < p_i < 1, i = 1, 2, 3...n. \tag{2}$$

1)

$$\sum_{i=0}^{2}(p_i) = 0.4 + 0.4 + 0.2 = 1 \tag{3}$$

Satisfies both (1) and (2), it is a probability distribution.

2)

$$\sum_{i=0}^{4}(p_i) = 0.1 + 0.5 + 0.2 - 0.1 + 0.3 = 1 \tag{4}$$

Satisfies (1) but does not satisfy (2) as $P(3) < 0$. Hence NOT a probability distribution.

3)

$$\sum_{i=-1}^{1}(p_i) = 0.6 + 0.1 + 0.2 = 0.9 \tag{5}$$

Condition (1) not satisfied, it is NOT a probability distribution.

4)

$$\sum_{i=0}^{4}(p_i) = 0.3 + 0.2 + 0.4 + 0.1 + 0.05 = 1.05 \tag{6}$$

Condition (1) not satisfied, it is NOT a probability distribution.