Assignment 6

K Vivek Kumar - CS21BTECH11026

I. Class-12-Probability-Exercise-13.4

Question 1: State which of the following are not the probability distributions of a random variable. Give reasons for your answer.

(i) Random variable: X

X	0	1	2
P(X)	0.4	0.4	0.2

(ii) Random variable: X

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

(iii) Random variable: Y

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

(iv) Random variable: Z

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

Solution: We can verify whether a probability distribution is valid for a given random variable by checking two of its properties. The below are the one to be verified in each case for a random variable X.

Property 1: The value of P(X) should always be positive.

$$p_i > 0, \text{for } i = \{1, 2, 3, ..., n\}$$

Property 2: The sum of all the values of P(X) should always sum upto one.

$$\sum_{i=1}^{n} p_i = 1, \text{for } i = \{1, 2, 3, ..., n\}$$

(i) For the random variable X, we can observe that all the p_i are positive, and also

$$p_1 + p_2 + p_3 = 0.4 + 0.4 + 0.2 \tag{I.1}$$
$$p_1 + p_2 + p_3 = 1 \tag{I.2}$$

$\therefore$ This probability distribution of the random variable X is a valid one.

(ii) For this probability distribution we can observe that the value of p_4 i.e., -0.1 is a negative value, which violates the first property of a probability distribution.
$\therefore$ This probability distribution of the random variable X is **NOT** a valid one.

(iii) For the random variable Y, we can observe that all the p_i are positive, and also

$$p_1 + p_2 + p_3 = 0.6 + 0.1 + 0.2 \tag{I.3}$$
$$p_1 + p_2 + p_3 = 0.9 < 1 \tag{I.4}$$

Though the property 1 is valid here, but the property 2 isn't a valid one. The sum is not coming out to be 1.
$\therefore$ This probability distribution of the random variable Y is **NOT** a valid one.

(iv) For the random variable Z, we can observe that all the p_i are positive, and also

$$p_1 + p_2 + p_3 + p_4 + p_5 = 0.3 + 0.2 + 0.4 + 0.1 + 0.05 \tag{I.5}$$
$$p_1 + p_2 + p_3 + p_4 + p_5 = 1.05 > 1 \tag{I.6}$$

Though the property 1 is valid here, but the property 2 isn't a valid one. The sum is not coming out to be 1.
$\therefore$ This probability distribution of the random variable Z is **NOT** a valid one.