

# Assignment-6

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May 15, 2022

# Class-12-Probability-Exercise-13.4

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# Problem 1

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

- |      |     |     |     |
|------|-----|-----|-----|
| X    | 0   | 1   | 2   |
| P(X) | 0.4 | 0.4 | 0.2 |

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

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

- |      |     |     |     |     |      |
|------|-----|-----|-----|-----|------|
| 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.

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

## Property-2

The sum of all the values of  $P(X)$  should always sum upto one.

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

## Solution (i)

(i) Random variable : X

|      |     |     |     |
|------|-----|-----|-----|
| X    | 0   | 1   | 2   |
| P(X) | 0.4 | 0.4 | 0.2 |

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

$$p_1 + p_2 + p_3 = 0.4 + 0.4 + 0.2 \quad (1)$$

$$p_1 + p_2 + p_3 = 1 \quad (2)$$

∴ This probability distribution of the random variable X is a valid one.

## Solution (ii)

(ii) Random variable :  $X$

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

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.

∴ This probability distribution of the random variable  $X$  is **NOT** a valid one.

## Solution (iii)

(iii) Random variable : Y

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

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

$$p_1 + p_2 + p_3 = 0.6 + 0.1 + 0.2 \quad (3)$$

$$p_1 + p_2 + p_3 = 0.9 < 1 \quad (4)$$

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.

## Solution (iv)

(iv) Random variable :  $Z$

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

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

$$p_1 + p_2 + p_3 + p_4 + p_5 = 0.3 + 0.2 + 0.4 + 0.1 + 0.05 \quad (5)$$

$$p_1 + p_2 + p_3 + p_4 + p_5 = 1.05 > 1 \quad (6)$$

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.

∴ This probability distribution of the random variable  $Z$  is **NOT** a valid one.