

A1110 Assignment 4

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Exercise 15.2 Q4: A box contains 12 balls out of which x are black. If one ball is drawn at random from the box, what is the probability that it will be a black ball?

If 6 more black balls are put in the box, the probability of drawing a black ball is now double of what it was before. Find x .

Solution: Let the random variable $X \in \{0, 1\}$ denote whether a ball drawn out of the box is black or not.

Event	Description
$X = 0$	Black ball is drawn out
$X = 1$	Black ball is not drawn out

TABLE 1

$$\Pr(X = 0) = \frac{\text{Number of black balls}}{\text{Total Balls}} \quad (1)$$

$$= \frac{x}{12} \quad (2)$$

$$\therefore \text{Probability that ball drawn is black} = \frac{x}{12} \quad (3)$$

Now, 6 more black balls are added

$$\Rightarrow \text{Number of black balls} = x + 6 \quad (4)$$

$$\text{Total balls} = 12 + 6 = 18 \quad (5)$$

$$\therefore \Pr(X = 0) = \frac{x + 6}{18} \quad (6)$$

Given,

$$2 \times \frac{x}{12} = \frac{x + 6}{18} \quad (7)$$

$$\Rightarrow \frac{x}{6} = \frac{x + 6}{18} \quad (8)$$

$$x = \frac{x + 6}{3} \quad (9)$$

$$3x = x + 6 \quad (10)$$

$$2x = 6 \quad (11)$$

$$\Rightarrow x = 3 \quad (12)$$

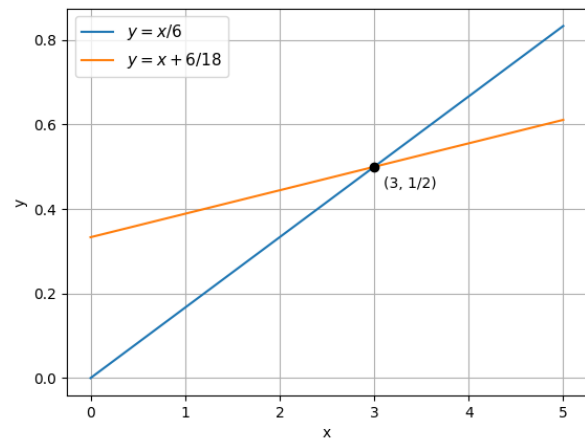


Fig. 1: Verification of the number of black balls

Hence,

$$\Pr(X = 0) (\text{initial}) = \frac{3}{12} = \frac{1}{4} \quad (13)$$

$$\Pr(X = 0) (\text{final}) = \frac{9}{18} = \frac{1}{2} \quad (14)$$