Assignment 5

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Download all python codes from

https://github.com/CS20BTECH11054/AI1103/blob/main/Assignment_5/codes/Assignment_5.py

and latex-tikz codes from

https://github.com/CS20BTECH11054/AI1103/blob/main/Assignment_5/Assignment_5.tex

1 Problem

A box contains 40 numbered red balls and 60 numbered black balls. From the box, balls are drawn one by one at random without replacement till all the balls are drawn. The probability that the last ball drawn is black equals

2 Solution

Let us name the red balls as R_1,R_2,...R_{40} and name the black balls as B_1,B_2,B_3,....B_{60}. Let us define the random variable X, such that $X = 0$ means the last drawn ball is red and $X = 1$ means the last ball drawn is black. So,

$$\Pr(X = 1) = \frac{N}{T} \tag{2.0.1}$$

where, in (2.0.1), N = Number of cases where last ball drawn is black. T = Total Cases. Now, this problem can be simulated to a problem where we have to arrange 40 distinct R's and 60 distinct B's such that, a B should come at last. So,

$$\begin{aligned} N &= (\text{placing a B at last}) \times (\text{arranging other letters}) \\ &= 60 \times 99! \end{aligned} \tag{2.0.2}$$

$$\begin{aligned} T &= \text{arranging 100 letters} \\ &= 100! \end{aligned} \tag{2.0.3}$$

Substituting (2.0.2) and (2.0.3) in (2.0.1), we get

$$\Pr(X = 1) = \frac{60 \times 99!}{100!} = \frac{3}{5} \tag{2.0.4}$$

Therefore, the probability that the last ball drawn is black is $\frac{3}{5}$

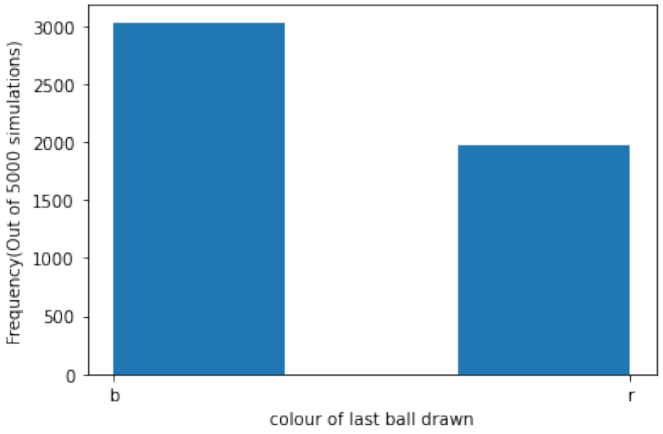

Fig. 0: **Frequency out of 5000 simulations vs colour of last ball drawn**