AI1103-Assignment 1

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Download all python codes from

https://github.com/Ramanathan−Annamalai/AI1103−Probability_and_Random_Variables/tree/main/Assignment%201/Codes

and latex-tikz codes from

https://github.com/Ramanathan−Annamalai/AI1103−Probability_and_Random_Variables/blob/main/Assignment%201/Assignment_1.tex

Question

Two cards are drawn successively with replacement from a well shuffled deck of 52 cards. Find the probability distribution of the number of aces.

Solution

A deck of 52 cards contains 4 Aces i.e 1 from each suit.
Let probability of picking an ace from a well shuffled deck be p

$$p = \frac{\text{No. of favourable cases}}{\text{Total no. of cases}} = \frac{4}{52} = \frac{1}{13} \tag{0.0.1}$$

Probability of not picking an ace from the deck will be represented by q

$$q = (1-p) = \frac{48}{52} = \frac{12}{13} \tag{0.0.2}$$

We are drawing two card from the deck, with replacement. Let $X \in \{0,1,2\}$ represent the random variable, where

1) 0 represents drawing no aces
2) 1 represents drawing one ace
3) 2 represents drawing two aces

Now, let us find the probability distribution:

1) Drawing no aces:

$$Pr(X=0) = q \times q \tag{0.0.3}$$
$$= \frac{12}{13} \times \frac{12}{13} = \frac{144}{169} \tag{0.0.4}$$
$$= 0.851344 \tag{0.0.5}$$

2) Drawing one ace:

$$Pr(X=0) = p \times q + q \times p \tag{0.0.6}$$
$$= \frac{1}{13} \times \frac{12}{13} + \frac{12}{13} \times \frac{1}{13}$$
$$= \frac{24}{169} = 0.142824 \tag{0.0.7}$$

3) Drawing both aces:

$$Pr(X=0) = p \times p \tag{0.0.8}$$
$$= \frac{1}{13} \times \frac{1}{13} = \frac{1}{169} \tag{0.0.9}$$
$$= 0.005833 \tag{0.0.10}$$

Random Variable [X]	Probability [Pr(X)
0	$\frac{144}{169}$
1	$\frac{24}{169}$
2	$\frac{1}{169}$

TABLE 3: Probability distribution values for the outcomes of the event.

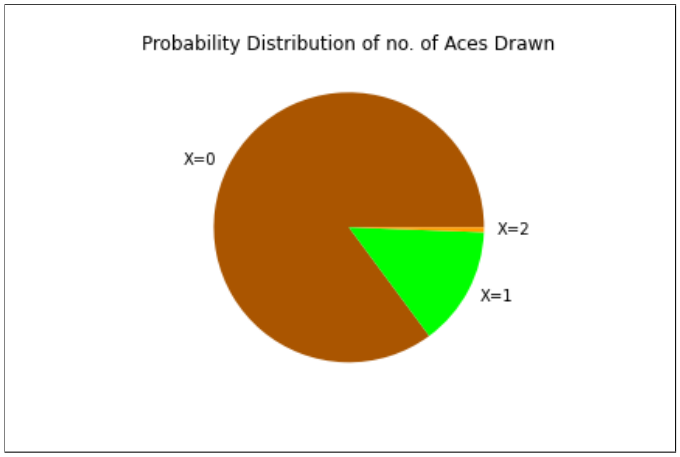

Fig. 3: Representation of Theory

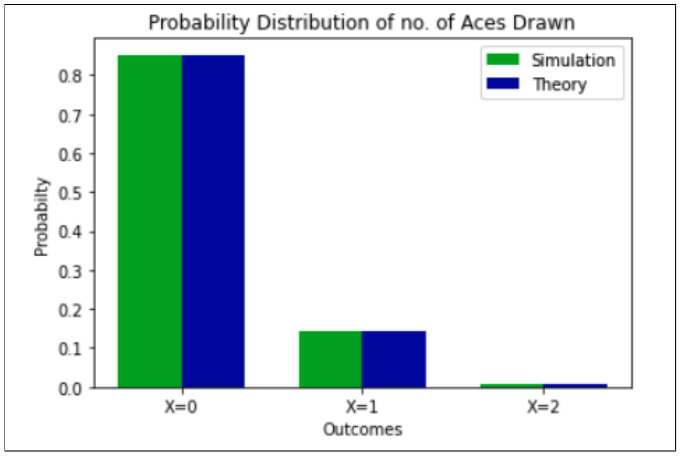

Fig. 3: Theory vs Simulation