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: The probability is obtained by multiplying the probabilities of not drawing an ace both times

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

2) Drawing one ace: The probability is obtained by adding the probabilities of drawing an ace in the first draw and drawing an ace in the second draw.The probability for each case is given by multiplying the probabilities of drawing an ace and not drawing an 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: The probability is obtained by multiplying the probabilities of drawing an ace both times

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

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.

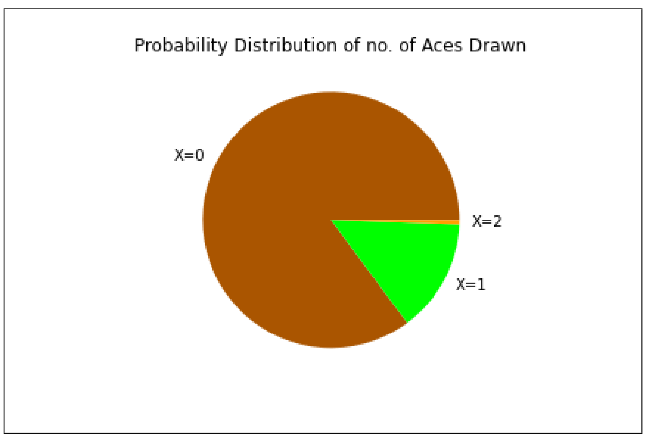

Fig. 3: Representation of Theory

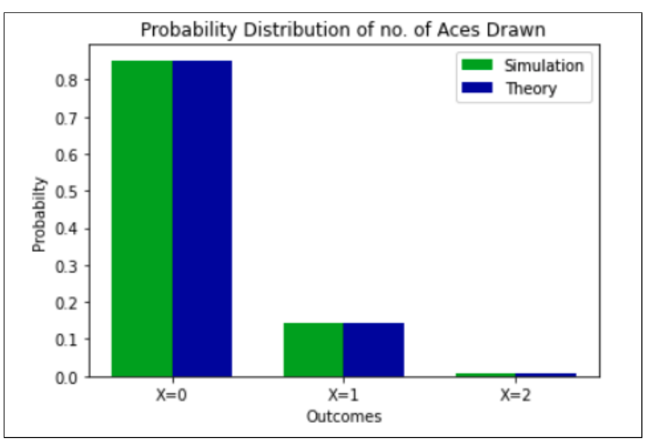

Fig. 3: Theory vs Simulation