Assignment No.: 01

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Topic : FDS (PROBABILITY)

Course: MSc DSAI PART 1 2020-21 (SEM 1)
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(1) Alice has 2 kids and one of them is a girl. What is the probability that the other child is also a girl?

You can assume that there are an equal number of male and females in the world.

⇒ As per given assumption there are an equal number of mal & females in world.

∴ Universal set for having 2 kids

$U = \{(B,B), (B,G), (G,B), (G,G)\}$

Where

B stands for Boy
G stands for Girl

As per given information one of them is a girl
Hence sample space is

$S = \{(G,B), (B,G), (G,G)\}$

Let's Consider, Event A is, the other child is also girl, i.e Both the kids are girls.

$E_A = \{(G,G)\}$

$\therefore n(S) = 3 \quad \& \quad n(E_A) = 1$

∴ The probability of the other child is also a girl is $= 1/3 = 0.333$

(2) A fair six-sided die is rolled twice. What is the probability of getting 2 on first roll and not getting 4 on the second roll?

⇒ Lets,

E_A (Event A) : Getting 2 on First roll.

E_B (Event B) : Getting 4 on the second roll.

Universal set

$U = \{(1,1), (1,2), (1,3), (1,4), (1,5), (1,6),$
$(2,1), (2,2), (2,3), (2,4), (2,5), (2,6),$
$(3,1), (3,2), (3,3), (3,4), (3,5), (3,6),$
$(4,1), (4,2), (4,3), (4,4), (4,5), (4,6),$
$(5,1), (5,2), (5,3), (5,4), (5,5), (5,6),$
$(6,1), (6,2), (6,3), (6,4), (6,5), (6,6)\}$

$n(U) = 36$

Sample set for Event A,

$E_A = \{(2,1), (2,2) (2,3) (2,4), (2,5) (2,6)\}$

$n(E_A) = 6$

Sample set For Event B,

$E_B = \{(1,1), (1,2), (1,3), (1,5), (1,6),$
$(2,1), (2,2), (2,3), (2,5), (2,6),$
$(3,1), (3,2), (3,3), (3,5) (3,6),$
$(4,1), (4,2), (4,3) (4,5), (4,6),$
$(5,1), (5,2), (5,3), (5,5), (5,6),$
$(6,1), (6,2), (6,3), (6,5), (6,6)\}$

$n(E_B) = 30$

The given Event A & Event B are independent.

$\therefore P(E_A) = 6/36 = 1/6$

$\therefore P(E_B) = 30/36 = 5/6$

∴ Given to events are independent.

∴ P(getting 2 on first roll & not 4 on second roll)

$= \frac{1}{6} \times \frac{5}{6}$

$= \frac{5}{36}$

$\boxed{P = 0.139}$

(3) Amita randomly picks 4 cards from a deck of 52-cards and places them back into the deck (Any set of 4 cards is equally likely). Then Babita randomly choose 8 cards out of the same deck (Any set of 8 cards is equally likely). Assume that the choice of 4 cards by Amita and the choice of 8 cards by Babita are independent. What is the probability that all 4 cards choosen by Amita are in the set of 8 cards chosen by Babita?

⇒

Total possible combination for selecting 4 cards by Amita $= {}^{52}C_4$

Total possible combination for selecting 8 cards by Babita $= {}^{52}C_8$

∴ Total possible combination for selecting 4 cards by Amita & 8 cards by Babita is

$n(S) = {}^{52}C_4 \times {}^{52}C_8$

∴ As per given event, all 4 cards choosen by Babita, since the 4 cards selected by Amita are common, so all possible combination

For the event is $^{48}C_4$

∴ For given Event number of all possible combination are $n(E) = {}^{52}C_4 \times {}^{48}C_4$

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{({}^{52}C_4 \times {}^{48}C_4)}{({}^{52}C_4 \times {}^{52}C_8)}$$

$$= \frac{48!}{4! \times 44!} \times \frac{8! \times 44!}{52 \times 51 \times 50 \times 49 \times 48!}$$

$$= \frac{1680}{649740}$$

$$\therefore \boxed{P(E) = 0.000259}$$

∴ Probability that all 4 cards chosen by Amita are in the set of 8 cards chosen by Babita. is 0.000259

(4) Cross-fertilizing a red and a white flower produces red flowers 25% of the time. Now we cross-fertilize five pair of read and white flowers and produce five offspring? What is the probability that there are no red flowers plants in the fiven offspring?

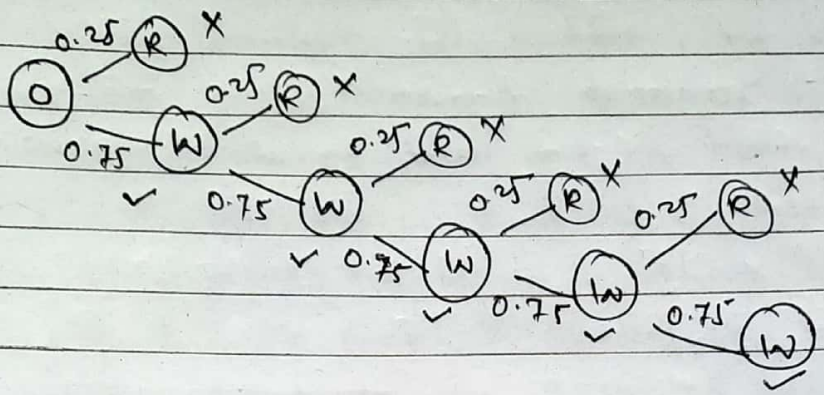
⇒ Lets consider,

Event A (E_A) = Cross-fertilizing produce red flowers

$P(E_A) = 0.25$

Event B (E_B) = Cross-fertilizing produce white flowers

$P(E_B) = 0.75$



∴ Probability of no red flower plant in the five offspring is = $0.75 \times 0.75 \times 0.75 \times 0.75 \times 0.75$

$$\boxed{P(R=0) = 0.237}$$

By Binomial Distribution

$p = 0.25$

$n = 5$

∴ $P(R=0)$ = No red flower plant in the five offspring

$$= {}^{n}C_{r} p^{r} q^{n-r} = \frac{n!}{r!(n-r)!} p^{r} q^{n-r}$$

$$= \frac{5!}{0!(5)!} \times (0.25)^{0} (0.75)^{5}$$

$$= (0.75)^{5}$$

$$= 0.237.$$

∴ $\boxed{P(R=0) = 0.237}$

∴ Probability of no red flower plant in the five offspring is = 0.237.

15) Ahmed is playing ~~matches the 2 As~~ a lottery game where he must pick 2 numbers from 0 and 9 followed by an English alphabet (from 26-letters). He may choose the same number both times.

If his ticket matches the 2 numbers and 1 letter drawn in order, he wins the grand prize and receives $10405. If just his letter matches but one or both of the numbers do not match, he wins $100. Under any other circumstance; he wins nothing. The game costs him $5 to play. Suppose he has chosen 04R to play. What is the expected net profit from playing this ticket?

⇒

Lets,

P(Number chose from 0-9) = 1/10

P(Letter chose) = 1/26

P(grand prize) = (1/10) * (1/10) * (1/26)

The game cost = $5

∵ Need to match both Numbers as well as Letter, to win grand prize.

P(small prize) = Just letter matches but one or both of the number do not match

∴ P(small prize) = (1/26) − (1/2600)

(∵ Eduding the case where where both the numbers also match [grand prize winning condition])

∴ Probability of losing the prize is

P(Losing Prize) = 1 − P(Winning)

= 1 − (1/26) − 1/(26×10×10)

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The game cost = $5
Grand Prize = $10405
Small prize = $100

∴ Expected Net profit
= P(grand prize) * (grand prize - game cost)
+ P(small prize) * (small prize - game cost)
- * P(Losing) * (game cost)

$$= \left(\frac{1}{2600}\right) * (10405 - 5) + \left(\frac{1}{26} - \frac{1}{2600}\right) (100 - 5) - \left(1 - \frac{1}{26} - \frac{1}{2600}\right) 5$$

$$= \boxed{2.81}$$

∴ Expected net profit = $2.81