FDS

Assignment No. 05

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COURSE : MSc DSAI PART 1 2020-21 (SEM 1)

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<1> Two dice are rolled, find the probability that the sum is:

1. equal to 1
2. equal to 4
3. less than 13

⇒ Two dice are thrown here.

$n(S) = 36$

<a> equal to 1

Probability that the sum is equal to 1 is Zero because they start with (1,1).... likewise other than in the dice we are not having zero.

<b> equal to 4

Event = { (1,3) (2,2) (3,1) }

$\therefore n(Event) = 3$

$$\therefore P(Event) = \frac{n(Event)}{n(S)} = \frac{3}{36} = 1/12 = 0.08$$

<c> sum is less than 13.

Event = S

$\therefore$ Here, the total sample space will come.

$\cancel{n(Event) = 36/36 = 1}$ $n(Event) = 36$

$$\therefore P(Event) = \frac{n(Event)}{n(S)} = \frac{36}{36} = 1.$$

$\therefore P(Event) = 1$

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(2) In the game of snakes and ladders, a fair die is thrown. If event E1 represents all the events of getting a natural number less than 4, event E2 consists of all the events of getting an even number and E3 denotes all the events of getting an odd number. List the sets representing the following:

(i) E1 or E2 or E3

(ii) E1 and E2 and E3

(iii) E1 but not E3

⇒ Let consider,

fair die is thrown.

$S = \{1, 2, 3, 4, 5, 6\}$

$n(S) = 6$

(i) E1 : Getting a natural number less than 4

$E1 = \{1, 2, 3\}$

(ii) E2 : Getting Even nuber

$E2 = \{2, 4, 6\}$

(iii) E3 : Getting Odd number

$E3 = \{1, 3, 5\}$

∴ As per given requirements

(i) E1 or E2 or E3 = $E1 \cup E2 \cup E3$

$= \{1,2,3\} \cup \{2,4,6\} \cup \{1,3,5\}$

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

(ii) E1 and E2 and E3 = $E1 \cap E2 \cap E3$

$= \{1,2,3\} \cap \{2,4,6\} \cap \{1,3,5\}$

$= \{\}$

$= \phi$

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(iii) E_1 but not E_3

$= E_1 - E_3$

$= \{1,2,3\} - \{1,3,5\}$

$= \{2\}$

(3) How many permutations of the letters of the word ARTICLE have consonants in the first and last positions?

⇒ In the word ARTICLE, there are 4 consonants. Since the first letter must be a consonant, we have four choices for the first position, and once we use up a consonant, there are only three consonants left for the last spot. We show as follows:

_ _ _ _ _ _ _
4 3

Since there are no more restrictions, we can go ahead and make the choice for the rest of the positions. So far we have used up 2 letters, therefore, five remain. So for the next position there are five choices, for the position after that there are four choices and so on, We get

_ _ _ _ _ _ _
4 5 4 3 2 1 3

So the total permutations are $4 \times 5 \times 4 \times 3 \times 2 \times 1 \times 3$
$= 1440$

Q.4 Give five letters {A, B, C, D, E}. Find the following.
1. The number of four letter word sequences.
2. The number of three-letter word sequences.
3. The number of two-letter word sequences.

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⇒ (1) The number of four-letter word sequence.

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5 4 3 2

for position 1st we have 5 letters available, for 2nd position we have 4 letters available & so on.

∴ The number of four letter word sequence

$= {}^nP_r = {}^5P_4 = \frac{5!}{1!}$

$= 5 \times 4 \times 3 \times 2$

$= 120$

(2) The number of three-letter word sequence.

— — —

5 4 3

For position 1st we have 5 letters available, for 2nd position we have 4 & for 3rd position we have 3 letters.

∴ the number of three-letter word sequence.

$= {}^nP_r = {}^5P_3 = \frac{5!}{2!}$

$= 5 \times 4 \times 3$

$= 60$

(3) The number of two letters word sequence

— —

5 4

for position 1st we have 5 letters available & for 2nd position we have 4 letters available.

$= {}^nP_r = {}^5P_2 = \frac{5!}{3!}$

$= 5 \times 4$

$= 20$

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(5) In how many different ways can 4 people be seated in a straight line if two of them insist on sitting next to each other.

→ Let us suppose we have four people A, B, C & D. Further suppose that A & B want to sit together. For the sake of argument, we tie A and B together & treat them as one person.

The four people are ABCD. Since AB is treated as one person, we have the following possible arrangments.

ABCD, ABDC, CABD, DABC, CDAB, DCAB

Note that there are six more such permutations because A and B could also be tied in the order BA. And they are

BACD, BADC, CBAD, DBAC, CDBA, DCBA

So altogether there are 12 different permutations.

After we tie two of the people together and treat them as one person, we can say we have only three people.

$$= {}^{3}P_{3} = \frac{3!}{(3-3)!} = 3!$$

∴ Since two people can be tied together 2! ways, they are $\;{}^{2}P_{2} = \frac{2!}{(2-2)!} = 2!$

∴ Total different arrangment are

$$= 3! \cdot 2!$$
$$= 12$$

(6) You have 4 math books and 5 History books to put on a shelf that has 5 slots. In how many ways can the books be shelved if the first three slots are filled with math books and the next two slots are filled with history books?

⇒ Since the math books go in the first three slots, there are 4 choices for the first slot, 3 choices for second & 2 choices for the third.

i.e. $4 \times 3 \times 2$ OR

$= {}^4P_3 = 4!$

The fourth slot requires a history book, and has five choices. Once that choice is made, there are 4 history books left, and therefore, 4 choices for the last slot.

i.e 5×4 or

$= {}^5P_2 = \frac{5!}{(5-2)!} = 5 \times 4$

∴ No. of ways books can be shelved

$= 4! \times 5 \times 4$

$= 480.$

(7) The shopping mall has a straight row of 5 flagpoles as its main entrance plaza. It has 3 identical green flags and 2 identical yellow flags. How many distinct arrangements of flags on the flagpoles are possible?

⇒ The shopping mall hass a straigh row of 5 flagpoles. That is arrangement 5 flags, where 3 flags are similar & the remaining 2 ~~letters~~ flags are similar.

∴ Distinct arrangements of flags $= \frac{{}^5P_5}{3!\,2!}$

$= \frac{5!}{3!\,2!}$

∴ Distinct arrangements of flags $= 10$.

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(8) A Birthday problem (Collision of Birth Days):

"If there are 'n' people in a room, what is the chance that some pair among them have the same birthday?"

⇒ The problem is to ~~produce~~ compute an ~~approximate~~ probability that in a group of n people at least two have the same birthday. For simplicity, variations in distribution, such as leap years, twins, seasonal or weekly variations are disregarded and it is assumed that all 365 possible birthdays are equally likely.

The goal is to compute P(A), the probability that at least two people in the room have the same birthday. However it is simpler to calculate P(A'), the probability that no two people in the room have the same birthday. Then, because A and A' are the only two possibilities and are also mutually exclusive, $P(A) = 1 - P(A')$

According to the pigeon hole principle, $\bar{p}(n)$ is zero when $n > 365$. When $n \le 365$:

$$\bar{p}(n) = 1 \times \left(1 - \frac{1}{365}\right) \times \left(1 - \frac{2}{365}\right) \times \cdots \times \left(1 - \frac{n-1}{365}\right)$$

$$\bar{p}(n) = \frac{365 \times 364 \times \cdots \times (365 - n + 1)}{365^n}$$

$$\bar{p}(n) = \frac{365!}{365^n \, (365-n)!} = \frac{n! \cdot \binom{365}{n}}{365^n} = \frac{365 P_n}{365^n}$$

The event of at least two of the n persons having the same birthday is complementary to all n birthday's being different.

Therefore, its probability $p(n)$ is,

$\therefore \; p(n) = 1 - \bar{p}(n)$

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(9) You have a fair, well shuffled deck of 52 cards. It consists of four suits. The suits are clubs, diamonds, hearts & spaces. There are 13 cards in each suit consisting of ~~1~~, 1, 2, 3, 4, 5, 6, 7, 8, 9, J (Jack), Q (Queen), K (King) of that suit.

Three cards are picked at random.

(a) Suppose you know that the picked cards are Q of spades, K of hearts and Q of spades. Can you decide if the sampling was with or without replacement?

(b) Suppose you know that the picked cards are Q of spades, K of hearts and J of spades. Can you decide if the sampling was with or without replacement?

⇒ (a)

Three card ~~are~~ picked = {SQ, HK, SQ}

So in this evevent SQ repeated while picking the cards.

Hence, we can decide that sampling was with replacement.

(b) Three card picked = {SQ, HK, SJ}

So in this event not single card repeated in sample. But we can not be sured whether same is selected with replacement or without replacement. Can' not decide on method type.

(10) You have a fair, well shuffled deck of 52 cards. It consists of four suits. The suits are clubs, diamonds, hearts and spaces. There are 13 cards in each suit consisting of 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, J (Jack), Q (Queen), K (King) of that suit. S = spades, H = Hearts, D = Diamonds, C = clubs, suppose that you sample four cards without replacement. Which of the following outcomes are possible

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Answer the Following questions for sampling with replacement.

(a) QS, 1D, 1C, QD

<b> KH, 7D, 6D, KH

<c> QS, 7D, 6D, KS

⇒ <a> QS, 1D, 1C, QD

All the elements ~~of~~ set are unique.

∴ Without Replacement is possible.

∴ With replacement is also possible.

<b> KH, 7D, 6D, KH

All the elements of set are not unique

∴ Without replacement is Not possible (impossible)

& with replacement is possible.

<c> QS, 1D, 1C, QD

All the elements of set are unique.

∴ Without Replacement is possible.

∴ With replacement is possible.