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Tutorial-2

U20CS110
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Sol-① given

$P(A \cup B) = 3/4$ $\quad$ $P(\bar{A}) = 2/3$

$P(A \cap B) = 1/4$

$P(A) = 1 - P(\bar{A})$

$= 1 - 2/3$

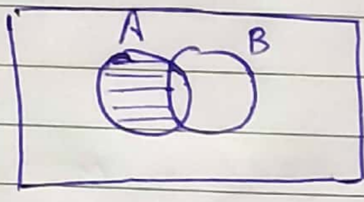
$$\boxed{P(A) = 1/3}$$

Now $\quad P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$P(B) = \frac{3}{4} - \frac{1}{3} + \frac{1}{4} = 2/3$

$P(A \cap \bar{B})$

→ from Venn diagram



$P(A \cap \bar{B}) = P(A) - P(A \cap B)$

$= \frac{1}{3} - \frac{1}{4}$

$= \frac{1}{12}$

$$\boxed{P(A \cap \bar{B}) = \frac{1}{12}}$$

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Ques 2) Equation is $ax^2 + bx + c = 0$
& $a, b, c \in \{1, 2, 3, \ldots 6\}$

for real roots $b^2 - 4ac \geq 0$
$b^2 \geq 4ac$

Now for $b = 1$ no a & c possible

$b = 2$; $a = c = 1$
$b = 3$; $\{a, c\} = \{1,1\}, \{1,2\}, \{2,1\}$
$b = 4$; $\{a, c\} = \{1,1\}, \{1,2\}, \{1,3\}, \{1,4\}$
$\{2,1\}, \{2,2\}, \{3,1\}, \{4,1\}$
$b = 5$, $\{a, c\} = \{1,1\}, \{2,1\}, \{1,3\}, \{1,4\}$
$\{1,5\}, \{1,6\}, \{2,1\}, \{2,2\}$
$\{2,3\}, \{3,1\}, \{3,2\}, \{4,1\}$
$\{5,1\}, \{6,1\}$.

$b = 6$ $\{a, c\} = \{1,1\}, \{1,2\}, \{1,3\}, \{1,4\}, \{1,5\}, \{1,6\}$
$\{2,1\}, \{2,2\}, \{2,3\}, \{2,4\}, \{3,1\}$
$\{3,2\}, \{3,3\}, \{4,1\}, \{4,2\}, \{5,1\}, \{6,1\}$.

Hence total favourable events = 43
and total possible events are $(6 \times 6 \times 6) = 216$

$P(A)$ = probability of eqn having real root $= \frac{43}{216}$

→ for complex roots $b^2 - 4ac < 0$
or we have to find $P(\bar{A})$
$P(\bar{A}) = 1 - P(A) = 1 - \frac{43}{216}$

$$\boxed{P(\bar{A}) = \frac{173}{216}}$$

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Sol-3

Acc to question

$P(\text{no six}) < \frac{1}{2}$

now $P(6) = \frac{1}{6}$ $P(\bar{6}) = \frac{5}{6}$

$P(\text{no six}) = \left(\frac{5}{6}\right)^n$

n is no. of throws

$\left(\frac{5}{6}\right)^n < \frac{1}{2}$

applying log on both side

$n(\log 5 - \log 6) > \log 1 - \log 2$

$n > \frac{-0.301}{-0.070}$

$n > 3.81$

$\boxed{n = 4}$ minimum

Hence minimum 4 trials are required

Sol-4

1B 1W		2B 1W
A		B

Both boxes are equivalent
$\therefore$ selecting one from both side is equally likelly for A & B

$\rightarrow$ $P(A) = P(B) = 1/2$

$P(\text{black})$ for A $= 1/2$
$P(\text{black})$ for B $= 2/3$

$$P(\text{marble is black}) = P(A) \times \frac{1}{2} + P(B) \times \frac{2}{3}$$

$$= \left(\frac{1}{2} \times \frac{1}{2}\right) + \left(\frac{1}{2} \times \frac{2}{3}\right)$$

$$= \frac{1}{4} + \frac{1}{3}$$

$$\boxed{P \text{ marble is black} = \frac{7}{12}}$$

Sol-5 $P(A) = \frac{1}{2}$ $P(B) = \frac{3}{4}$ $P(C) = \frac{1}{4}$

probability of question solved $= P(A)$

also $P(\theta) = 1 -$ probability of question not solved

$$P(\theta) = 1 - P(\bar{A})P(\bar{B})P(\bar{C})$$

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$$P(Q) = 1 - P(\bar{A})P(\bar{B})P(\bar{C})$$
$$= 1 - (1 - P(A))(1 - P(B))(1 - P(C))$$

$$= 1 - \left[1 - \frac{1}{2}\right]\left[1 - \frac{3}{4}\right]\left[1 - \frac{1}{4}\right]$$

$$= 1 - \left[\frac{1}{2} \times \frac{1}{4} \times \frac{3}{4}\right]$$

$$P(Q) = 1 - \frac{3}{32} = \frac{29}{32}$$

$$\boxed{P(\text{Question solved}) = \frac{29}{32}}$$

Sol-6 Here $n = 20$, $p = 0.3$ (very small compared to n)

we can apply poissan distribution

$$\lambda = np = 20 \times 0.3 = 6$$

$$PMF = \frac{\lambda^x e^{-\lambda}}{x!} = \frac{6^x e^{-6}}{x!}$$

from bionomial distribution

$$PMF = \binom{20}{x} p^x q^{20-x} = \binom{20}{x} (0.3)^x (0.7)^{20-x}$$

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i) $P(X=7) = \binom{20}{7} (0.3)^7 (0.7)^{13}$

$= 0.164$

from poisson distribution

$P(X=7) = \frac{6^7}{7!} e^{-6} = 55.543 \times 0.0024 = 0.137$

ii) $P(x \le 2) = P(X=0) + P(X=1) + P(X=2)$

$= \binom{20}{0} (0.3)^0 (0.7)^{20} + \binom{20}{1} (0.3)^1 (0.7)^{19}$

$+ \binom{20}{2} (0.3)^2 (0.7)^{18}$

$= (0.7)^{18} [0.49 + 4.2 + 17.1]$

$= 0.035$

from poisson distribution

$P(X \le 2) = e^{-6} \left[\frac{6^0}{0!} + \frac{6^1}{1!} + \frac{6^2}{2!} \right]$

$= e^{-6} [1 + 6 + 18]$