Probability

Question1

All possible words (with or without meaning) are formed by taking atleast 2 letters (all different) from the letters of the word 'CURVE'. If a word is chosen at random from all the words thus formed, then the probability of getting a letter word is

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Options:

A.

1/16

B.

3/8

C.

1/4

D.

3/16

Answer: D

Solution:

Total number of possible words in the word 'CURVE' is

2-letter words $= {}^5P_2 = \frac{5!}{(5-2)!} = 5 \times 4 = 20$

3-letter words $= {}^5P_3 = 5 \times 4 \times 3 = 60$

4-letter words $= {}^5P_4 = 5 \times 4 \times 3 \times 2 = 120$

5-letter words

$= {}^5P_5 = 5 \times 4 \times 3 \times 2 \times 1 = 120$

So, total words $= 20 + 60 + 120 + 120$

$= 320$

$\therefore$ P(3-letter words)

$= \frac{\text{Number of 3 - letter words}}{\text{Total words}}$

$= \frac{60}{320} = \frac{3}{16}$

Question2

Three numbers are chosen from 1 to 30 . The probability that they are not three consecutive numbers is

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Options:

A.

$\frac{1}{145}$

B.

$\frac{142}{145}$

C.

$\frac{143}{145}$

D.

$\frac{144}{145}$

Answer: D

Solution:

Total ways of choosing 3 numbers

$= {}^{30}C_3 = \frac{30 \times 29 \times 28}{3 \times 2 \times 1}$
$= 4060$

The number of sets of three consecutive numbers

$\{(1, 2, 3), (2, 3, 4) \ldots (28, 29, 30)\}$
$\Rightarrow$ 28 sets.

So, the number of sets that are not consecutive numbers $= 4060 - 28 = 4032$

Hence, required probability

$= \frac{4032}{4060} = \frac{144}{145}$

Question3

If two events A and B are such that $P(\bar{A}) = 03, P(B) = 0.4$ and $P(A \cap \bar{B}) = 0.5$, then $P(B/A \cup \bar{B}) =$

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Options:

A.

0.25

B.

0.6

C.

0.45

D.

0.8

Answer: A

Solution:

$P(\bar{A}) = 0.3, P(B) = 0.4, P(A \cap \bar{B}) = 0.5$

So, $P(A) = 1 - P(\bar{A}) = 0.7,$

$P(\bar{B}) = 1 - 0.4 = 0.6$

Now, $P(A \cap B)$

$\because \quad P(A) = P(A \cap B) + P(A \cap \bar{B})$

$\Rightarrow \quad 0.7 = P(A \cap B) + 0.5$

$\Rightarrow \quad P(A \cap B) = 0.2$

then, $P(B/A \cup \bar{B}) = \dfrac{P(B \cap (A \cup \bar{B}))}{P(A \cup \bar{B})}$

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

$= \dfrac{P(A \cap B)}{0.7 + 0.6 - 0.5} = \dfrac{0.2}{0.8} = 0.25$

Question4

Two candidates A and B have attended an interview conducted by a recruitment board for two jobs, If the probability that candidate A will get the job is 0.8 and the probability that candidate B will get the job is 0.7 , then the probability that atleast one of them will get the job is

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Options:

A.

0.96

B.

0.94

C.

0.92

D.

0.9

Answer: B

Solution:

- Probability that **A** will get the job, $P(A) = 0.8$
- Probability that **B** will get the job, $P(B) = 0.7$

We are asked to find the probability that **at least one** of them will get the job.

Step 1: Formula for "at least one"

$P(\text{at least one}) = P(A \cup B) = P(A) + P(B) - P(A \cap B)$

Step 2: If events A and B are *independent*:

$P(A \cap B) = P(A) \times P(B)$

$P(A \cap B) = 0.8 \times 0.7 = 0.56$

Step 3: Substitute values

$P(A \cup B) = 0.8 + 0.7 - 0.56 = 0.94$

✅ **Final Answer: 0.94**

Correct Option: (B) 0.94

Question5

X denotes the number of times heads that occur in n tosses of a fair coin. If $P(X=4), P(X=5)$ and $P(X=6)$ ate in arithmetic progression. The largest value of n is

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Options:

A.

7

B.

14

C.

21

D.

28

Answer: B

Solution:

$\because P(x=k)={ }^n C_k p^{n-k} q^k$
Here, $p=q=1/2$
and $2P(X=5)=P(X=4)+P(X=6)$

$$\Rightarrow 2^n C_5\left(\frac{1}{2}\right)^{n-5}\left(\frac{1}{2}\right)^5={ }^n C_4\left(\frac{1}{2}\right)^{n-4}\left(\frac{1}{2}\right)^4+{ }^n C_6\left(\frac{1}{2}\right)^{n-6}\left(\frac{1}{2}\right)^6$$

$$\Rightarrow 2^n C_5\left(\frac{1}{2}\right)^n={ }^n C_4\left(\frac{1}{2}\right)^n+{ }^n C_6\left(\frac{1}{2}\right)^n$$

$$\Rightarrow 2\left[\frac{n!}{5!(n-5)!}\right]=\frac{n!}{4!(n-4)!}+\frac{n!}{6!(n-6)!}$$

$$\Rightarrow \frac{2}{5!(n-5)}=\frac{1}{4!}+\frac{1}{6!(n-6)(n-5)}$$

$$\Rightarrow \frac{2}{5(n-5)}=1+\frac{1}{30(n-6)(n-9)}$$

$$\Rightarrow \frac{2}{5(n-5)}=\frac{30\left(n^2-11n+30\right)+1}{30(n-6)(n-9)}$$

$$\Rightarrow 12(n-6)=30\left(n^2-11n+30\right)+1$$

$$\Rightarrow n^2-21n+98=0 \Rightarrow (n-14)(n-7)=0$$

So, $n=7$ or 14

Hence, largest value of $n=14$

Question6

The probability distribution of a random variable X is as follows. Then, the mean of x is

$X=XI_1$	$P(X=X_i)$
-2	$\frac{k^2}{3}$
-1	k^2
0	$\frac{2k^2}{3}$
1	$\frac{k}{2}$
2	$\frac{k}{2}$

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Options:

A.

$\frac{1}{3}$

B.

$\frac{1}{5}$

C.

$\frac{11}{2}$

D.

$\frac{13}{2}$

Answer: A

Solution:

$\boldsymbol{X}=x_i$	-2	-1	0	1	2
$\boldsymbol{P}\left(\boldsymbol{X}=x_i\right)$	$k^2/3$	k^2	$2k^2/3k/2$	$k/2$	

$$\begin{aligned}
& \because \quad \sum_{i=1}^n P\left(X=x_i\right)=1 \\
& \Rightarrow \quad \frac{k^2}{3}+k^2+\frac{2k^2}{3}+k/2+k/2=1 \\
& \Rightarrow \quad 2k^2+k-1=0 \\
& \Rightarrow \quad 2k^2+2k-k-1=0 \\
& \Rightarrow \quad (2k-1)(k+1)=0
\end{aligned}$$

so, $k=-1, 1/2$

for $k=1/2$

$k^2/3=1/12>0, k^2=1/4>0$

$\frac{2k^2}{3}=1/6>0$

$k/2=1/4>0$

and sum of

$1/12+1/4+1/6+1/4+1/4=1$

thus, $k=1/2$ is a valid solution

Now, $E(X)=\sum x_i P\left(X=x_i\right)$

$$\begin{aligned}
& =-2\times 1/12+(-1)\times 1/4+0\times 1/6+1\times 1/4+2\times 1/4 \\
& =-1/6-1/4+1/4+1/2
\end{aligned}$$

$=1/2-1/6=\frac{3-1}{6}=1/3$

Question7

A company representative is distributing 5 identical samples of a product among 12 houses in a row such that each house gets at most one sample. The probability that no two consecutive house get one sample is

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Options:

A.

$\frac{7}{99}$

B.

$\frac{5}{12}$

C.

$\frac{4}{13}$

D.

$\frac{5}{31}$

Answer: A

Solution:

Total ways of distributing 5 identical samples among 12 house, with atmost one sample $= {}^{12}\mathrm{C}_5$

Number of ways to select 5 house with no two consecutive

$$= {}^{n-r+1}C_r = {}^{12-5+1}C_5 = {}^{8}C_5$$

$$\therefore \text{ Required probability } = \frac{{}^{8}C_5}{{}^{12}C_6} = \frac{\frac{8!}{3!5}}{\frac{12!}{5!7}}$$

$$= \frac{8!7!}{12!3!} = \frac{7 \times 6 \times 5 \times 4}{12 \times 11 \times 10 \times 9} = \frac{7}{99}$$

Question8

A and B are two independent events of a random experiment and $P(A) > P(B)$.

If the probability that both A and B occurs is $\frac{1}{6}$ and neither of them occurs is $\frac{1}{3}$, then the probability of the occurance of B is

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Options:

A.

$\frac{1}{4}$

B.

$\frac{1}{3}$

C.

$\frac{1}{2}$

D.

$\frac{3}{8}$

Answer: B

Solution:

Step 1: Show what we know.

A and B are independent, so $P(A \cap B) = P(A) \cdot P(B) = \frac{1}{6}$.

The chance that neither happens is $P(\bar{A} \cap \bar{B}) = (1 - P(A)) \cdot (1 - P(B)) = \frac{1}{3}$.

Step 2: Set up equations.

From above, we have two equations:

- $P(A) \cdot P(B) = \frac{1}{6}$
- $(1 - P(A)) \cdot (1 - P(B)) = \frac{1}{3}$

Step 3: Expand the second equation.

Expand $(1 - P(A)) \cdot (1 - P(B)) = 1 - P(A) - P(B) + P(A) \cdot P(B) = \frac{1}{3}$.

Step 4: Replace $P(A) \cdot P(B)$.

Since $P(A) \cdot P(B) = \frac{1}{6}$, substitute:

- $1 - P(A) - P(B) + \frac{1}{6} = \frac{1}{3}$

Solve for $P(A) + P(B)$:

- $1 + \frac{1}{6} - \frac{1}{3} = P(A) + P(B)$
- $1 + \frac{1}{6} - \frac{2}{6} = P(A) + P(B)$
- $1 - \frac{1}{6} = P(A) + P(B)$
- $\frac{5}{6} = P(A) + P(B)$

Step 5: Build a quadratic equation.

Let $P(A) = x$. Then $P(B) = \frac{5}{6} - x$.

Also, $x \cdot P(B) = \frac{1}{6}$.

So, $x\left(\frac{5}{6} - x\right) = \frac{1}{6}$

$5x/6 - x^2 = 1/6$

Multiply both sides by 6: $5x - 6x^2 = 1$

$6x^2 - 5x + 1 = 0$

Step 6: Solve the quadratic equation.

$x = \frac{5 \pm \sqrt{25-24}}{12}$

$x = \frac{5 \pm 1}{12}$, so $x = \frac{6}{12} = \frac{1}{2}$ and $x = \frac{4}{12} = \frac{1}{3}$

Step 7: Choose the correct values using $P(A) > P(B)$.

Since $P(A) > P(B)$, $P(A) = \frac{1}{2}$ and $P(B) = \frac{1}{3}$.

Question9

Two dice are thrown and the sum of the numbers appeared on the dice is noted. If A is the event of getting a prime number as their sum and B is the event of getting a number greater than 8 as their sum, then $P(A \cap \bar{B}) =$

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Options:

A.

$\frac{1}{4}$

B.

$\frac{13}{36}$

C.

$\frac{2}{9}$

D.

$\frac{5}{18}$

Answer: B

Solution:

Step 1: Understand events A and B

Event A means the sum that comes from the two dice is a prime number.

Event B means the sum is more than 8.

$\bar{B}$ means the sum is 8 or less.

Step 2: List all possible sums when rolling two dice

When rolling two dice, the possible sums go from 2 to 12.

Step 3: Find all ways to get a prime sum (A)

The prime numbers between 2 and 12 are: 2, 3, 5, 7, and 11.

We need to count all pairs of dice rolls that add up to one of these numbers.

Step 4: Find the pairs for $A \cap \bar{B}$

We only want the pairs where the sum is a prime number and also less than or equal to 8.

The prime numbers that are 8 or less are: 2, 3, 5, and 7.

Let's list all pairs for each:

Sum = 2: (1,1)
Sum = 3: (1,2), (2,1)
Sum = 5: (1,4), (2,3), (3,2), (4,1)
Sum = 7: (1,6), (2,5), (3,4), (4,3), (5,2), (6,1)

Counting all these, there are 13 pairs.

Step 5: Total number of possible outcomes

There are 36 possible combinations when rolling two dice (6 sides on the first die times 6 sides on the second die).

Step 6: Write the probability

The probability of both A happening and $\bar{B}$ (sum is a prime less than or equal to 8) happening is:

$P(A \cap \bar{B}) = \frac{13}{36}$

Question10

A family consists of 8 persons. If 4 persons are chosen a random and they are found to be 2 men and 2 women, then the probability that there are equal number of men and women in that family is

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Options:

A.

$\frac{1}{5}$

B.

$\frac{3}{7}$

C.

$\frac{2}{5}$

D.

$\frac{2}{7}$

Answer: D

Solution:

$\Sigma_1 =$ In the family of 8 , men and women are in equal number $\Sigma_i =$ In the family of 8 , men and women are not in equal number.

Total cases $= 9$ for each case $P\left(\Sigma_1\right) = 1/9 A = 4$ persons are selected in which ^{2} are men and 2 are women.

$$
\begin{aligned}
P\left(\Sigma_1/A\right) &= \frac{P(A)\cdot P\left(A/\Sigma_1\right)}{P(A)\cdot P\left(A/\Sigma_1\right)+P\left(\Sigma_i\right)\cdot P\left(A/\Sigma_i\right)} \\
&= \frac{\frac{1}{9}\cdot\frac{{}^4C_2\cdot{}^4C_2}{{}^8C_4}}{\frac{1}{9}\cdot\frac{{}^4C_2\cdot{}^4C_2}{{}^8C_4}+\frac{1}{9}\frac{\left({}^2C_2\cdot{}^6C_2+{}^3C_2\cdot{}^5C_2\right)_2}{{}^8C_4}} \\
&= \frac{1}{1+\frac{2(15+30)}{36}} = \frac{1}{1+\frac{45}{18}} = \frac{1}{1+\frac{5}{2}} = \frac{2}{7}
\end{aligned}
$$

Question11

The number of trials conducted in a binomial distribution is 6 . If the difference between the mean and variance of this variate is $\frac{27}{8}$, then the probability of getting atmost 2 successes is

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Options:

A.

$\frac{106}{4^6}$

B.

$\frac{144}{4^6}$

C.

$\frac{126}{4^6}$

D.

$\frac{154}{4^6}$

Answer: D

Solution:

We have, $n=6$

Mean - Variance $=27/8$

$$
\begin{aligned}
&\Rightarrow np-npq=\frac{27}{8}\Rightarrow np(1-q)=\frac{27}{8} \\
&\Rightarrow np^2=\frac{27}{8}\Rightarrow p^2=\frac{27}{8\times 6}\Rightarrow p^2=\frac{9}{16}\Rightarrow p=\frac{3}{4} \\
\therefore\ & P(X\leq 2)=P(X=0)+P(X=1)+P(X=2) \\
&= {}^6C_0\left(\frac{3}{4}\right)^0\left(\frac{1}{4}\right)^6+{}^6C_1\left(\frac{3}{4}\right)^1\left(\frac{1}{4}\right)^5+{}^6C_2\left(\frac{3}{4}\right)^2\cdot\left(\frac{1}{4}\right)^2 \\
&= \frac{1}{4^6}(1+18+135)=\frac{154}{4^6}
\end{aligned}
$$

Question12

Let $X\sim B(n,p)$ with mean μ and variance σ^2. If $\mu=2\sigma^2$ and $\mu+\sigma^2=3$, then $P(X\leq 3)=$

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Options:

A.

$\frac{40}{49}$

B.

$\frac{40}{43}$

C.

$\frac{100}{101}$

D.

$\frac{15}{16}$

Answer: D

Solution:

The mean of a binomial distribution is $\mu = np$.

The variance is $\sigma^2 = npq$ where $q = 1 - p$.

Given $\mu = 2\sigma^2$, so $np = 2(npq)$. This means $np = 2npq$.

Dividing both sides by np (assuming $np \neq 0$), we get $1 = 2q$, so $q = \frac{1}{2}$.

Since $q = \frac{1}{2}$, then $p = 1 - q = \frac{1}{2}$.

Also, we are told that $\mu + \sigma^2 = 3$. Substitute the formulas to get: $np + npq = 3$.

Factor np to get $np(1 + q) = 3$.

Now, substitute $p = \frac{1}{2}$ and $q = \frac{1}{2}$ into the equation:$n\left(\frac{1}{2}\right)\left(1 + \frac{1}{2}\right) = 3$.

Rewrite $1 + \frac{1}{2} = \frac{3}{2}$, so $n\left(\frac{1}{2}\right)\left(\frac{3}{2}\right) = 3$.

This becomes $n \cdot \frac{3}{4} = 3$. Divide both sides by $\frac{3}{4}$:$n = 3 \div \frac{3}{4} = 3 \times \frac{4}{3} = 4$.

The distribution is $B(4, \frac{1}{2})$.

We need to find $P(X \leq 3)$.

For a binomial distribution, $P(X \leq 3) = 1 - P(X = 4)$, because the only other possible value for X is 4 when $n = 4$.

$P(X = 4) = \binom{4}{4}\left(\frac{1}{2}\right)^4 = 1 \times \left(\frac{1}{16}\right) = \frac{1}{16}$

Therefore, $P(X \leq 3) = 1 - \frac{1}{16} = \frac{15}{16}$.

Question13

A basket contains 5 apples and 7 oranges and another basket contains 4 apples and 8 oranges. If one fruit is picked out at random from each basket, then the probability of getting one apple and one orange is

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Options:

A.

$\frac{1}{6}$

B.

$\frac{7}{18}$

C.

$\frac{17}{36}$

D.

$\frac{19}{36}$

Answer: C

Solution:

Total number of fruits in one basket $= 5$ apples $+7$ oranges $= 12$

Probability of picking an apple from Ist basket $= \frac{5}{12} = P(A_1)$ Probability of picking an orange from Ist basket $= \frac{7}{12} = P(B_1)$ Total number of fruits in second baskd $= 4$ apples $+8$ oranges $= 12$ Probability of picking an apples from IInd basket, $P(A_2) = \frac{4}{12}$

Probability of picking an oranges from IInd basket $P(B_2) = \frac{8}{12}$

Probability of picking an apple from Ist and an orange from IInd basket

$= \frac{5}{12} \times \frac{8}{12} = \frac{40}{144} = \frac{10}{36} = \frac{5}{18}$

Probability of picking an apple from IInd basket and an orange from Ist basket $= \frac{4}{12} \times \frac{7}{12} = \frac{28}{144}$

So, total probability

$= \frac{40}{144} + \frac{28}{144} = \frac{68}{144} = \frac{17}{36}$

Question14

Two cards are drawn from a pack of 52 playing cards one after the other without replacement. If the first card drawn is a queen, then the probability of getting a face card from a black suit in the second draw is

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Options:

A.

$\frac{11}{663}$

B.

$\frac{11}{1326}$

C.

$\frac{11}{312}$

D.

$\frac{11}{156}$

Answer: B

Solution:

Probability of drawing a black queen first $= \frac{2}{52}$

Remaining black face card $= 5$

Probability of drawing a black face card after a black queen $= \frac{5}{51}$

Now, probability of red queen first $= \frac{2}{52}$

Probability of a black face card after a red queen $= \frac{6}{51}$

So, total probability $= \frac{2}{52} \times \frac{5}{51} + \frac{2}{52} \times \frac{6}{51}$

$= \frac{10}{2652} + \frac{12}{2652} = \frac{22}{2652} = \frac{11}{1326}$

Question15

An item is tested on a device for its defectiveness. The probability that such an item is defective is 0.3 . The device gives accurate result in 8 out of 10 such tests.

If the device reports that an item tested is not defective, then the probability that it is actually defective is

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Options:

A.

$\frac{2}{15}$

B.

$\frac{3}{29}$

C.

$\frac{3}{31}$

D.

$\frac{4}{51}$

Answer: C

Solution:

Let D be the event that an item is defective, and N be the event that an item is not defective.

So, $P(D) = 0.3$ and $P(N) = 1 - 0.3 = 0.7$

Probability of an accurate result

$= \frac{8}{10} = 0.8 = P(R_D/D)$

Probability of an inaccurate result

$$\begin{aligned} &= 1 - 0.8 = 0.2 = P(R_N/D) \\ &\text{So, } P(D \cap R_N) = P(R_N/D) \times P(D) \\ &= 0.2 \times 0.3 = 0.06 \\ &P(N \cap R_N) = P(R_N/N) \times P(N) \\ &\qquad = 0.8 \times 0.7 = 0.56 \end{aligned}$$

$$\begin{aligned} &0, P(R_N) = P(D \cap R_N) + P(N \cap R_N) \\ &\qquad = 0.06 + 0.56 = 0.62 \\ &P(D/R_N) = \frac{P(D \cap R_N)}{P(R_N)} = \frac{0.06}{0.62} = \frac{6}{62} = \frac{3}{31} \end{aligned}$$

$\therefore$ The probability of an item is actually defective given device reports it as not defective is $\frac{3}{31}$.

Question16

In a school there are 3 sections A, B and C. Section A contains 20 girls and 30 boys, section B contains 40 girls and 20 boys and section C contains 10 girls and 30 boys. The probabilities of selecting the section A, B and C are $0.2, 0.3$ and 0.5 respectively. If a student selected at random from the school is a girl, then the probability that she belongs to section A is

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Options:

A.

$\frac{121}{200}$

B.

$\frac{16}{121}$

C.

$\frac{14}{81}$

D.

$\frac{16}{81}$

Answer: D

Solution:

Let A, B and C be the event that a student is from section A, B and C.

So, $P(A)=0.2, P(B)=0.3, P(C)=0.5$

Now, section A : 20 girls, 30 boys, total 50 students

Section B : 40 girls, 20 boys, total 60 students

Section C : 10 girls, 30 boys, total 40 students

$$P(G/A)=\frac{20}{50}=0.4, P(G/B)=\frac{40}{60}=\frac{2}{3}$$
$$P(G/C)=\frac{10}{40}=0.25$$
$$\begin{aligned} P(G) &= P(G/A)\cdot P(A)+P(G/B)\cdot P(B)+P(G/C)\cdot P(C) \\ &= 0.4\times 0.2+\frac{2}{3}\times 0.3+0.25\times 0.5 \\ &= 0.08+0.2+0.125 \\ &= 0.405 \end{aligned}$$

Now, $P(G\cap A)=P(G/A)\cdot P(A)$

$=0.4\times 0.2=0.08$

Using Bayes' theorem,

$$P(A/G)=\frac{P(A\cap G)}{P(G)}$$
$$=\frac{0.08}{0.405}=\frac{80}{405}=\frac{16}{81}$$

So, the probability that a randomly selected girl belongs to section A is $\frac{16}{81}$.

Question17

If the probability distribution of a random variable X is as follows, then the mean of X is

$X=x_i$	-1	0	1	2
$P(X=x_i)$	k^3	$2k^3+k$	$4k-10k^2$	$4k-1$

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Options:

A.

$\frac{193}{27}$

B.

$\frac{25}{27}$

C.

$\frac{23}{27}$

D.

$\frac{83}{27}$

Answer: C

Solution:

$X = x_i$	-1	0	1	2
$P(X = x_i)$	k^3	$2k^3 + k$	$4k - 10k^2$	$4k - 1$

$$\sum_{i=-1}^{2} P(X = x_i) = 1$$
$$\Rightarrow k^3 + 2k^3 + k + 4k - 10k^2 + 4k - 1 = 1$$
$$\Rightarrow 3k^3 - 10k^2 + 9k - 2 = 0$$
$$\Rightarrow (k-1)\left(3k^2 - 7k + 2\right) = 0$$
$$\Rightarrow 3(k-1)(k-2)\left(k - \frac{1}{3}\right) = 0$$

So, $k = 1, 2$ or $\frac{1}{3}$

$k \neq 1, 2$

For $k = \frac{1}{3}$,

$$\begin{aligned} \mu &= -1 \cdot \left(\frac{1}{3}\right)^3 + 1 \cdot \left(\frac{4}{3} - \frac{10}{9}\right) + 2 \cdot \left(\frac{4}{3} - 1\right) \\ &= \frac{-1}{27} + 0 + \frac{12 - 10}{9} + 2 \cdot \frac{1}{3} \\ &= \frac{-1}{27} + \frac{2}{9} + \frac{2}{3} = \frac{-1 + 6 + 18}{27} = \frac{23}{27} \end{aligned}$$

So, $\mu = \frac{23}{27}$

Question18

If X is a binomial variate with mean $\frac{16}{5}$ and variance $\frac{48}{25}$, then $P(X \leq 2) =$

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Options:

A.

$\frac{3^6(169)}{5^8}$

B.

$\frac{3^7(71)}{5^8}$

C.

$\frac{3^8}{(43)5^8}$

D.

$\frac{3^6(158)}{5^8}$

Answer: A

Solution:

Mean, $\mu = \frac{16}{5}$, variance, $\sigma^2 = \frac{48}{25}$

We know that, $\mu = np$ and $\sigma^2 = np(1-p)$

So, $\frac{16}{5} = np$ and $\frac{48}{25} = np(1-p)$

$$\Rightarrow \quad \frac{16}{5}(1-p) = \frac{48}{25}$$
$$\Rightarrow \quad 1-p = \frac{48}{25} \times \frac{5}{16} = \frac{3}{5}$$

$\Rightarrow \quad p = 1 - \frac{3}{5} = \frac{2}{5}, 1-p = \frac{3}{5}$

Now, $np = \frac{16}{5}$

$$\Rightarrow \quad n \cdot \frac{2}{5} = \frac{16}{5}$$
$$\Rightarrow \quad n = 8$$

Now,

$$P(X \leq 2) = P(X=0) + P(X=1) + P(X=2)$$
$$= \binom{8}{0} P^0 (1-p)^8 + \binom{8}{1} p^1 (1-p)^7 + \binom{8}{2} p^2 (1-p)^6$$
$$= 1 \cdot \left(\frac{2}{5}\right)^0 \cdot \left(\frac{3}{5}\right)^8 + 8 \cdot \frac{2}{5} \cdot \left(\frac{3}{5}\right)^7 + 28 \cdot \left(\frac{2}{5}\right)^2 \cdot \left(\frac{3}{5}\right)^6$$
$$= \left(\frac{3}{5}\right)^8 + \frac{16 \cdot 3^7}{5^8} + \frac{28 \cdot 4 \cdot 3^6}{5^8}$$
$$= \frac{3^8 + 16 \cdot 3^7 + 28 \cdot 4 \cdot 3^6}{5^8}$$
$$= \frac{3^6 \left(3^2 + 16 \cdot 3 + 112\right)}{5^8} = \frac{3^6(169)}{5^8}$$

Question19

There are 8 boys and 7 girls in a class room. If the names of all those children are written on paper slips and 3 slips are drawn at random from them, then the probability of getting the names of one boy and two girls or one girl and two boys is

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Options:

A.

$\frac{1}{5}$

B.

$\frac{3}{4}$

C.

$\frac{4}{5}$

D.

$\frac{1}{4}$

Answer: C

Solution:

Total childrens $= 15(8B + 7G)$

Total ways of choosing 3 childrens out of 15 is

$= {}^{15}C_3 = \frac{15 \times 14 \times 13}{3 \times 2 \times 1} = 455$

Case I Choosing 1 boy and 2 girls

$= {}^8C_1 \cdot {}^7C_2 = \frac{8 \times 7 \times 6}{2} = 168$

Case II Choosing 2 boys and 1 girl

$= {}^8C_2 \cdot {}^7C_1 = \frac{8 \times 7}{2} \times 7 = 196$

Thus, required probability

$= \frac{168+196}{455} = \frac{364}{455} = \frac{4}{5}$

Question20

A four member committee is to be formed from a group containing 9 men and 5 women. If a committee is formed randomly, then the probability that it contains atleast one woman is

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Options:

A.

$\frac{125}{143}$

B.

$\frac{18}{143}$

C.

$\frac{60}{143}$

D.

$\frac{65}{143}$

Answer: A

Solution:

Total people $= 14(9\mathrm{M} + 5\ \mathrm{W})$

Total ways to choose 4 peoples from 14 is

$= {}^{14}C_4$

Total ways to choose all men is $= {}^{9}C_4$

So, total ways to choose atleast one women

$$= {}^{14}C_4 - {}^{9}C_4 = \frac{14 \times 13 \times 12 \times 11}{4 \times 3 \times 2 \times 1} - \frac{9 \times 8 \times 7 \times 6}{4 \times 3 \times 2 \times 1}$$
$$= 1001 - 126 = 875$$

Hence, required probability

$= \frac{875}{1001} = \frac{125}{143}$

Question21

A die is thrown twice. Let A be the event of getting a prime number when the die is thrown first time and B be the event of getting an even number when the die is thrown second time. Then, $P(A/\bar{B}) =$

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Options:

A.

$\frac{1}{2}$

B.

$\frac{2}{3}$

C.

$\frac{1}{5}$

D.

$\frac{3}{5}$

Answer: A

Solution:

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

Prime number $= \{2, 3, 5\} = 3$

So, $P(A) = 3/6 = 1/2$

and even numbers $= \{2, 4, 6\} = 3$

$\therefore P(B) = 3/6 = 1/2$

Thus, $P(\bar{B}) = 1 - P(B) = 1 - 1/2 = 1/2$

Total sample for 2 throws $= 6 \times 6 = 36$

Then, $P(A/\bar{B}) = \frac{P(A \cap \bar{B})}{P(\bar{B})}$

First throw is prime $= \{2, 3, 5\}$

Second throw is not even $= \{1, 3, 5\}$

Pairs where first is in $\{2, 3, 5\}$ and second is in $\{1, 3, 5\}$

$= 3 \times 3 = 9$ outcomes
So, $P(A \cap \bar{B}) = 9/36 = 1/4$
Therefore, $P(A/\bar{B}) = \dfrac{(1/4)}{(1/2)} = 1/2$

Question22

A bag contains 5 balls of unknown colours. There are equal chances that out of these five balls, there may be 0 or 12 or or 3 or 4 or 5 red balls, A ball is taken out from the bag at random and is found to be red. The probability that it is the only red ball in the bag is

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Options:

A.

$\frac{1}{5}$

B.

$\frac{1}{6}$

C.

$\frac{1}{15}$

D.

$\frac{1}{30}$

Answer: C

Solution:

Let R_k be the event that are exactly k red balls is in bag, where

$k=1,2,3,4,5$

So, $P(R_k)=\frac{1}{5}$ for $k=1,2,3,4,5$

Let A be the event that a red ball is drawn.

$$P(R_1/A)=\frac{P(R_1\cap A)}{P(A)}$$

$$\because\quad P(A/R_1)=\frac{1}{5}$$

$$\text{and } P(R_1\cap A)=P(R_1)\cdot P(A/R_1)$$

$$=\frac{1}{5}\cdot\frac{1}{5}=\frac{1}{25}$$

$$\text{and } P(A)=\sum_{k=0}^{5}P(R_k)\cdot P(A/R_k)$$

$$=\frac{1}{5}\sum_{k=0}^{5}\frac{k}{5}=\frac{1}{25}(1+2+3+4+5)$$

$$=\frac{1}{25}\times 15=\frac{15}{25}$$

$$\text{Hence, } P(R_1/A)=\frac{P(R_1\cap A)}{P(A)}=\frac{\frac{1}{25}}{\frac{15}{25}}=\frac{1}{15}$$

Question23

If $X\sim B(9,p)$ is a binomial variate satisfying the equation $P(X=3)=P(X=6)$, then $P(X<3)=$

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Options:

A.

$\frac{23}{256}$

B.

$\frac{65}{256}$

C.

$\frac{5}{256}$

D.

$\frac{45}{512}$

Answer: A

Solution:

$\because P(X=r)={}^nC_rp^r(1-p)^{n-r}$

and $\quad P(X=3)=P(X=6)$

$\Rightarrow\quad {}^9C_3p^3(1-p)^6={}^9C_6p^6(1-p)^3$

$\Rightarrow\quad (1-p)^3=p^3$

$\Rightarrow\quad \frac{1-p}{p}=1$

$\Rightarrow\quad p=1/2$

So, $P(X<3)=P(X=0)+P(X=1)+P(X=2)$

$$={}^9C_0\left(\frac{1}{2}\right)^9+{}^9C_1\left(\frac{1}{2}\right)^9+{}^9C_2\left(\frac{1}{2}\right)^9$$

$$=\frac{1}{512}+\frac{9}{512}+\frac{36}{512}=\frac{46}{512}=23/256$$

Question24

If 3 squares are chosen at random from the 64 squares of a chess board, then the probability that all of them lie along the same diagonal line is

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Options:

A.

$\frac{21}{764}$

B.

$\frac{14}{745}$

C.

$\frac{7}{744}$

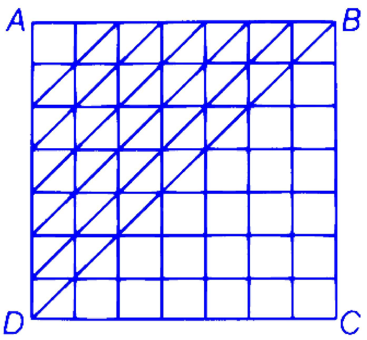
D.

$\frac{7}{736}$

Answer: C

Solution:

We can choose three squares in a diagonal line parallel to BD in the $\triangle ABD$. Clearly, three squares in $\triangle ABD$ and in a diagonal line parallel to BD can be chosen in



${}^3C_3 + {}^4C_3 + {}^5C_3 + {}^6C_3 + {}^7C_3 + {}^8C_3$ ways

Similarly, in $\triangle BCD$ the squares can be chosen parallel to BD in an equal number of ways.

Hence, the total number of ways in which three squares can be chosen in a diagonal line parallel to BD is

$= 2\left({}^3C_3 + {}^4C_3 + {}^5C_3 + {}^6C_3 + {}^7C_3\right) + {}^8C_3$

($\because$ BD is common to both the triangles) Similarly, squares can be chosen in a diagonal line parallel to AC and hence the total number of favourable ways

$= 4\left({}^3C_3 + {}^4C_3 + {}^5C_3 + {}^6C_3 + {}^7C_3\right) + 2 \cdot {}^8C_3 = 392$

Hence, the required probability

$= \frac{392}{{}^{64}C_3} = \frac{392\times 6}{64\times 63\times 62} = \frac{7}{744}$

Question25

In a shoe rack there are 4 pairs of shoes and 4 shoes. are drawn one after the other at random without replacement. Then, the probability of getting atleast one correct pair of shoes among the four shoes drawn is

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Options:

A.

$\frac{8}{35}$

B.

$\frac{27}{35}$

C.

$\frac{1679}{1680}$

D.

$\frac{1}{1680}$

Answer: B

Solution:

Total number of ways to choose 4 shoes from $8 = {}^8C_4 = 70$

We want to choose 4 shoes that none of them form a pair.

Firstly, choose 4 different pairs from the 4 available pairs $= {}^4C_4 = 1$

For each of the 4 pairs, 2 choices (left or right) $= 2^4 = 16$.

Hence, total number of ways to choose 4 shoes with no pair $= 1 \times 2^4 = 16$.

Thus, number of ways with atleast one pair $= 70 - 16 = 54$.

$\therefore$ Required probability $= \frac{54}{70} = \frac{27}{35}$

Question26

A rational number is selected at random from the distinct rational numbers of the form p/q formed with p and q belonging to the set $\{1, 2, 3, 4, 5, 6\}$. The probability that the rational number selected is a proper fraction, is

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Options:

A.

$\frac{1}{2}$

B.

$\frac{5}{6}$

C.

$\frac{11}{23}$

D.

$\frac{13}{35}$

Answer: A

Solution:

We consider all distinct rational numbers $\frac{p}{q}$ such that $p, q \in \{1, 2, 3, 4, 5, 6\}$ and GCD $(p, q) = 1$

Now, we will consider each possible q from 1 to 6 and for each, count the $p \in \{1, 2, 3, 4, 5, 6\}$ such that g.c.d. $(p, q) = 1$

q	Valid p (C.G.D. $(p, q) = 1$	Count
1	$2,3,4,5,6$	5
2	$1,3,5$	3
3	$1,2,4,5$	4
4	$1,3,5$	3
5	$1,2,3,4,6$	5
6	$1,5$	2
Total		**22**

So, there are 22 distinct reduced rational numbers of the form $\frac{p}{q}$.

As we know that, a proper fraction is one where $p

Among the 22 reduced fractions, we will now count how many satisfy $p

When, $q=1; p=2,3,4,5,6 \rightarrow$ all $p>q \rightarrow$ None proper fraction.

when $q=2, p=1,3,5 \rightarrow$ only $p=1 \rightarrow 1$ proper fraction.

When $q=3; p=1,2,4,5 \rightarrow p=1,2 \rightarrow 2$ proper fraction.

when $q=4; p=1,3,5 \rightarrow p=1,3 \rightarrow 2$ proper fraction when $q=5; p=1,2,3,4,6 \rightarrow p=1,2,3,4 \rightarrow 4$ proper fraction when $q=6, p=1,5 \rightarrow p=1,5 \rightarrow$ both $<6 \rightarrow 2$ proper fraction

$\therefore$ Total proper fraction

$=1+2+2+4+2=11$

So, required probability

$$= \frac{\text{Number of proper fraction}}{\text{Total distinct reduced fractions}}$$
$$= \frac{11}{22} = \frac{1}{2}$$

Question27

The probability distribution of a discrete random variable X is given below

$X=x$	-1	0	1	2
$P(X=x)$	$\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{3}$

Then, the value of $6\sum\left(x^2\right)P(X=x)-\operatorname{var}(X)=$

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Options:

A.

$\frac{113}{12}$

B.

$\frac{151}{12}$

C.

$\frac{19}{12}$

D.

$\frac{1}{2}$

Answer: A

Solution:

$\Sigma x^2 \cdot P(X=x)=(-1)^2 \cdot \frac{1}{3}+0^2 \cdot \frac{1}{6}+1^2 \cdot \frac{1}{6}+2^2 \cdot \frac{1}{3}=1 \cdot \frac{1}{3}+0+1 \times \frac{1}{6}+4 \times \frac{1}{3}=\frac{11}{6}$

$E(X)=\Sigma x \cdot P(X)=(-1) \cdot \frac{1}{3}+0 \cdot \frac{1}{6}+1 \times \frac{1}{6}+2 \times \frac{1}{3}=\frac{1}{2}$

$\therefore \operatorname{var}(X)=E\left(X^2\right)-(E(X))^2$

$=\frac{11}{6}-\frac{1}{4}=\frac{19}{12}$

Hence, $6 \cdot \Sigma x^2 \cdot P(X=x)-\operatorname{var}(X)$

$=6 \times \frac{11}{6}-\frac{19}{12}=\frac{132-19}{12}=\frac{113}{12}$

Question28

If the average number of accidents occurring at a particular junction on a highway in a week is 5 , then the probability that atmost one accident occurs in a particular week is

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Options:

A.

$\frac{25}{e^4}$

B.

$\frac{24}{e^4}$

C.

$\frac{121}{e^5}$

D.

$\frac{6}{e^5}$

Answer: D

Solution:

Average number of accidents per weeks $(\lambda)=5$

We want to find the probability of at most one accident i.e.

$P(X \leq 1)=P(0)+P(1)$.

As we know that, poisson probability formula,

$$P(X=k)=\frac{e^{-\lambda} \lambda^k}{k!}$$

$$\therefore \quad P(0)=\frac{e^{-5} \cdot 5^0}{0!}=e^{-5}$$

$$P(1)=\frac{e^{-5} \cdot 5^1}{1!}=5 e^{-5}$$

$\therefore P(X \leq 1)=e^{-5}(1+5)=6 e^{-5}=\frac{6}{e^5}$

Question29

An unbiased coin is tossed 8 times. The probability that head appears consecutively at least 5 times is

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Options:

A.

$\frac{5}{256}$

B.

$\frac{5}{128}$

C.

$\frac{5}{64}$

D.

$\frac{5}{32}$

Answer: B

Solution:

Total number of outcomes

$= 2^8 = 256 = n(S)$

Favourable outcomes $n(E) = 10$

$\Rightarrow P(E) = \frac{n(E)}{n(S)} = \frac{10}{256} = \frac{5}{128}$

Question30

A box contains twelve balls of which 4 are red, 5 are green and 3 are white. If three balls are drawn at random simultaneously from the box, then the probability that exactly 2 balls have the same colour is

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Options:

A.

$\frac{27}{44}$

B.

$\frac{29}{44}$

C.

$\frac{17}{22}$

D.

$\frac{31}{44}$

Answer: B

Solution:

Total number of ways

$= {}^{12}C_3 = \frac{12!}{3! \times 9!} = 220$

Number of ways to draw exactly 2 red balls and 1 non-red ball

$= {}^4C_2 \times {}^8C_1 = 6 \times 8 = 48$

Number of ways to draw exactly 2 green balls and 1 non-green ball

$= {}^5C_2 \times {}^7C_1$
$= \frac{5!}{2! \times 3!} \times \frac{7!}{1!6!} = 10 \times 7 = 70$

Number of ways to choose 2 white balls from 3.

$= {}^3C_2$

Number of ways to draw exactly 2 white balls and 1 non-white ball

$= {}^3C_2 \times {}^9C_1 = \frac{3!}{2! \times 1!} \times \frac{9!}{1!8!}$
$= 3 \times 9 = 27$

Total number of ways to draw exactly 2 balls of the same colour

$= 48 + 70 + 27 = 145$

$\therefore$ Required probability $= \frac{145}{220} = \frac{29}{44}$

Question31

There are three families F_1, F_2, F_3. F_1 has 2 boys and 1 girl; F_2 has 1 boy and 2 girls; F_3 has 1 boy and 1 girl. A family is randomly chosen and a child is chosen from that family randomly. If it is known that the child thus selected is a girl, then the probability that she is form F_2 is

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Options:

A.

$\frac{4}{9}$

B.

$\frac{2}{9}$

C.

$\frac{3}{7}$

D.

$\frac{5}{7}$

Answer: A

Solution:

We want to find the chance that the selected girl comes from F_2.

Step 1: Find the chance of picking each family.
There are three families, so the chance of picking any one family (F_1, F_2, or F_3) is $\frac{1}{3}$.

Step 2: Find the chance of picking a girl from each family.

- For F_1 (2 boys, 1 girl): Probability of picking a girl = $\frac{1}{3}$
- For F_2 (1 boy, 2 girls): Probability of picking a girl = $\frac{2}{3}$
- For F_3 (1 boy, 1 girl): Probability of picking a girl = $\frac{1}{2}$

Step 3: Find the total probability of picking a girl (from any family).

To get the total chance of picking a girl, add up the chance for each family:

$P(G) = P(G|F_1) \cdot P(F_1) + P(G|F_2) \cdot P(F_2) + P(G|F_3) \cdot P(F_3)$

$= \frac{1}{3} \cdot \frac{1}{3} + \frac{2}{3} \cdot \frac{1}{3} + \frac{1}{2} \cdot \frac{1}{3}$

$= \frac{1}{9} + \frac{2}{9} + \frac{1}{6} = \frac{1+2+3}{18} = \frac{6}{12} = \frac{1}{2}$

Step 4: Use Bayes' Theorem to find the chance that the girl is from F_2.
Bayes' Theorem tells us:$P(F_2|G) = \frac{P(G|F_2)\cdot P(F_2)}{P(G)} = \frac{\frac{2}{3}\cdot\frac{1}{3}}{\frac{1}{2}} = \frac{\frac{2}{9}}{\frac{1}{2}} = \frac{2}{9} \times 2 = \frac{4}{9}$

Final Answer:
The probability that the selected girl is from F_2 is $\frac{4}{9}$.

Question32

An urn A contains 4 white and 1 black ball; urn B contains 3 white and 2 black balls and urn C contains 2 white and 3 black balls. One ball is transferred randomly from A to B; later one ball is transferred randomly from B to C. Finally, if a ball is drawn randomly from C, then the probability that it is a black ball is

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Options:

A.

$\frac{7}{12}$

B.

$\frac{89}{180}$

C.

$\frac{101}{180}$

D.

$\frac{17}{36}$

Answer: C

Solution:

The probability of transferring a white ball from A to $B = \frac{4}{5}$

The probability of transferring a black ball from A to $B = \frac{1}{5}$

The probability of drawing a black ball from C after transferring a white ball from A to B

$= \frac{4}{6}\cdot\frac{3}{6} + \frac{2}{6}\cdot\frac{4}{6} = \frac{12}{36} + \frac{8}{36} = \frac{20}{36}$

The probability of drawing a black ball from C after transferring a black ball from A to B

$= \frac{3}{6}\cdot\frac{3}{6} + \frac{3}{6}\cdot\frac{4}{6} = \frac{9}{36} + \frac{12}{36} = \frac{21}{36}$

The total probability of drawing a black ball from C is

$= \frac{4}{5}\cdot\frac{20}{36} + \frac{1}{5}\cdot\frac{21}{36} = \frac{101}{180}$

Question33

If the probability distribution of a discrete random variable X is given by $P(X = k) = \frac{2^{-k}(3k+1)}{2^c}, k = 0, 1, 2, \ldots\ldots\infty$, then $P(X \leq c) =$

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Options:

A.

$\frac{c}{5}$

B.

$\frac{c}{4}$

C.

$\frac{c+2}{5}$

D.

$\frac{c-2}{7}$

Answer: B

Solution:

$$\sum_{k=0}^{\infty} P(X=k)=1$$
$$\Rightarrow \sum_{K=0}^{\infty} \frac{2^{-k}(3k+1)}{2^C}=1$$
$$\Rightarrow \frac{1}{2^C}\left(3\sum_{k=0}^{\infty} k\cdot 2^{-k}+\sum_{k=0}^{\infty} 2^{-k}\right)=1$$
$$\Rightarrow \frac{1}{2^C}\left(3\cdot\frac{2^{-1}}{(1-2^{-1})^2}+\frac{1}{1-2^{-1}}\right)=1$$
$$\Rightarrow \frac{1}{2^C}\left(\frac{\frac{3}{2}}{\frac{1}{4}}+\frac{1}{\frac{1}{2}}\right)=1$$
$$\Rightarrow \frac{1}{2^c}(6+2)=1\Rightarrow \frac{8}{2^c}=1$$
$$\Rightarrow 2^c=8\Rightarrow 2^c=2^3$$
$$\Rightarrow c=3$$
$$P(X\le c)=P(X\le 3)=P(X=0)+P(X=1)+P(X=2)+P(X=3)$$
$$=\frac{1}{2^3}+\frac{2^{-1}\times 4}{2^3}+\frac{2^{-2}\times 7}{2^3}+\frac{2^{-3}\times 10}{2^3}$$
$$=\frac{1}{2^3}+\frac{4}{2^4}+\frac{7}{2^5}+\frac{10}{2^6}$$
$$=\frac{2^3+16+14+10}{2^6}$$
$$=\frac{8+16+14+10}{2^6}=\frac{48}{64}=\frac{3}{4}$$
$$P(X\le c)=\frac{3}{4}=\frac{c}{4}$$

Question34

In a binomial distribution, if $n=4$ and $P(X=0)=\frac{16}{81}$, then $P(X=4)=$

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Options:

A.

$\frac{1}{8}$

B.

$\frac{1}{27}$

C.

$\frac{1}{16}$

D.

$\frac{1}{81}$

Answer: D

Solution:

We know that $n = 4$ (there are 4 trials) and $P(X = 0) = \frac{16}{81}$ (the chance of getting zero successes is $\frac{16}{81}$).

In a binomial distribution, p is the chance of success each time, and q is the chance of failure. $q = 1 - p$.

The formula to find the probability of getting k successes is: $P(X = k) = {}^nC_k p^k q^{n-k}$.

Step 1: Find q

$P(X = 0) = {}^4C_0 p^0 q^4$
${}^4C_0 = 1$ and $p^0 = 1$, so:
$P(X = 0) = 1 \cdot 1 \cdot q^4 = q^4$
We know $q^4 = \frac{16}{81}$.

To find q, take the fourth root of both sides:
$q = \frac{2}{3}$ because $(\frac{2}{3})^4 = \frac{16}{81}$.

Step 2: Find p

Since $q = \frac{2}{3}$,
$p = 1 - \frac{2}{3} = \frac{1}{3}$.

Step 3: Find $P(X = 4)$

$P(X = 4)$ is the probability of getting 4 successes out of 4 tries.
$P(X = 4) = {}^4C_4 p^4 q^0$
${}^4C_4 = 1$ and $q^0 = 1$,
So:
$P(X = 4) = 1 \cdot \left(\frac{1}{3}\right)^4 \cdot 1 = \left(\frac{1}{3}\right)^4$

Calculate $(\frac{1}{3})^4 = \frac{1}{81}$.

Final Answer:

$P(X = 4) = \frac{1}{81}$

Question35

The probability that a person A completes a work in a given time is $\frac{2}{3}$ and the probability that another person$B$ completes the same work in the same time is $\frac{3}{4}$.If both A and B start doing this work at the same time, then the probability that the work is completed in the given time is

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Options:

A.

$\frac{11}{12}$

B.

$\frac{1}{2}$

C.

$\frac{5}{12}$

D.

$\frac{8}{9}$

Answer: A

Solution:

Given that,

$$P(A)=\frac{2}{3}, \quad P(B)=\frac{3}{4}$$

$$P(\text{ not } A)=P\left(A^{\prime}\right)=1-\frac{2}{3}=\frac{1}{3}$$

$$P\left(B^{\prime}\right)=1-\frac{3}{4}=\frac{1}{4}$$

$$\begin{aligned} P(A \text{ or } B) \text{ or both })&=1-P\left(A^{\prime}\right) P\left(B^{\prime}\right) \\ &=1-\frac{1}{3} \times \frac{1}{4}=\frac{11}{12}\end{aligned}$$

Question36

If l, m represent any two elements (identical or different) of the set $\{1,2,3,4,5,6,7\}$, then the probability that $l x^2+m x+1>0 \forall x \in R$ is

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Options:

A.

$\frac{12}{{}^7C_2}$

B.

$\frac{22}{7^2}$

C.

$\frac{10}{{}^7C_2}$

D.

$\frac{36}{7^2}$

Answer: B

Solution:

Given set $\{1,2,3,4,5,6,7\}$

Two number can be taken from set $=49$ ways.

Now, for $l x^2+m x+1>0$

$m^2-4 l<0 \Rightarrow m^2<4 l$

If $l=1 \Rightarrow m^2<4 \Rightarrow m=1$

$l=2 \Rightarrow m^2<8 \Rightarrow m=1,2$
$l=3 \Rightarrow m^2<12 \Rightarrow m=1,2,3$
$l=4 \Rightarrow m^2<16 \Rightarrow m=1,2,3$
$l=5 \Rightarrow m^2<20 \Rightarrow m=1,2,3,4$
$l=6 \Rightarrow m^2<24 \Rightarrow m=1,2,3,4$
$l=7 \Rightarrow m^2<28 \Rightarrow m=1,2,3,4,5$

$\therefore$ Required probability $=\frac{22}{49}=\frac{22}{7^2}$

Question37

A and B are playing chess game with each other. The probability that A wins the game is 0.6 . the probability that he loses is 0.3 and the probability its draw is 0.1 . If they played three games, then the probability that A wins atleast two games is

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Options:

A.

$\frac{54}{125}$

B.

$\frac{81}{125}$

C.

$\frac{18}{25}$

D.

$\frac{9}{25}$

Answer: B

Solution:

Given that,

$P(A \text{ wins }) = 0.6$

$P(A \text{ loses }) = 0.3$

$P(\text{ game draw }) = 0.1$

$P(\text{ A win at least two game })$

$\Rightarrow \quad P(WWW) + P(WWL) + P(WLW)$

$+P(LWW) + P(WWD)$

$+P(DWW) + P(WDW)$

$= (0.6)^3 + 3(0.6)^2(0.3) + 3(0.6)^2(0.1)$

$= (0.6)^2(0.6 + 0.9 + 0.3)$

$= 0.36(1.8) = 0.648 = \frac{648}{1000} = \frac{81}{125}$

Question38

U_1, U_2, U_3 are three urns. U_1 contains 5 red, 3 white, 2 back balls: U_2 contains 4 red 4 white, 2 black balls and U_3 contains 3 red. 4 white, 3 black balls. If a ball is chosen at random from an urn chosen at random, then the probability of not getting a black ball is

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Options:

A.

$\frac{7}{30}$

B.

$\frac{23}{30}$

C.

$\frac{2}{5}$

D.

$\frac{11}{30}$

Answer: B

Solution:

Given that

$UrnU_1$ contains 5 red, 3 white, 2 black balls

$UrnU_2$ contains 4 red, 4 white, 2 black balls

$UrnU_3$ contains 3 red, 4 white, 3 black balls

Total number of balls $= 30$

Non-black balls = 23

Total probability of selecting one Ur $n = \frac{1}{3}$

Probability of getting not a black balls from U_1 or U_2 and U_3.

$= \frac{1}{3}\left(\frac{8}{10} + \frac{8}{10} + \frac{7}{10}\right)$

$\therefore$ Required probability $= \frac{1}{3} \times \frac{23}{10} = \frac{23}{30}$

Question39

If the probability distribution of a random variable X is as follows, then $P(X \leq 2) =$

x_i	0	1	2	3	4
$P(X = x_i)$	$3k$	$5k$	$3k^2$	$4k^2 + k$	$3k^2$

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Options:

A.

$\frac{14}{25}$

B.

$\frac{23}{32}$

C.

$\frac{41}{49}$

D.

$\frac{83}{100}$

Answer: D

Solution:

We know, $\Sigma P_i = 1$

$\therefore \quad 3k + 5k + 3k^2 + 4k^2 + k + 3k^2 = 1$

$\Rightarrow \quad 10k^2 + 9k - 1 = 0$

$\Rightarrow \quad (10k - 1)(k + 1) = 0$

$\Rightarrow \quad k = \frac{1}{10}$

$k \neq -1$

$P(X \leq 2) = P(X = 0) + P(X = 2) + P(X = 3)$

$= 3k + 5k + 3k^2 = \frac{8}{10} + \frac{3}{100} = \frac{83}{100}$

Question40

If X follows poisson distribution with variance 2 , then $P(X \geq 3) =$

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Options:

A.

$\frac{5}{e^2}$

B.

$\frac{e^2-5}{e^2}$

C.

$5+\frac{2}{e^2}$

D.

$\frac{5-e^2}{4}$

Answer: B

Solution:

$$\begin{aligned} &\text{ Variance } = 2 = \lambda \\ &\sigma = 2 \end{aligned}$$

$$\begin{aligned} &P(X=k) = \frac{e^{-\lambda}\lambda^k}{k!} \\ &P(X \geq 3) = 1 - P(X=0) - P(X=1) \\ &\quad -P(X=2) \\ &\qquad = 1 - \left(\frac{e^{-2}2^0}{0!} + \frac{e^{-2}2^1}{1!} + \frac{e^{-2}2^2}{2!}\right) \\ &\qquad = 1 - 5e^{-2} = \frac{e^2-5}{e^2} \end{aligned}$$

Question41

A problem in Algebra is given to two students A and B whose chances of solving it are $\frac{2}{5}$ and $\frac{3}{4}$ respectively.

The probability that the problem is solved if both of them try independently is

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Options:

A.

$\frac{17}{20}$

B.

$\frac{3}{20}$

C.

$\frac{1}{2}$

D.

$\frac{13}{20}$

Answer: A

Solution:

Given, $P(A)=\frac{2}{5}, P(B)=\frac{3}{4}$

$P($ Problem is solved $)=1-P($ Problem is not solve$)$

$$
\begin{aligned}
P(A \cup B) & =1-P\left(A^{\prime} \cap B^{\prime}\right) \\
& =1-P(A) \cdot P(B) \\
& =1-\frac{3}{5} \times \frac{1}{4}=\frac{20-3}{20}=\frac{17}{20}
\end{aligned}
$$

Question42

Three dice are thrown simultaneously and the sum of the numbers appeared on them is noted. If A is the event of getting a sum greater than 14 and B is the event of getting a sum which is a multiple of 3 , then $P(A \cap \bar{B})+P(\bar{A} \cap B)=$

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Options:

A.

$\frac{35}{108}$

B.

$\frac{17}{54}$

C.

$\frac{45}{108}$

D.

$\frac{5}{54}$

Answer: A

Solution:

$A=$ getting a sum >14

$B=$ sum is multiple of 3

$$
\begin{aligned}
& n(A)=14 \quad P(A)=\frac{14}{216} \\
& n(B)=78 \quad P(B)=\frac{78}{216} \\
& n(A \cap B)=11 P(A \cap B)=\frac{11}{216} \\
& \because P(A \cap \bar{B})+P(\bar{A} \cap B) \\
& \qquad=P(A)+P(B)-2 P(A \cap B) \\
& \qquad=\frac{14}{216}+\frac{78}{216}-\frac{11 \times 2}{216} \\
& \qquad=\frac{92-22}{216}=\frac{70}{216}=\frac{35}{108}
\end{aligned}
$$

Question43

A manufacturing company of bulbs has 3 units A, B and C which produce $25\%, 35\%$ and 40% of the bulbs respectively. Out of the bulbs produced by A, B, C units, $5\%, 4\%$ and 2% are defective, respectively. If a bulb is chosen at random and found to be defective, then the probability that it is produced by unit B is

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Options:

A.

$\frac{28}{69}$

B.

$\frac{28}{71}$

C.

$\frac{29}{67}$

D.

$\frac{25}{69}$

Answer: A

Solution:

Let E_1 mean the bulb was made by unit A.

Let E_2 mean the bulb was made by unit B.

Let E_3 mean the bulb was made by unit C.

Let E mean the bulb is defective.

The chance a bulb comes from each unit is:
$P(E_1) = \frac{25}{100}$ (from A), $P(E_2) = \frac{35}{100}$ (from B), and $P(E_3) = \frac{40}{100}$ (from C).

The chance a bulb is defective from each unit is:
$P\left(\frac{E}{E_1}\right) = \frac{5}{100}, P\left(\frac{E}{E_2}\right) = \frac{4}{100}, P\left(\frac{E}{E_3}\right) = \frac{2}{100}$.

To find how likely it is a defective bulb came from unit B, use Bayes' theorem:

$$P\left(\frac{E_2}{E}\right) = \frac{P(E_2)P\left(\frac{E}{E_2}\right)}{P(E_1)P\left(\frac{E}{E_1}\right)+P(E_2)P\left(\frac{E}{E_2}\right)+P(E_3)P\left(\frac{E}{E_3}\right)}$$

Now plug in the numbers:

$$P\left(\frac{E_2}{E}\right) = \frac{\frac{35}{100}\times\frac{4}{100}}{\frac{25}{100}\times\frac{5}{100}+\frac{35}{100}\times\frac{4}{100}+\frac{40}{100}\times\frac{2}{100}}$$

The top ($35 \times 4 = 140$) and the bottom adds up ($25 \times 5 = 125, 35 \times 4 = 140, 40 \times 2 = 80$) so:

$$P\left(\frac{E_2}{E}\right) = \frac{140}{125+140+80}$$

$$P\left(\frac{E_2}{E}\right) = \frac{140}{345} = \frac{28}{69}$$

Question44

The probability distribution of a random variable X is given below

X	1	2	3	4	5	6
$P(X = x_i)$	α	α	α	β	β	0.3

If μ and σ^2 represent the mean and variance of X and $\mu = 4.2$, then $\sigma^2 + \mu^2 =$

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Options:

A.

20.4

B.

10.8

C.

16.4

D.

21.4

Answer: A

Solution:

X_i	P_i	X_iP_i	${X_i}^2$	$P_i{X_i}^2$
1	α	α	1	α
2	α	2α	4	4α
3	α	3α	9	9α
4	β	4β	16	16β
5	β	5β	25	25β
6	0.3	1.8	36	10.8

$$\begin{aligned} \because \quad & \Sigma P_i = 1 \\ & 3\alpha + 2\beta + 0.3 = 1 \\ & 3\alpha + 2\beta = 0.7 \quad \ldots (i) \\ \because \quad & \mu = \Sigma X_i P_i \\ & 6\alpha + 9\beta + 1.8 = 4.2 \\ & 2\alpha + 3\beta = 0.8 \quad \ldots (ii) \end{aligned}$$

Solving Eqs. (i) and (ii) we get,

$\alpha = 0.1$ and $\beta = 0.2$

$$\begin{aligned} \operatorname{var}(x) = \sigma^2 &= \Sigma P_i X_i^2 - (\mu)^2 \\ \sigma^2 + \mu^2 &= \Sigma P_i X_i^2 \\ &= 14\alpha + 41\beta + 10.8 \\ &= 1.4 + 8.2 + 10.8 = 20.4 \end{aligned}$$

Question45

The probability that a student gets distinction in a Mathematics test is $\frac{2}{3}$. If five such tests are conducted over a certain period of time, then the probability that he gets distinction in atleast 3 tests is

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Options:

A.

$\frac{112}{243}$

B.

$\frac{17}{81}$

C.

$\frac{131}{243}$

D.

$\frac{64}{81}$

Answer: D

Solution:

$X =$ Students get distinction

$$p = \frac{2}{3}, q = 1 - p = \frac{1}{3}, n = 5$$

$P(X \geq 3) = P(X = 3) + P(X = 4) + P(X = 5)$

We know that, $P(X = r) = {}^nC_r p^r q^{n-r}$

$P(X = 3) = {}^5C_3\left(\frac{2}{3}\right)^3\left(\frac{1}{3}\right)^2 = 10 \times \frac{8}{3^5} = \frac{80}{3^5}$

$P(X = 4) = {}^5C_4\left(\frac{2}{3}\right)^4 \cdot \frac{1}{3} = \frac{5 \times 16}{3^5} = \frac{80}{3^5}$

$P(X = 5) = {}^5C_5\left(\frac{2}{3}\right)^5 = \frac{32}{3^5}$

$P(X \geq 3) = \frac{192}{3^5} = \frac{64}{3^4} = \frac{64}{81}$

Question46

If A and B are events of a random experiment such that $P(A \cup B) = \frac{3}{4}, P(A \cap B) = \frac{1}{4}, P(\overline{\mathrm{A}}) = \frac{2}{3}$, then $P(\overline{\mathrm{A}} \cap \mathrm{B}) =$

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Options:

A.

$\frac{5}{8}$

B.

$\frac{5}{12}$

C.

$\frac{3}{8}$

D.

$\frac{2}{5}$

Answer: B

Solution:

Given, $P(A \cup B) = \frac{3}{4} P(A \cap B) = \frac{1}{4}$

$P(\bar{A}) = \frac{2}{3} \Rightarrow P(A) = \frac{1}{3}$

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

Now, $P(B) = \frac{2}{3}$

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

$= \frac{2}{3} - \frac{1}{4} = \frac{8-3}{12} = \frac{5}{12}$

Question47

Two cards are drawn at random from a pack of 52 playing cards. If both the cards drawn are found to be black in colour, then the probability that atleast one of them is face card is

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Options:

A.

$\frac{3}{13}$

B.

$\frac{3}{5}$

C.

$\frac{9}{65}$

D.

$\frac{27}{65}$

Answer: D

Solution:

$A =$ Both cards are black

$B =$ At least one card is a face card.

$P(A) = \frac{26}{52} \times \frac{25}{51} = \frac{650}{2652}$

$\because$ 20 Black card are not a face card.

$\because P$ (two black non-face card)

$= \frac{20}{52} \times \frac{19}{51} = \frac{380}{2652}$

$P(B) = P($ two black card $)$

$-P$ (two non-face card)

$= \frac{650}{2652} - \frac{380}{2652} = \frac{270}{2652}$

$\because P\left(\frac{B}{A}\right) = \frac{\frac{270}{2652}}{\frac{650}{2652}} = \frac{270}{650} = \frac{27}{65}$

Question48

A person is known to speak the truth in 3 out of 4 occasions. If he throws a die and reports that it is six, then the probability that it actually six is

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Options:

A.

$\frac{3}{8}$

B.

$\frac{2}{7}$

C.

$\frac{1}{9}$

D.

$\frac{4}{5}$

Answer: A

Solution:

The person tells the truth 3 out of every 4 times.

Let's define:
- A: The die really shows six.
- B: The die does not show six.
- E: The person says the die shows six.

The chance of rolling a six when throwing a die, $P(A)$, is $\frac{1}{6}$.

The chance of not rolling a six, $P(B)$, is $\frac{5}{6}$.

If a six really comes up, the chance the person will say "six" (tells the truth) is $P(E|A) = \frac{3}{4}$.

If a six did NOT come up, the chance the person wrongly says "six" (tells a lie) is $P(E|B) = \frac{1}{4}$.

We want to find: What is the chance the die REALLY shows six if the person says it is a six? This is $P(A|E)$.

Use Bayes' Theorem:
$P(A|E) = \frac{P(A) \cdot P(E|A)}{P(A) \cdot P(E|A) + P(B) \cdot P(E|B)}$

Put in the values:
$P(A|E) = \frac{\frac{1}{6} \times \frac{3}{4}}{\frac{1}{6} \times \frac{3}{4} + \frac{5}{6} \times \frac{1}{4}}$

Solve:
$P(A|E) = \frac{\frac{3}{24}}{\frac{3}{24} + \frac{5}{24}} = \frac{3}{8}$

Question49

70% of the total employees of a factory are men. Among the employees of that factory 30\% of men and 15% of women are technical assistants. If an employee chosen at random is found to be a technical assistant, then the probability that this employee is a man is

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Options:

A.

$\frac{9}{23}$

B.

$\frac{3}{17}$

C.

$\frac{14}{17}$

D.

$\frac{14}{23}$

Answer: C

Solution:

Let $E_1 =$ Employee be a man $E_2 =$ Employee be a woman $E =$ Employee be a technical assistants

$$Given\ \mathrm{n}(E_1)=\frac{70}{100}=\frac{7}{10}, P(E_2)=\frac{3}{10}$$

$$P\left(\frac{E}{E_1}\right)=\frac{3}{10}$$

$$P\left(\frac{E}{E_2}\right)=\frac{15}{100}$$

$$P\left(\frac{E_1}{E}\right)=\frac{P(E_1)P\left(\frac{E}{E_1}\right)}{P(E_1)P\left(\frac{E}{E_1}\right)+P(E_2)P\left(\frac{E}{E_2}\right)}$$

$$=\frac{\frac{7}{10}\times\frac{3}{10}}{\frac{7}{10}\times\frac{3}{10}+\frac{3}{10}\times\frac{15}{100}}$$

$$=\frac{210}{210+45}=\frac{210}{255}$$

$$P\left(\frac{E_1}{E}\right)=\frac{42}{51}=\frac{14}{17}$$

Question50

If a discrete random variable X has the probability distribution $P(X=x)=k\frac{2^{2x+1}}{(2x+1)!}, x=0,1,2\ldots\infty$, then $k=$

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Options:

A.

$\sinh 2$

B.

sec2

C.

$\operatorname{cosech} 2$

D.

$\cosh 2$

Answer: C

Solution:

Given, $P(X=x)=K\cdot\frac{2^{2x+1}}{(2x+1)!}$

$$\because \quad \sum P(X=x)=1$$

$$\Rightarrow \sum_{x=0}^{\infty} k\cdot\frac{2^{2x+1}}{(2x+1)!}=1$$

$$\Rightarrow 2k\sum_{x=0}^{\infty}\frac{4^x}{(2x+1)!}=1$$

We know that $\sin hx=\sum_{n=0}^{\infty}\frac{x^{2n+1}}{(2n+1)!}$

$$\frac{\sin hx}{x}=\sum_{n=0}^{\infty}\frac{x^{2n}}{(2n+1)!}$$

$$\because \quad \sum_{x=0}^{\infty}\frac{4^x}{(2x+1)!}=\frac{\sin h(2)}{2}$$

$$2k\cdot\frac{\sin h(2)}{2}=1$$

$$k=\frac{1}{\sin h2}=\operatorname{cosech} 2$$

Question51

A random variable X follows a binomial distribution in which the difference between its mean and variance is 1. if $2P(x=2)=3P(x=1)$, then $n^2P(x>1)=$

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Options:

A.

13

B.

11

C.

15

D.

12

Answer: B

Solution:

Given, mean - variance $=1$

$$np-npq=1$$
$$np(1-q)=1$$
$$np^2=1 \qquad \ldots(i)$$

and given $2P(X=2)=3P(X=1)$

$$2\cdot {}^nC_2p^2q^{n-2}=3\cdot {}^nC_1pq^{n-1}$$
$$2\cdot\frac{n(n-1)}{2}p=3\cdot n\cdot q$$
$$(n-1)p=3q=3(1-p)$$
$$p(n+2)=3 \qquad \ldots(ii)$$

Solving Eqs. (i) and (ii), we get

$p=\frac{1}{2}, q=\frac{1}{2}$ and $n=4$

Now, $P(X>1)=1-P(X=0)-P(X=1)$

$$=1-4\left(\frac{1}{2}\right)^4-\left(\frac{1}{2}\right)^4$$
$$=1-\frac{5}{16}=\frac{11}{16}$$

$\because \quad n^2P(X>1)=16\cdot\frac{11}{16}=11$

Question52

When two dice are thrown the probability of getting the sum of the values on them as 10 or 11 is

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Options:

A. $\frac{7}{36}$

B. $\frac{5}{36}$

C. $\frac{5}{18}$

D. $\frac{7}{18}$

Answer: B

Solution:

When two dice are rolled, the total number of possible outcomes is $6 \times 6 = 36$.

We need to find the probability that the sum of the numbers on the two dice is either 10 or 11.

Here are the combinations that result in a sum of 10 or 11:

For a sum of 10: $(4, 6), (6, 4), (5, 5)$

For a sum of 11: $(6, 5), (5, 6)$

This gives us a total of 5 favorable outcomes: $(4, 6), (6, 4), (5, 5), (6, 5), (5, 6)$.

Therefore, the probability of getting a sum of 10 or 11 is:

$\frac{5}{36}$

Question53

It is given that in a random experiment events A and B are such that $P(A) = \frac{1}{4}, P(A/B) = \frac{1}{2}$ and $P(B/A) = \frac{2}{3}$, then $P(B)$ is equal to

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Options:

A. $1/3$

B. $2/3$

C. $1/2$

D. $1/6$

Answer: A

Solution:

Given the probabilities: $P(A) = \frac{1}{4}$, $P(A \mid B) = \frac{1}{2}$, and $P(B \mid A) = \frac{2}{3}$, we need to find $P(B)$.

First, consider the formula for conditional probability:

$P(B \mid A) = \frac{P(A \cap B)}{P(A)}$

Inserting the known values:

$\frac{P(A \cap B)}{P(A)} = \frac{2}{3}$

This implies:

$P(A \cap B) = \frac{2}{3} \times P(A)$

Substituting $P(A) = \frac{1}{4}$:

$P(A \cap B) = \frac{2}{3} \times \frac{1}{4} = \frac{1}{6}$

Next, for $P(A \mid B)$:

$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$

Given $P(A \mid B) = \frac{1}{2}$, we have:

$\frac{P(A \cap B)}{P(B)} = \frac{1}{2}$

Substituting $P(A \cap B) = \frac{1}{6}$:

$\frac{1}{6} = \frac{1}{2} \times P(B)$

Solving for $P(B)$:

$P(B) = \frac{1}{3}$

Question54

The probability that A speaks truth is 75% and the probability that B speaks truth is 80%. The probability that they contradict each other when asked to speak on a fact is

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Options:

A. $\frac{3}{20}$

B. $\frac{4}{20}$

C. $\frac{7}{20}$

D. $\frac{5}{20}$

Answer: C

Solution:

Given the problem, we have the following probabilities:

The probability that person A speaks the truth is 75%, which can be expressed as $P(A) = \frac{3}{4}$.

The probability that person B speaks the truth is 80%, which can be expressed as $P(B) = \frac{4}{5}$.

From these, we can find the probabilities that they do not speak the truth:

$P(A') = 1 - P(A) = \frac{1}{4}$

$P(B') = 1 - P(B) = \frac{1}{5}$

The probability that A and B contradict each other happens in two scenarios:

A speaks the truth, and B does not. This probability is given by:

$P(A) \cdot P(B') = \frac{3}{4} \times \frac{1}{5} = \frac{3}{20}$

A does not speak the truth, and B does. This probability is given by:

$P(A') \cdot P(B) = \frac{1}{4} \times \frac{4}{5} = \frac{4}{20} = \frac{1}{5}$

The total probability that they contradict each other is the sum of these probabilities:

$P(\text{contradiction}) = \frac{3}{20} + \frac{4}{20} = \frac{7}{20}$

Question55

Bag A contains 2 white and 3 red balls and bag B contains 4 white and 5 red balls. If one ball is drawn at random from one of the bags and is found to be red, then the probability that it was drawn from the bag B is

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Options:

A. $\frac{23}{54}$

B. $\frac{25}{51}$

C. $\frac{25}{52}$

D. $\frac{27}{55}$

Answer: C

Solution:

Let E_1 be the event of choosing bag A. E_2 be the event of choosing bag B, and B be the event of drawing a red ball

$$P(E_1) = \frac{1}{2}, P(E_2) = \frac{1}{2}$$
$$P\left(\frac{E}{E_1}\right) = \frac{3}{5}, P\left(\frac{E}{E_2}\right) = \frac{5}{9}$$

$$\therefore P\left(\frac{E_2}{E}\right) = \frac{P\left(\frac{E}{E_2}\right)P(E_2)}{P(E_1)P\left(\frac{E}{E_1}\right) + P(E_2)P\left(\frac{E}{E_2}\right)}$$
$$= \frac{\frac{5}{9} \times \frac{1}{2}}{\frac{1}{2} \times \frac{3}{5} + \frac{5}{9} \times \frac{1}{2}} = \frac{\frac{5}{9}}{\frac{3}{5} + \frac{5}{9}}$$
$$= \frac{\frac{5}{9}}{\frac{(27+25)}{45}} = \frac{5}{9} \times \frac{45}{52} = \frac{25}{52}$$

Question56

If the probability distribution of a random variable X is as follows, then k is equal to

$X = x$	1	2	3	4
$P(X = x)$	$2k$	$4k$	$3k$	k

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Options:

A. $\frac{1}{10}$

B. $\frac{2}{10}$

C. $\frac{3}{10}$

D. $\frac{4}{10}$

Answer: A

Solution:

To find the value of k, we start by considering the probability distribution table of the random variable X:

$X = x$	1	2	3	4
$P(X = x)$	$2k$	$4k$	$3k$	k

The probabilities must sum up to 1, as they represent a complete probability distribution. Therefore, we have:

$2k + 4k + 3k + k = 1$

Simplify the equation:

$10k = 1$

Solve for k:

$k = \frac{1}{10}$

Hence, the value of k is $\frac{1}{10}$.

Question57

In a binomial distribution $B(n, p)$ the sum and product of the mean and the variance are 5 and 6 respectively, then $6(n+p-q)$ is equal to

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Options:

A. 50

B. 53

C. 52

D. 51

Answer: C

Solution:

Given the conditions for a binomial distribution $B(n, p)$:

The sum of the mean and the variance is 5.

The product of the mean and the variance is 6.

Starting with the formulas for the mean and variance:

Mean $= np$

Variance $= npq$, where $q = 1 - p$.

Using these expressions:

Sum equation:

$np + npq = 5 \quad \Rightarrow \quad np(1+q) = 5 \quad \text{(Equation 1)}$

Product equation:

$np \times npq = 6 \quad \Rightarrow \quad (np)^2 \times q = 6$

Substitute from Equation 1:

$\left(\frac{5}{1+q}\right)^2 \times q = 6$

Simplify this to:

$25q = 6(1+q)^2$

Expanding and rearranging:

$25q = 6(1+q^2+2q)$

$25q = 6 + 6q^2 + 12q$

$6q^2 - 13q + 6 = 0$

Solving the quadratic equation:

$(3q-2)(2q-3) = 0$

Solving gives possible values for q:

$q = \frac{2}{3} \quad (\text{choose this as } q \neq \frac{3}{2})$

From $q = \frac{2}{3}$, calculate p and n:

$p = 1 - q = \frac{1}{3}$

From Equation 1:

$np(1+q) = 5$

$n \cdot \frac{1}{3} \cdot \left(1 + \frac{2}{3}\right) = 5$

$n \times \frac{1}{3} \times \frac{5}{3} = 5$

$n = 9$

Finally, calculate $6(n+p-q)$:

$6(n+p-q)=6\left(9+\frac{1}{3}-\frac{2}{3}\right)$

$=6\left(9-\frac{1}{3}\right)$

$=6\times\frac{26}{3}=52$

Question58

If each of the coefficients a, b and c in the equation $ax^2+bx+c=0$ is determined by throwing a die, then the probability that the equation will have equal roots, is

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Options:

A. $\frac{1}{36}$

B. $\frac{1}{72}$

C. $\frac{7}{216}$

D. $\frac{5}{216}$

Answer: D

Solution:

Given that the coefficients a, b, and c in the quadratic equation $ax^2+bx+c=0$ are determined by rolling a die, we need to find the probability that the equation will have equal roots.

For a quadratic equation to have equal roots, the discriminant must be zero. Therefore:

$b^2-4ac=0$

Rewriting, we get:

$\left(\frac{b}{2}\right)^2=ac$

Each coefficient a, b, and c is an integer between 1 and 6, inclusive. We examine possible integer values for equal roots by considering different values of b.

If $b=1$:

$\left(\frac{1}{2}\right)^2=ac\Rightarrow\frac{1}{4}=ac$

No integer values of a and c satisfy this condition.

If $b=2$:

$1=ac\Rightarrow a=1, c=1$ so possible combination is $(1,2,1)$

If $b=3$:

$\left(\frac{3}{2}\right)^2=ac\Rightarrow\frac{9}{4}=ac$

No integer values of a and c satisfy this condition.

If $b=4$:

$4=ac$

Possible pairs (a, c) are:

$a=4, c=1$ leading to $(4,4,1)$

$a=1, c=4$ leading to $(1,4,4)$

$a=2, c=2$ leading to $(2,4,2)$

If $b=5$:

$\left(\frac{5}{2}\right)^2=ac\Rightarrow\frac{25}{4}=ac$

No integer values of a and c satisfy this condition.

If $b=6$:

$9 = ac$

Possible pair (a, c):

$a = 3, c = 3$ leading to $(3, 6, 3)$

In total, these configurations give us five favorable outcomes:

$(1, 2, 1)$

$(4, 4, 1)$

$(1, 4, 4)$

$(2, 4, 2)$

$(3, 6, 3)$

The total number of possible equations is:

$6 \times 6 \times 6 = 216$

Each coefficient can have any of the 6 possible values from a die roll.

Therefore, the required probability is:

$\frac{5}{216}$

Question59

A and B throw a pair of dice alternately and they note the sum of the numbers appearing on the dice. A wins if he throws 6 before B throws 7 and B wins if he throws 7 before A throws 6 . If A begins then, the probability of his winning is

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Options:

A. $\frac{15}{61}$

B. $\frac{21}{61}$

C. $\frac{30}{61}$

D. $\frac{36}{61}$

Answer: C

Solution:

To solve for the probability that player A wins the game, we need to calculate the probabilities and consider the alternating turns of A and B, where A needs to roll a sum of 6 before B rolls a sum of 7.

Calculate the probability of sums:

Sum of 6: The outcomes that sum to 6 are (1,5), (5,1), (2,4), (4,2), and (3,3). Therefore, there are 5 outcomes.

Probability of rolling a 6: $P(\text{Sum } 6) = \frac{5}{36}$

Sum of 7: The outcomes that sum to 7 are (1,6), (6,1), (2,5), (5,2), (3,4), and (4,3). This gives us 6 outcomes.

Probability of rolling a 7: $P(\text{Sum } 7) = \frac{6}{36} = \frac{1}{6}$

Calculate the probability of A winning:

Since A rolls first, for A to win, the following sequence can occur:

A rolls a 6 on the first turn.

If A does not roll a 6, with probability $\frac{31}{36}$ (the complementary probability of not rolling 6), and B does not roll a 7, with probability $\frac{5}{6}$, then the game is in the same state again after one complete cycle (both A and B have thrown once each), and we recalculate.

This forms a geometric series where the success probability is $\frac{5}{36}$, and the continuation state probability is $\frac{31}{36} \times \frac{5}{6}$.

Use the formula for geometric series to find the probability A wins:

$P(A \text{ wins}) = \frac{\frac{5}{36}}{1 - \frac{31}{36} \times \frac{5}{6}}$

Solving this evaluates to:

$P(A \text{ wins}) = \frac{30}{61}$

Therefore, the probability that A wins is $\frac{30}{61}$.

Question60

E_1 and E_2 are two independent events of a random experiment such that $P(E_1) = \frac{1}{2}$ and $P(E_1 \cup E_2) = \frac{2}{3}$. Then, match the items of List I with the items of List II.

	List I	List II
(A)	$P(E_2)$	(i) $1/2$
(B)	$P(E_1/E_2)$	(ii) $5/6$
(C)	$P(E_2/E_1)$	(iii) $1/3$
(D)	$P(E_1 \cup E_2)$	(iv) $1/6$
		(v) $2/3$

The correct match is

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Options:

A. A-iii B-iv C-i D-v

B. A-iii B-i C-v D-ii

C. A-i B-v C-ii D-iv

D. A-v B-i C-iii D-ii

Answer: B

Solution:

Given:

$P(E_1) = \frac{1}{2}$

$P(E_1 \cup E_2) = \frac{2}{3}$

Since E_1 and E_2 are independent events:

$P(E_1 \cap E_2) = P(E_1) \cdot P(E_2)$

Using the formula for the union of two events:

$P(E_1 \cup E_2) = P(E_1) + P(E_2) - P(E_1 \cap E_2)$

Substituting the given values:

$\frac{2}{3} = \frac{1}{2} + P(E_2) - P(E_1) \cdot P(E_2)$

Simplifying:

$\frac{2}{3} = \frac{1}{2} + P(E_2) - \frac{1}{2}P(E_2)$

$\frac{2}{3} = \frac{1}{2} + (1 - \frac{1}{2})P(E_2)$

$\frac{2}{3} = \frac{1}{2} + \frac{1}{2}P(E_2)$

Rearranging terms:

$\frac{2}{3} - \frac{1}{2} = \frac{1}{2}P(E_2)$

Calculate $\frac{2}{3} - \frac{1}{2}$:

$\frac{4}{6} - \frac{3}{6} = \frac{1}{6}$

Substitute back:

$\frac{1}{6} = \frac{1}{2} P(E_2)$

Solving for $P(E_2)$:

$P(E_2) = \frac{1}{3}$

For the conditional probability $P(E_1 \mid E_2)$:

$P(E_1 \mid E_2) = \frac{P(E_1 \cap E_2)}{P(E_2)} = \frac{P(E_1) \cdot P(E_2)}{P(E_2)} = P(E1) = \frac{1}{2}$

Additional probability calculations:

$P(\bar{E}_2 \mid E_1) = \frac{2}{3}$

$P(\bar{E}_1 \cup \bar{E}_2) = \frac{5}{6}$

In summary, the matches are:

$P(E_2) = \frac{1}{3}$

$P(E_1 \mid E_2) = \frac{1}{2}$

Additional calculated probabilities align with the conditions provided.

Question61

A bag contains 4 red and 5 black balls. Another bag contains 3 red and 6 black balls. If one ball is drawn from first bag and two balls from the second bag at random. The probability that out of the three, two are black and one is red, is

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Options:

A. $\frac{20}{27}$

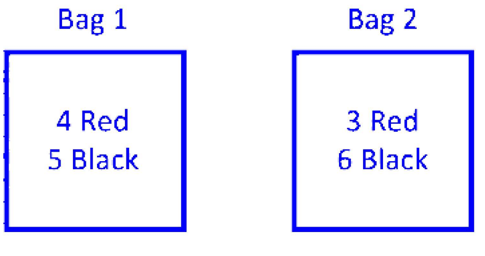
B. $\frac{17}{18}$

C. $\frac{25}{54}$

D. $\frac{25}{108}$

Answer: C

Solution:



$P_1(R_1) = \frac{4}{9} \quad P_2(R_2) = \frac{3}{9}$
$P_1(B_1) = \frac{5}{9} \quad P_2(B_2) = \frac{6}{9}$
$1R$ and $2B$ Ball $= RBB + BRB + BBR$
$= P(R_1)P(B_2)P(B_2) + P(B_1)P(R_2)P(B_2)$
$+ P(B_1)P(B_2)P(R_2)$
$= \frac{4}{9} \times \frac{6}{9} \times \frac{5}{8} + \frac{5}{9} \times \frac{3}{9} \times \frac{6}{8} + \frac{5}{9} \times \frac{6}{9} \times \frac{3}{8}$
$= \frac{5}{27} + \frac{5}{36} + \frac{5}{36} = \frac{5}{27} + \frac{10}{36}$
$= \frac{5}{27} + \frac{5}{18} = \frac{10+15}{54} = \frac{25}{54}$

Question62

If a random variable X has the following probability distribution, then its variance is nearly

$X = x$	-3	-2	-1	0	1	2	3
$P(X = x)$	0.05	0.1	$2K$	0	0.3	K	0.1

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Options:

A. 2.8875

B. 2.9875

C. 2.7865

D. 2.785

Answer: A

Solution:

To determine the variance of the random variable X with the given probability distribution, we first need to find the value of k by ensuring the probabilities sum to 1.

Step 1: Solve for k

Given:

$0.05 + 0.1 + 2k + 0 + 0.3 + k + 0.1 = 1$

Simplifying, we find:

$3k = 0.45$

$k = 0.15$

Step 2: Construct the probability distribution with the calculated k

The probability distribution is:

$X = x$	-3	-2	-1	0	1	2	3
$P(X = x)$	0.05	0.1	0.3	0	0.3	0.15	0.1

Step 3: Calculate the mean μ

The mean μ is calculated as:

$\mu = \sum x_i P(x_i) = (-3)(0.05) + (-2)(0.1) + (-1)(0.3) + (0)(0) + (1)(0.3) + (2)(0.15) + (3)(0.1)$

$\mu = -0.15 - 0.2 - 0.3 + 0 + 0.3 + 0.3 + 0.3 = 0.25$

Step 4: Calculate the variance σ^2

Variance is calculated using:

$\sigma^2 = \sum x_i^2 P(x_i) - \mu^2$

Calculating $\sum x_i^2 P(x_i)$:

$= (-3)^2(0.05) + (-2)^2(0.1) + (-1)^2(0.3) + (0)^2(0) + (1)^2(0.3) + (2)^2(0.15) + (3)^2(0.1)$

$= 0.45 + 0.4 + 0.3 + 0 + 0.3 + 0.6 + 0.9$

$= 2.95$

Thus, variance σ^2 is:

$\sigma^2 = 2.95 - (0.25)^2$

$\sigma^2 = 2.95 - 0.0625$

$\sigma^2 = 2.8875$

Therefore, the variance of the random variable X is approximately 2.8875.

Question63

A radar system can detect an enemy plane in one out of 10 consecutive scans. The probability that it cannot detect an enemy plane at least two times in four consecutive scans, is

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Options:

A. 0.9477

B. 0.9523

C. 0.9037

D. 0.9063

Answer: A

Solution:

To find the probability that a radar system cannot detect an enemy plane at least two times in four consecutive scans, follow these steps:

Probability of Detection:

$P(\text{Detection}) = P(D) = \frac{1}{10}$

Probability of Not Detecting:

$P(\text{Not Detection}) = P(ND) = \frac{9}{10}$

Event Description: We are looking for the probability that the radar fails to detect the enemy plane at least two times (which includes all combinations where the plane is detected fewer than two times in four consecutive scans).

Calculate Complement Events:

The event we're interested in is the complement of detecting the plane all four times or detecting it exactly three times. First, calculate those probabilities:

All Four Detections:

$P(\text{All Four Detections}) = \left(\frac{1}{10}\right)^4$

Exactly Three Detections:

There are 4 combinations (combinations of choosing 3 detections out of 4), and one scenario where detection doesn't happen:

$P(\text{Exactly Three Detections}) = \binom{4}{3}\left(\frac{1}{10}\right)^3\left(\frac{9}{10}\right)$

Calculate and Subtract from 1:

$= 1 - \left(\left(\frac{1}{10}\right)^4 + 4 \times \left(\frac{1}{10}\right)^3 \times \frac{9}{10}\right)$

Result:

$= 1 - \left(\frac{1}{10000} + \frac{36}{10000}\right) = \frac{10000-523}{10000} = \frac{9477}{10000} = 0.9477$

Thus, the probability that the radar cannot detect the plane at least two times in four consecutive scans is 0.9477.

Question64

Three numbers are chosen at random from 1 to 20 , then the probability that the sum of three numbers is divisible by 3 is

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Options:

A. $\frac{1}{114}$

B. $\frac{147}{342}$

C. $\frac{16}{47}$

D. $\frac{32}{95}$

Answer: D

Solution:

Let the modular arithmetic modulo 3. Each number from 1 to 20 can be represented as either 0,1 or 2 modulo 3. Specifically numbers divisible by 3 are congruent to 0 , numbers leaving remainder 1 are congruent to 1 and number having remainder 2 are congruent to 2 .

The valid combinations of the sum of three numbers to be 0 modulo are There 0 's, three 1's, three 2 's, one 0 and two numbers that are 1 and 2 or vice-versa.

Total number to choose 3 numbers from 20.

$= {}^{20}C_3 = \frac{20!}{17!3!} = 1140$

All three number are congruent to 0 m^3.

$\binom{6}{3} = 20$

All three numbers are congruent to

$1m^3 = \binom{7}{3} = 35$

All three number are congruent to

$2m^3 = \binom{7}{3} = 35$

One numbers congruent to 0,1 and 2

$$\begin{aligned} &= 6 \times 7 \times 7 = 294 \\ \text{On adding } &= 20 + 35 + 35 + 294 \\ &= 384 \end{aligned}$$

Then, probability $= \frac{384}{1140} = \frac{32}{95}$

Question65

Two persons A and B throw three unbiased dice one after the another. If A gets the sum 13, then the probability that B gets higher sum is

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Options:

A. $\frac{5}{216}$

B. $\frac{4}{27}$

C. $\frac{35}{216}$

D. $\frac{20}{216}$

Answer: C

Solution:

The possible sum values for three dice range from 3 (when all dice show 1) to 18 (when all dice show 6).

If person A gets a sum of 13, we need to calculate the number of ways person B can get a sum higher than 13, which would be sums of 14, 15, 16, 17, or 18.

Here is the breakdown of the number of ways to achieve each of these sums with three dice:

Sum of 14: There are 15 ways.

Sum of 15: There are 10 ways.

Sum of 16: There are 6 ways.

Sum of 17: There are 3 ways.

Sum of 18: There is 1 way.

Therefore, the total number of favorable outcomes for B to get a sum higher than 13 is:

$15 + 10 + 6 + 3 + 1 = 35$ ways

The total possible outcomes when rolling three dice is:

$6^3 = 216$

Thus, the probability that person B gets a sum higher than 13 is:

$\frac{35}{216}$

Question66

8 teachers and 4 students are sitting around a circular table at random, then the probability that no two students sit together is

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Options:

A. $\frac{7}{88}$

B. $\frac{14}{33}$

C. $\frac{8}{33}$

D. $\frac{7}{33}$

Answer: D

Solution:

Total possible arrangements

12 people (8 teacher +4 students). total number of possible arrangement is $= (12 - 1) = 111$

Favourable arrangements

8 teachers can be arrange in a circle in $(8 - 1)! = 7!$ ways

Now, there are 8 gaps between teachers where students can be seated such that no two students are adjacent.

We need to choose 4 out of 8 gaps $= \binom{8}{4}$

$$= \frac{8!}{4!4!} = \frac{8 \times 7 \times 6 \times 5 \times 4!}{4 \times 3 \times 2 \times 1 \times 4!} = 7 \times 2 \times 5$$
$$= 70$$

Total favorable arrangements

$$= 7! \times 70 \times 4!$$

$$\text{Probability} = \frac{\text{Favourable arrangement}}{\text{Total arrangement}}$$

$$= \frac{7}{33}$$

Question67

A bag contains 6 balls. If three balls are drawn at a time and all of them are found to be green, then the probability that exactly 5 of the balls in the bag are green is

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Options:

A. $\frac{4}{35}$

B. $\frac{5}{35}$

C. $\frac{2}{7}$

D. $\frac{1}{7}$

Answer: C

Solution:

Let $E =$ Drawn balls be green

$A = 3$ green balls in the bag

$B = 4$ green balls in the bag

$C = 5$ green balls in the bag

$D = 6$ green balls in the bag

So, $P(A) = P(B) = P(C) = P(D) \quad \ldots(i)$

$$So, \; P\left(\frac{E}{A}\right) = \frac{{}^3C_3}{{}^6C_3} = \frac{1}{\frac{6!}{3!3!}} = \frac{1}{20}$$

$$P\left(\frac{E}{B}\right) = \frac{{}^4C_3}{{}^6C_3} = \frac{4}{20}$$

$$P\left(\frac{E}{C}\right) = \frac{{}^5C_3}{{}^6C_3} = \frac{\frac{5!}{3!2!}}{\frac{6!}{3!3!}} = \frac{10}{20}$$

$$P\left(\frac{E}{D}\right) = \frac{{}^6C_3}{{}^6C_3} = 1 = \frac{20}{20}$$

Thus, $P\left(\frac{C}{E}\right)$

$$= \frac{P(B) \cdot P\left(\frac{E}{C}\right)}{P(A) \cdot P\left(\frac{E}{A}\right) + P(B)P\left(\frac{E}{B}\right) + P(C)P\left(\frac{E}{C}\right)} + P(D)P\left(\frac{E}{D}\right)$$

$$= \frac{P(B)P\left(\frac{E}{B}\right)}{P(B)P\left(\frac{E}{A}\right) + P(B)P\left(\frac{E}{B}\right) + P(B)P\left(\frac{E}{C}\right)} + P(B)P\left(\frac{E}{D}\right)$$

[from Eq. (i)]

$$= \frac{P\left(\frac{E}{B}\right)}{P\left(\frac{E}{A}\right) + P\left(\frac{E}{B}\right) + P\left(\frac{E}{C}\right) + P\left(\frac{E}{D}\right)}$$

$$= \frac{\frac{10}{20}}{\frac{1}{20} + \frac{4}{20} + \frac{10}{20} + \frac{20}{20}}$$

$$= \frac{10}{1 + 4 + 10 + 20} = \frac{2}{7}$$

Question68

In a binomial distribution the difference between the mean and standard deviation is 3 and the difference between their squares is 21 , then $P(x=1):P(x=2)=$

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Options:

A. 2 : 1

B. 1 : 2

C. 1 : 3

D. 3 : 1

Answer: C

Solution:

In a binomial distribution, the mean (μ) is given by np, and the standard deviation (σ) is defined as:

$\sigma=\sqrt{np(1-p)}$

Given:

$\mu-\sigma=3\quad$ (i)

$\mu^2-\sigma^2=21\quad$ (ii)

From equation (ii), using the identity $(a-b)(a+b)=a^2-b^2$, we get:

$(\mu-\sigma)(\mu+\sigma)=21$

Substituting the value from equation (i):

$3(\mu+\sigma)=21$

$\mu+\sigma=7\quad$ (iii)

Adding equations (i) and (iii):

$2\mu=10\Rightarrow\mu=5$

Thus:

$5+\sigma=7\quad\Rightarrow\quad\sigma=2$

Now, with $\mu=np=5$ and using the expression for standard deviation:

$\sigma=\sqrt{np(1-p)}=2$

Squaring both sides gives:

$5(1-p)=4\quad\Rightarrow\quad 1-p=\frac{4}{5}\quad\Rightarrow\quad p=\frac{1}{5}$

$np=5\quad\Rightarrow\quad n=\frac{5}{p}=\frac{5}{1/5}=25$

For the binomial distribution, the probability of $x=k$ is:

$P(x=k)=\binom{n}{k}p^k(1-p)^{n-k}$

Calculate $P(x=1)$ and $P(x=2)$:

For $k=1$:

$P(x=1)=\binom{25}{1}\left(\frac{1}{5}\right)\left(\frac{4}{5}\right)^{24}=25\cdot\frac{1}{5}\cdot\left(\frac{4}{5}\right)^{24}=5\left(\frac{4}{5}\right)^{24}$

For $k=2$:

$P(x=2)=\binom{25}{2}\left(\frac{1}{5}\right)^2\left(\frac{4}{5}\right)^{23}=300\cdot\frac{1}{25}\cdot\left(\frac{4}{5}\right)^{23}=12\left(\frac{4}{5}\right)^{23}$

Thus, the ratio $P(x=1):P(x=2)$ is:

$\frac{5\left(\frac{4}{5}\right)^{24}}{12\left(\frac{4}{5}\right)^{23}}=\frac{5\cdot\frac{4}{5}}{12}=\frac{4}{12}=\frac{1}{3}$

Therefore:

$P(x=1):P(x=2)=1:3$

Question69

When an unfair dice is thrown the probability of getting a number k on it is $P(X=k)=k^2P$, where $k=1,2,3,4,5,6$ and X is the random variable denoting a number on the dice, then the mean of X is

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Options:

A. 25

B. 5

C. $\frac{441}{9}$

D. $\frac{441}{91}$

Answer: D

Solution:

Lets denote P as the normalization constant.

Since, k can take values $1,2,3,4,5$ and 6 we have the probabilities $P(x=k)=k^2p$.

$$\sum_{k=1}^{6} p(x=k)=1$$
$$p\sum_{k=1}^{6} k^2=1$$
$$p\left(l^2+2^2+3^2+4^2+5^2+6^2\right)=1$$
$$p\cdot 91=1$$
$$\Rightarrow \quad p=\frac{1}{91}$$

Mean of x

$$E(X)=\sum_{k=1}^{6} k[P(x=k))]$$
$$=\sum_{k=1}^{6} k\cdot k^2P=\sum_{k=1}^{6} k^3p$$
$$E(x)=P\sum_{k=1}^{6} k^3$$
$$=P\left(l^3+2^3+3^3+4^3+5^3+6^3\right)$$
$$=P(1+8+27+64+125+216)$$
$$=P\cdot 441=\frac{1}{91}441$$
$$E(x)=\frac{441}{91}$$

Question70

If all the letters of the word 'SENSELESSNESS' are arranged in all possible ways and an arrangement among them is chosen at random, then the probability that all the E's come together in that arrangement is

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Options:

A. $\frac{1}{990}$

B. $\frac{2}{143}$

C. $\frac{1}{120}$

D. $\frac{1}{429}$

Answer: B

Solution:

The word S E N S E L E S S N E S

S have 13 letters

$S=6, E=4, N=2, L=1$

The total number of distinct arrangement

$=\frac{13!}{6!4!2!1!}$

Let all the E's as a single unit, then E E E E $=1$

$\therefore$ The number of distinct arrangements of these 10 units is

$\frac{10!}{6!!2!1!}$

So, Probability

$$=\frac{\text{Number of favourable arrangements}}{\text{Total number of arrangement}}$$

$$=\frac{\frac{10!}{6!21!!1!}}{\frac{13!}{6!4!2!1!}}=\frac{10!4!}{13!}=\frac{10!4!}{13\cdot 12\cdot 11\cdot 10!}$$

$$=\frac{4\cdot 3\cdot 2\cdot 1}{13\cdot 12\cdot 11}=\frac{2}{143}$$

Question71

If two numbers x and y are chosen one after the other at random with replacement from the set of number $\{1,2,3,\ldots\ldots 10\}$. Then, the probability that $\left|x^2-y^2\right|$ is divisible by 6 is

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Options:

A. $\frac{8}{25}$

B. $\frac{6}{25}$

C. $\frac{3}{10}$

D. $\frac{13}{50}$

Answer: C

Solution:

First we calculate the square of the numbers from 1 to 10 modules 6

$1^2 \equiv 1(\bmod 6)$
$2^2 \equiv 4(\bmod 6)$
$3^2 \equiv 9 \equiv 3(\bmod 6)$
$4^2 \equiv 16 \equiv 4(\bmod 6)$
$5^2 \equiv 25 \equiv 1(\bmod 6)$
$6^2 \equiv 36 \equiv 0(\bmod 6)$
$7^2 \equiv 49 \equiv 1(\bmod 6)$
$8^2 \equiv 64 \equiv 4(\bmod 6)$
$9^2 \equiv 81 \equiv 3(\bmod 6)$
$10^2 \equiv 100 \equiv 4(\bmod 6)$

Next we determine possible values of x^2+y^2 modulo 6 which are $0,1,3$ and 4 consider,

$0-0 \equiv 0(\bmod 6)$
$1-1 \equiv 0(\bmod 6)$
$3-3=0(\bmod 6)$
$4-4 \equiv 0(\bmod 6)$
$1-4 \equiv-3 \equiv 3(\bmod 6)$
$4-1 \equiv 3(\bmod 6)$
$1-3 \equiv-2 \equiv 4(\bmod 6)$
$3-1 \equiv 2(\bmod 6)$
$4-3 \equiv 1(\bmod 6)$
$3-4 \equiv-1 \equiv 5(\bmod 6)$

$0-1 \equiv-1 \equiv 5(\bmod 6)$
$0-3 \equiv-3 \equiv 3(\bmod 6)$
$0-4 \equiv-4 \equiv 2(\bmod 6)$
$1-0 \equiv 1(\bmod 6)$
$4-2 \equiv 2(\bmod 6)$
$2-4 \equiv-2 \equiv 4(\bmod 6)$

From the above only cases where $\left|x^2-y^2\right|$ is divisible by 6 occur, when $x^2 \equiv y^2$ (mod 6), these pairs are

$x^2 \equiv y^2 \equiv 0(\bmod 6)$
$x^2 \equiv y^2 \equiv 1(\bmod 6)$
$x^2 \equiv y^2 \equiv 3(\bmod 6)$
$x^2 \equiv y^2 \equiv 4(\bmod 6)$

Now, counting the number of possible pairs (x, y) that satisfy each condition.

$0(\bmod 6)$ is satisfied by 6 .

$1(\bmod 6)$ is satisfied by $1,5,7$.

$3(\bmod 6)$ is satisfied by 3,9 .

$4(\bmod 6)$ is satisfied by $2,4,8,10$

The total number of favorable outcomes

0 has 1 pair $(6,6)$

1 has $3 \times 3=9$ pairs $(\{1,5,7\} \times\{1,5,7\})$

3 has $2 \times 2=4$ pairs $(\{3,9\} \times\{3,9\})$

4 has $4 \times 4=16$ pairs

$(\{2,4,8,10\} \times\{2,4,8,10\})$

Total number of favorable outcomes

$=1+9+4+16=30$

Total possible outcomes $=10 \times 10=100$

Thus, the probability that $\left|x^2-y^2\right|$ is divisible by 6 is

$$
\begin{aligned}
& =\frac{\text { Number of favourable outcomes }}{\text { Total number of possible outcomes }} \\
& =\frac{30}{100}=\frac{3}{10}
\end{aligned}
$$

Question72

Bag A contains 3 white and 4 red balls, bag B contains 4 white and 5 red balls and bag C is contains 5 white and 6 red balls. If one ball is drawn at random from each of these three bags, then the probability of getting one white and two red balls is

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Options:

A. $\frac{268}{693}$

B. $\frac{310}{693}$

C. $\frac{38}{99}$

D. $\frac{26}{63}$

Answer: D

Solution:

Here's the step-by-step explanation:

We have three bags:

Bag A contains 3 white balls and 4 red balls.

Bag B contains 4 white balls and 5 red balls.

Bag C contains 5 white balls and 6 red balls.

We are drawing one ball from each of these bags. We need to find the probability of drawing exactly one white ball and two red balls from these bags.

First, calculate the probability of drawing a white ball from each bag:

From Bag A: $P(W_A) = \frac{3}{7}$

From Bag B: $P(W_B) = \frac{4}{9}$

From Bag C: $P(W_C) = \frac{5}{11}$

Next, calculate the probability of drawing a red ball from each bag:

From Bag A: $P(R_A) = \frac{4}{7}$

From Bag B: $P(R_B) = \frac{5}{9}$

From Bag C: $P(R_C) = \frac{6}{11}$

Now, consider the combinations of drawing one white ball and two red balls:

White from A, Red from B and C:

$P(W_A) \times P(R_B) \times P(R_C) = \frac{3}{7} \times \frac{5}{9} \times \frac{6}{11} = \frac{90}{693}$

Red from A, White from B, Red from C:

$P(R_A) \times P(W_B) \times P(R_C) = \frac{4}{7} \times \frac{4}{9} \times \frac{6}{11} = \frac{96}{693}$

Red from A and B, White from C:

$P(R_A) \times P(R_B) \times P(W_C) = \frac{4}{7} \times \frac{5}{9} \times \frac{5}{11} = \frac{100}{693}$

Add up these probabilities to find the total probability of getting one white and two red balls:

$\frac{90}{693} + \frac{96}{693} + \frac{100}{693} = \frac{286}{693} = \frac{26}{63}$

Thus, the probability of drawing one white ball and two red balls from the bags is $\frac{26}{63}$.

Question73

Two persons A and B throw a pair of dice alternately until one of them gets the sum of the numbers appeared on the dice as 4 and the person who gets this result first is declared as the winner. If A starts the game, then the probability that B wins the game is

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Options:

A. $\frac{11}{23}$

B. $\frac{1}{2}$

C. $\frac{5}{11}$

D. $\frac{8}{17}$

Answer: A

Solution:

The possible outcomes to get sum of 4 with a pair of dice are $(1,3),(2,2),(3,1)$

Favourable outcomes $= 3$

So, the probability P of getting a sum of 4 in a single throw $= \frac{3}{36} = \frac{1}{12}$

Now, probability (not getting a sum of 4)

$\bar{P} = 1 - P = 1 - \frac{1}{12} = \frac{11}{12}$

If A starts the game, the sequence of throw is A, B, A, B and so on.

$\therefore$ The probability that B wins the game on his first throw.

$P(\text{ B wins }) = \frac{11}{12} \times \frac{1}{12} = \frac{11}{144}$

If both A and B fail on their first throw, the same sequence repeats.

Therefore, P (B wins) $= \left(\frac{11}{12}\right)^2 \times P(\text{ B wins})$

This gives us a recursive equation

$$P(\text{ B wins }) = \frac{11}{144} + \left(\frac{11}{12}\right)^2 \times P(\text{ B wins })$$
$$\Rightarrow P(\text{ B wins }) = \frac{11}{144} + \frac{121}{144} \times P\text{ (B wins)}$$
$$\Rightarrow P\text{ (B wins) } \left(1 - \frac{121}{144}\right) = \frac{11}{144}$$
$$\Rightarrow P\text{ (B wins) } \left(\frac{23}{144}\right) = \frac{11}{144}$$
$$\Rightarrow P\text{ (B wins) } = \frac{11}{23}$$

Hence, the probability that B wins the game is $\frac{11}{23}$.

Question74

An urn contains 3 black and 5 red balls. If 3 balls are drawn at random from the urn, the mean of the probability distribution of the number of red balls drawn is

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Options:

A. $\frac{45}{28}$

B. $\frac{15}{8}$

C. $\frac{2}{5}$

D. $\frac{3}{2}$

Answer: B

Solution:

Given, number of black balls $= 3$

and number of red balls $= 5$

$\therefore$ Total number of balls $= 5 + 3 = 8$

Probability of black ball $= \frac{3}{8}$

and Probability of real ball $= \frac{5}{8}$

Now, probability distribution of number of red balls

X	0	1	2	3
$P(x)$	${}^3C_0\left(\frac{3}{8}\right)^3$	${}^3C_1\left(\frac{3}{8}\right)^2\left(\frac{5}{8}\right)$	${}^3C_2\left(\frac{3}{8}\right)\left(\frac{5}{8}\right)^2$	${}^3C_3\left(\frac{5}{8}\right)^3$
$\Rightarrow$ Mean $= \Sigma X(PX) = np(r) = 3 \times \frac{5}{8} = \frac{15}{8}$				

Question75

If $X \sim B(5, p)$ is a binomial variate such that $P(X=3)=P(X=4)$, then $P(|X-3|<2)=$

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Options:

A. $\frac{242}{243}$

B. $\frac{201}{243}$

C. $\frac{200}{243}$

D. $\frac{121}{243}$

Answer: C

Solution:

Given that $X \sim B(5, p)$ is a binomial random variable and $P(X=3)=P(X=4)$, we can equate the probabilities:

$\Rightarrow {}^5C_3 p^3(1-p)^2 = {}^5C_4 p^4(1-p)$

Calculating each term:

The binomial coefficient for $X=3$ is ${}^5C_3 = \frac{5!}{3!2!} = 10$

The binomial coefficient for $X=4$ is ${}^5C_4 = \frac{5!}{4!1!} = 5$

Equating and simplifying the expression:

$10p^3(1-p)^2 = 5p^4(1-p)$

$\Rightarrow 2(1-p) = p \Rightarrow 2-2p = p \Rightarrow 3p = 2 \Rightarrow p = \frac{2}{3}$

Thus, $p = \frac{2}{3}$ and $q = 1-p = \frac{1}{3}$.

Now calculate $P(|X-3|<2)$, which is equivalent to $P(1<X<5) = P(X=2)+P(X=3)+P(X=4)$:

$P(X=2) = {}^5C_2\left(\frac{2}{3}\right)^2\left(\frac{1}{3}\right)^3 = 10 \cdot \frac{4}{9} \cdot \frac{1}{27} = \frac{40}{243}$

$P(X=3) = {}^5C_3\left(\frac{2}{3}\right)^3\left(\frac{1}{3}\right)^2 = 10 \cdot \frac{8}{27} \cdot \frac{1}{9} = \frac{80}{243}$

$P(X=4) = {}^5C_4\left(\frac{2}{3}\right)^4\left(\frac{1}{3}\right) = 5 \cdot \frac{16}{81} \cdot \frac{1}{3} = \frac{80}{243}$

Adding these probabilities together:

$P(|X-3|<2) = \frac{40}{243} + \frac{80}{243} + \frac{80}{243} = \frac{200}{243}$

Therefore, $P(|X-3|<2) = \frac{200}{243}$.

Question76

If 12 dice are thrown at a time, then the probability that a multiple of 3 does not appear on any dice is

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Options:

A. $\left(\frac{1}{2}\right)^{12}$

B. $\left(\frac{1}{3}\right)^{12}$

C. $\left(\frac{2}{3}\right)^{12}$

D. $\left(\frac{5}{6}\right)^{12}$

Answer: C

Solution:

To find the probability that a multiple of 3 does not appear on any of the 12 dice when they are thrown, follow these steps:

Identify Possible Outcomes: When you roll a single die, you have 6 possible outcomes: 1, 2, 3, 4, 5, and 6.

Identify Multiples of 3: The multiples of 3 on a single die are 3 and 6. Therefore, there are 2 favorable outcomes.

Calculate Probability of Getting a Multiple of 3: Use the formula for probability:

$P(\mathrm{A}) = \frac{\text{Number of favorable outcomes}}{\text{Total number of possible outcomes}} = \frac{2}{6} = \frac{1}{3}$

Determine Probability of Not Getting a Multiple of 3: The probability of not getting a multiple of 3 on a single die is:

$1 - \frac{1}{3} = \frac{2}{3}$

Compute Probability for 12 Dice: Since each die throw is independent, the probability that none of the 12 dice shows a multiple of 3 is:

$\left(\frac{2}{3}\right)^{12}$

Therefore, the probability that a multiple of 3 does not appear on any of the 12 dice is:

$\left(\frac{2}{3}\right)^{12}$

Question77

In a class consisting of 40 boys and 30 girls. 30% of the boy and 40% of the girls are good at Mathematics. If a student selected at random from that class is found to be a girl, then the probability that she is not good at Mathematics is

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Options:

A. $\frac{3}{5}$

B. $\frac{2}{5}$

C. $\frac{3}{10}$

D. $\frac{7}{10}$

Answer: A

Solution:

Given:

Total number of boys = 40

Total number of girls = 30

First, calculate the number of girls who are good at Mathematics. To do this, multiply the total number of girls by the percentage of girls who are good at Mathematics:

Number of girls good at Mathematics $= 30 \times 40\% = 12$ girls

Next, find the number of girls who are not good at Mathematics by subtracting the number of girls who are good at Mathematics from the total number of girls:

$30 - 12 = 18$

Now, calculate the probability that a girl selected at random is not good at Mathematics. Divide the number of girls who are not good at Mathematics by the total number of girls:

$\frac{18}{30} = \frac{3}{5}$

Therefore, the probability that a randomly selected girl is not good at Mathematics is $\frac{3}{5}$.

Question78

A basket contains 12 apples in which 3 are rotten. If 3 apples are drawn at random simultaneously from it, then the probability of getting atmost one rotten apple is

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Options:

A. $\frac{34}{55}$

B. $\frac{48}{55}$

C. $\frac{21}{55}$

D. $\frac{42}{55}$

Answer: B

Solution:

Total ways to choose 3 apples from 12.

${}^{12}C_3 = \frac{12!}{3!(12-3)!} = \frac{12\times11\times10}{3\times2\times1} = 220$

Now, favourable outcome (atmost one rotten apples)

$$\begin{aligned}\text{Zero rotten apples } \left({}^9C_3\right) &= \frac{9!}{2!(9-2)!}\\ &= \frac{9\times8\times7}{3\times2\times1} = 84\end{aligned}$$

One rotten apples ${}^3\mathrm{C}_1 \times {}^9\mathrm{C}_2 = 108$

Total favourable outcomes $= 84 + 108$

$= 192$

$\therefore$ Probability of getting atmost one rotten apples $= \frac{192}{220} = \frac{48}{55}$

Therefore, the probability of drawing atmost one rotten apple when 3 apples are drawn from the basket is $\frac{48}{55}$

Question79

7 coins are tossed simultaneously and the number of heads turned up is denoted by random variable X. If μ is the mean and σ^2 is the variance of X, then $\frac{\mu\sigma^2}{P(X=3)} =$

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Options:

A. $\frac{56}{5}$

B. $\frac{84}{5}$

C. $\frac{112}{5}$

D. $\frac{224}{5}$

Answer: C

Solution:

Find the mean of the binomial distribution since, then are 2 possible out comes for each coin toss, the probability of getting heads is $P = \frac{1}{2}$. On substitute $P = \frac{1}{2}$ and $n = 7$ into formula for the mean of a binomial distribution.

$\mu = nP = 7 \cdot \frac{1}{2} = \frac{7}{2}$

Now, find the variance of the bin 0 mind distribution substitute $P = \frac{1}{2}$ and $n \approx ?$ into formula

$$\sigma^2 = nP(1-P)$$
$$= \frac{7}{2}\left(1-\frac{1}{2}\right) = \frac{7}{4}$$
or $\sigma = \pm\frac{\sqrt{7}}{2}$

Find the probability of getting 3 heads

$$P(X=K) = {}^nC_k P^k (1-P)^{n-k}$$
$$P(3 \text{ heads }) = {}^7C_3\left(\frac{1}{2}\right)^3\left(1-\frac{1}{2}\right)^{7-3} = \frac{35}{128}$$

Now, find the required

On substituting $\mu = \frac{7}{2}, \sigma^2 = \frac{7}{4}$ and

$P(3 \text{ head }) = \frac{35}{128}$

into the given expression $\frac{\frac{7}{2}\times\frac{7}{4}}{\frac{35}{128}} = \frac{112}{5}$

Therefore, the value of $\frac{\mu\sigma^2}{P(X=3)}$ is $\frac{112}{5}$.

Question80

A manufacturing company noticed that 1% of its products are defective. If a dealer order for 300 items from this company, then the probability that the number of defective items is atmost one is

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Options:

A. $\frac{3}{e^3}$

B. $\frac{2}{e^2}$

C. $\frac{3}{e^2}$

D. $\frac{4}{e^3}$

Answer: D

Solution:

1% of its product are defective. $n = 300$ items

On using binomial distribution $n = 300$

$p = 0.01$ (probability of an item defectire) and x be the number of defective items PMF (probability mass function) of X

$$P(X=k) = \binom{n}{k} p^k q^{n-k} = \binom{n}{k} p^k (1-p)^{n-k}$$
$$P(X \leq 1) = P(X=0) + P(X=1)$$
$$= \binom{300}{0}(0.01)^0(1-0.01)^{300} + \binom{300}{1}(0.01)^1(1-0.01)^{299}$$
$$= \frac{300!}{0!300!} 1 \times (0.99)^{300} + \frac{300!}{299!1!} \times 0.01$$
$$\times (0.99)^{299}$$
$$= 1 \times 0.0490 + 300 \times 0.01 \times 0.0495$$
$$= 0.0490 + 0.486687 = 0.1976087$$
So, check option (1) 3/e $= 3/20.0855$
$= 0.14936$

(2) $2/e^2 = 2/7.38905 = 0.270670$

(3) $3/e^2 = 3/7.38905 = 0.406006$

(4) $4/e^3 = 4/20.0855 = 0.199148$

$= 0.1976087$

Question81

If five-digit numbers are formed from the digits $0, 1, 2, 3, 4$ using every digit exactly only once. Then, the probability that a randomly chosen number from those numbers is divisible by 4 is

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Options:

A. $\frac{5}{16}$

B. $\frac{3}{16}$

C. $\frac{3}{8}$

D. $\frac{7}{16}$

Answer: A

Solution:

To find the probability that a randomly chosen five-digit number, formed from the digits 0, 1, 2, 3, and 4 (each used exactly once), is divisible by 4, follow these steps:

First, calculate the total number of five-digit numbers you can form from these digits:

Choose the first digit (to avoid starting with 0): 4 choices (1, 2, 3, or 4).

Choose the second digit: 4 remaining choices.

Choose the third digit: 3 remaining choices.

Choose the fourth digit: 2 remaining choices.

The last digit is the final remaining digit.

Thus, the total number of possible numbers is:

$4 \times 4 \times 3 \times 2 \times 1 = 96$

For a number to be divisible by 4, its last two digits must form a number divisible by 4. From the set of digits $\{0, 1, 2, 3, 4\}$, the pairs that are divisible by 4 are: 12, 20, 24, 32, and 40.

Let's consider the formation of numbers with each of these pairs as the last two digits:

Pairs 20, 40:

The first digit (non-zero) has 3 choices.

The second digit has 2 remaining choices.

The third digit is the last remaining digit.

$3 \times 2 \times 1 = 6$ arrangements per pair

Pairs 12, 24, 32:

The first digit (non-zero) has 2 choices.

The second digit has 2 remaining choices.

The third digit is the last remaining digit.

$2 \times 2 \times 1 = 4$ arrangements per pair

Now, combine these results:

Two pairs (20, 40) with 6 arrangements each contribute:

$2 \times 6 = 12$

Three pairs (12, 24, 32) with 4 arrangements each contribute:

$3 \times 4 = 12$

Hence, the total number of numbers divisible by 4 is:

$18 + 12 = 30$

Therefore, the probability that a randomly chosen number is divisible by 4 is:

$\frac{30}{96} = \frac{5}{16}$

Question82

Two natural numbers are chosen at random from 1 to 100 and are multiplied. If A is the event that the product is an even number and B is the event that the product is divisible by 4 , then $P(A \cap \bar{B})=$

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Options:

A. $\frac{25}{198}$

B. $\frac{49}{198}$

C. $\frac{25}{99}$

D. $\frac{50}{99}$

Answer: C

Solution:

Total natural number of cases obtained by taking multiplication of only two numbers out of 100 $= {}^{100}C_2$

$n(U)=\frac{100 \times 99}{2}=4950$

Now, A be the event that product is an even number,

$$\begin{aligned} \therefore \quad n(A) & = {}^{50}C_1 \times {}^{50}C_1 + {}^{50}C_2 \\ & = 50 \times 50 + 1225 = 3725 \end{aligned}$$

and out of 100 , there are the numbers 4 , 8, . . . , 100 which is divisible by 4 .

Which are 25 in numbers such that when any one of them is multiplied with any of remaining 75 numbers.

Then, the pairs of numbers whose product is divisible by

$$\begin{aligned} 4 & = {}^{25}C_1 \times {}^{75}C_1 + {}^{25}C_2 \\ & = 25 \times 75 + 300 = 1875 + 300 \\ & = 2175 \end{aligned}$$

$n(B)=2175$

Since, all the number divisible by 4 is also an even number.

$$\begin{aligned} & n(A \cap B)=2475 \\ & n(A \cap \bar{B})=n(A)-n(A \cap B) \\ & \qquad = 3725-2475=1250 \end{aligned}$$

$$\begin{aligned} \text{Thus, required probability } & = \frac{n(A \cap \bar{B})}{n(U)} \\ & = \frac{1250}{4950} = \frac{25}{99} \end{aligned}$$

Question83

A box P contains one white ball, three red ball and two black balls. Another box Q contains two white balls, three red balls and four black balls. If one ball is drawn at random from each one of the two boxes, then the probability that the balls drawn are of different colour is

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Options:

A. $\frac{29}{54}$

B. $\frac{25}{42}$

C. $\frac{35}{54}$

D. $\frac{39}{52}$

Answer: C

Solution:

In Box P

Red Balls 3, White Balls 1, Black balls 2 In Box Q

Red Balls 3, White Balls 2, Black balls 4 Total Balls in Box $P = 3 + 1 + 2 = 6$

Total Balls in Box $Q = 9$

Thus, required probability = Red from $P \times$ White from $Q +$ Red from $P \times$ Black from $Q +$ White from $P \times$ Red from $Q +$ White from $P \times$ Black from $Q +$ Black from $P \times$ Red from $Q +$ Black from $P \times$ White from Q

$$= \frac{\begin{array}{c} {}^3C_1 \times {}^2C_1 + {}^3C_1 \times {}^4C_1 + {}^1C_1 \times {}^3C_1 \\ + {}^1C_1 \times {}^4C_1 + {}^2C_1 \times {}^3C_1 + {}^2C_1 \times {}^2C_1 \end{array}}{{}^6C_1 \times {}^9C_1}$$
$$= \frac{6 + 12 + 3 + 4 + 6 + 4}{54} = \frac{35}{54}$$

Question84

A person is known to speak false once out of 4 times, If that person picks a card at random from a pack of 52 cards and reports that it is a king, then the probability that it is actually a king is

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Options:

A. $\frac{1}{37}$

B. $\frac{1}{5}$

C. $\frac{12}{37}$

D. $\frac{25}{37}$

Answer: B

Solution:

E_1 : Card drawn is king

E_2 : Card drawn is not king

A : Man reports it is a king

We have,

$$P(E_1) = \frac{4}{52} = \frac{1}{13}$$
$$P(E_2) = \frac{12}{13}$$
$$P\left(\frac{A}{E_1}\right) = \frac{3}{4}$$
$$\text{and } P\left(\frac{A}{E_2}\right) = \frac{1}{4}$$

By Baye's rule,

$$P\left(\frac{E_1}{A}\right) = \frac{P(E_1)P\left(\frac{A}{E_1}\right)}{P(E_1) \cdot P\left(\frac{A}{E_1}\right) + P(E_2) \cdot P\left(\frac{A}{E_2}\right)}$$
$$= \frac{\left(\frac{1}{13}\right)\left(\frac{3}{4}\right)}{\left(\frac{1}{13}\right)\left(\frac{3}{4}\right) + \left(\frac{12}{13}\right)\left(\frac{1}{4}\right)}$$
$$= \frac{3}{3+12} = \frac{3}{15} = \frac{1}{5}$$

Question85

For a binomial variate $X \sim B(n, p)$ the difference between the mean and variance is 1 and the difference between their square is 11 . If the probability of $P(x=2)=m\left(\frac{5}{6}\right)^n$ and $n=36$, then $m:n$

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Options:

A. 6 : 5

B. 7 : 10

C. 36 : 1

D. 42 : 25

Answer: B

Solution:

Mean - Variance $= 1$

$$\begin{aligned} & np - npq = 1 \\ \Rightarrow \quad & np(1-q) = 1 \quad \ldots \text{(i)} \\ \Rightarrow \quad & np^2 = 1 \end{aligned}$$

$$\begin{aligned} \text{Also,} \quad & n^2p^2 - n^2p^2q^2 && = 11 \\ \Rightarrow \quad & n^2p^2\left(1-q^2\right) && = 11 \\ \Rightarrow \quad & n^2p^2(1-q)(1+q) && = 11 \\ \Rightarrow \quad & n^2p^2 \cdot p \cdot (1+q) && = 11 \\ \Rightarrow \quad & np^2 \cdot np(1+q) && = 11 \\ \Rightarrow \quad & np(1+q) && = 11 \\ \Rightarrow \quad & np + npq && = 11 \quad \ldots \text{(ii)} \end{aligned}$$

From Eqs. (i) and (ii), we get

$np = 6$

and $\quad npq = 5$

Now, $np^2 = 1$

$\Rightarrow \quad 6 \cdot p = 1 \Rightarrow p = \frac{1}{6}$

$\therefore \quad q = \frac{5}{6}$ and $n = 36$

Also, $p(x=2) = m\left(\frac{5}{6}\right)^n$

$$\Rightarrow \quad {}^{36}C_2\left(\frac{1}{6}\right)^2\left(\frac{5}{6}\right)^{34} = m\left(\frac{5}{6}\right)^n$$

$$\Rightarrow \quad m = \frac{126}{5}$$

$$\Rightarrow \quad m : n = 7 : 10$$

Question86

The probability that a man failing to hit a target is $\frac{1}{3}$. If he fires 4 times, then the probability that he hits the target at least thrice is

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Options:

A. $\frac{16}{27}$

B. $\frac{11}{27}$

C. $\frac{8}{81}$

D. $\frac{32}{81}$

Answer: A

Solution:

Probability to hit a target $(p) = \frac{1}{3}$

and not hit the target $(q) = \frac{2}{3}$

Total times he fires $= 4$

$\therefore$ Probability of hit the target atleast thrice

$$= P(X \geq 3)$$
$$= P(X = 3) + P(X = 4)$$
$$= {}^4C_3 \left(\frac{2}{3}\right)^3 \cdot \left(\frac{1}{3}\right) + {}^4C_4 \left(\frac{2}{3}\right)^4 \cdot \left(\frac{1}{3}\right)^0$$
$$= \frac{4}{3^3} \times \frac{2^3}{3} + \frac{2^4}{3^4}$$
$$= \frac{32}{3^4} + \frac{16}{3^4} = \frac{48}{81} = \frac{16}{27}$$

Question87

S is the sample space and A, B are two events of a random experiment. Match the items of List A with the items of List B

List A		List B	
I	A, B are mutually exclusive events	a.	$P(A \cap B) = P(B) - P(\bar{A})$
II	A, B are independent events	b.	$P(A) \leq P(B)$
III	$A \cap B = A$	c.	$P\left(\frac{\bar{A}}{B}\right) = 1 - P(A)$
IV	$A \cup B = S$	d.	$P(A \cup B) = P(A) + P(B)$
		e.	$P(A) + P(B) = 2$

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Options:

A. $(I - e)(II - d)(III - c)(IV - b)$

B. (l-a) (II-c) (III-e) (IV-b)

C. $(I - d)(II - c)(III - b)(IV - a)$

D. $(\mathrm{I} - \mathrm{b})(\mathrm{II} - \mathrm{d})(\mathrm{III} - \mathrm{a})(\mathrm{IV} - \mathrm{c})$

Answer: C

Solution:

Explanation

(I) Mutually Exclusive Events

Since A and B are mutually exclusive, they have no outcomes in common. This implies:

$A \cap B = \emptyset$

Thus, we have:

$P(A \cap B) = 0$

Therefore:

$P(A \cup B) = P(A) + P(B)$

(II) Independent Events

For independent events A and B, we have:

$P(A \cap B) = P(A) \cdot P(B)$

The probability of the complement of A given B is:

$P\left(\frac{\bar{A}}{B}\right) = 1 - P\left(\frac{A}{B}\right)$

Calculating further:

$P\left(\frac{\bar{A}}{B}\right) = 1 - \frac{P(A \cap B)}{P(B)}$

$P\left(\frac{\bar{A}}{B}\right) = 1 - \frac{P(A) \cdot P(B)}{P(B)}$

Thus:

$P\left(\frac{\bar{A}}{B}\right) = 1 - P(A)$

(III) Event Intersection Equal to A

Given:

$A \cap B = A$

This implies that all outcomes of A also occur in B. Therefore, the probability satisfies:

$P(A) \leq P(B)$

(IV) Union Equals Sample Space

Since $A \cup B = S$, the entire sample space is covered:

$P(A \cup B) = P(S) = 1$

Using the formula for the probability of a union:

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

Equating this to the total probability, we have:

$1 = P(A) + P(B) - P(A \cap B)$

Rearranging yields:

$P(A \cap B) = P(A) + P(B) - 1$

Substituting the complement:

$P(A \cap B) = P(B) - (1 - P(A))$

Finally:

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

Question88

$P(A \mid A \cap B) + P(B \mid A \cap B) =$

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Options:

A. 1

B. $P(A \cup B)$

C. $P(A \cap B)$

D. 2

Answer: D

Solution:

To solve this problem, we need to calculate $P(A \mid A \cap B) + P(B \mid A \cap B)$.

Step 1: Determine $P(A \mid A \cap B)$.

Using the formula for conditional probability, we have:

$P(A \mid A \cap B) = \frac{P(A \cap (A \cap B))}{P(A \cap B)}$

Since $A \cap (A \cap B) = A \cap B$, it follows that:

$P(A \mid A \cap B) = \frac{P(A \cap B)}{P(A \cap B)} = 1$

Step 2: Determine $P(B \mid A \cap B)$.

Similarly, using the conditional probability formula:

$P(B \mid A \cap B) = \frac{P(B \cap (A \cap B))}{P(A \cap B)}$

Since $B \cap (A \cap B) = A \cap B$, it follows that:

$P(B \mid A \cap B) = \frac{P(A \cap B)}{P(A \cap B)} = 1$

Conclusion:

Adding the two results:

$P(A \mid A \cap B) + P(B \mid A \cap B) = 1 + 1 = 2$

Question89

Two digits are selected at random from the digits 1 through 9. If their sum is even, then the probability that both are odd, is

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Options:

A. $\frac{3}{8}$

B. $\frac{1}{2}$

C. $\frac{5}{8}$

D. $\frac{3}{4}$

Answer: C

Solution:

We have,

$S = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$

For even sum $\rightarrow$ both number are even

$\rightarrow$ both number are odd

even numbers $= 2, 4, 6, 8$

odd numbers $= 1, 3, 5, 7, 9$

Then, $P(B/A) = \frac{P(B \cap A)}{P(A)}$

Where A is an event when sum is evenand B is an event when numbers are odd.

$$P(B \cap A) = \frac{^5C_2}{^9C_2}$$
$$P(A) = \frac{^5C_2 + {^4C_2}}{^9C_2}$$

$$P(B/A) = \frac{P(B \cap A)}{P(A)} = \frac{^5C_2/{^9C_2}}{\frac{^5C_2 + {^4C_2}}{^9C_2}}$$
$$= \frac{^5C_2}{^5C_2 + {^4C_2}} = \frac{10}{10+6} = \frac{10}{16} = \frac{5}{8}$$

Question90

A, B and C are mutually exclusive and exhaustive events of a random experiment and E is an event that occurs in conjunction with one of the events A, B and C. The conditional probabilities of E given the happening of A, B and C are respectively $0.6, 0.3$ and 0.1. If $P(A) = 0.30$ and $P(B) = 0.50$, then $P(C/E) =$

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Options:

A. $\frac{2}{35}$

B. $\frac{15}{35}$

C. $\frac{18}{35}$

D. $\frac{17}{35}$

Answer: A

Solution:

We are given that A, B, and C are mutually exclusive and exhaustive events of a random experiment, and E is an event that occurs together with either A, B, or C. The conditional probabilities are provided as follows:

$P(E \mid A) = 0.6$

$P(E \mid B) = 0.3$

$P(E \mid C) = 0.1$

Along with the probabilities:

$P(A) = 0.3$

$P(B) = 0.5$

These conditions lead us to find $P(C/E)$.

Since A, B, and C are mutually exclusive and exhaustive, $P(C) = 1 - P(A) - P(B) = 1 - 0.3 - 0.5 = 0.2$.

To find $P(E)$, we use the law of total probability:

$P(E) = P(E \mid A) \cdot P(A) + P(E \mid B) \cdot P(B) + P(E \mid C) \cdot P(C)$

Substituting in the given values:

$P(E) = (0.6)(0.3) + (0.3)(0.5) + (0.1)(0.2)$

Calculating each term:

$0.6 \cdot 0.3 = 0.18$

$0.3 \cdot 0.5 = 0.15$

$0.1 \cdot 0.2 = 0.02$

Adding these results:

$P(E) = 0.18 + 0.15 + 0.02 = 0.35$

Now, to find $P(C \mid E)$, we use Bayes' theorem:

$P(C \mid E) = \frac{P(E|C) \cdot P(C)}{P(E)}$

Substituting the known values:

$P(C \mid E) = \frac{(0.1)(0.2)}{0.35} = \frac{0.02}{0.35} = \frac{2}{35}$

Question91

For the probability distribution of a discrete random variable X as given below, then mean of X is

X = x	-2	-1	0	1	2	3
P(X = x)	$\frac{1}{10}$	$K+\frac{2}{10}$	$K+\frac{3}{10}$	$K+\frac{3}{10}$	$K+\frac{4}{10}$	$K+\frac{2}{10}$

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Options:

A. $\frac{3}{5}$

B. $\frac{4}{5}$

C. $\frac{6}{5}$

D. $\frac{8}{5}$

Answer: B

Solution:

To find the mean of the discrete random variable X, we start with the given probability distribution:

$X=x$	-2	-1	0	1	2	3
$P(X=x)$	$\frac{1}{10}$	$\frac{K+2}{10}$	$\frac{K+3}{10}$	$\frac{K+3}{10}$	$\frac{K+4}{10}$	$\frac{K+2}{10}$

Step 1: Determine K

The sum of all probabilities should be equal to 1:

$\frac{1}{10}+\frac{K+2}{10}+\frac{K+3}{10}+\frac{K+3}{10}+\frac{K+4}{10}+\frac{K+2}{10}=1$

Simplifying the equation:

$\frac{1+5K+14}{10}=1$

$5K+15=10$

$5K=-5 \quad \Rightarrow \quad K=-1$

Step 2: Calculate Individual Probabilities

Using $K=-1$:

$P(X=-1)=\frac{-1+2}{10}=\frac{1}{10}$

$P(X=0)=\frac{-1+3}{10}=\frac{2}{10}$

$P(X=1)=\frac{-1+3}{10}=\frac{2}{10}$

$P(X=2)=\frac{-1+4}{10}=\frac{3}{10}$

$P(X=3)=\frac{-1+2}{10}=\frac{1}{10}$

Step 3: Find Mean $\mu=E(X)$

$\mu=E(X)=\sum x_i\cdot P(X=x_i)$

$=(-2)\cdot\frac{1}{10}+(-1)\cdot\frac{1}{10}+0\cdot\frac{2}{10}+1\cdot\frac{2}{10}+2\cdot\frac{3}{10}+3\cdot\frac{1}{10}$

$=-\frac{2}{10}-\frac{1}{10}+0+\frac{2}{10}+\frac{6}{10}+\frac{3}{10}$

$=\frac{8}{10}=\frac{4}{5}$

Therefore, the mean μ of the random variable X is $\frac{4}{5}$.

Question92

In a random experiment, two dice are thrown and the sum of the numbers appeared on them is recorded. This experiment is repeated 9 times. If the probability that a sum of 6 appears atleast once is P_1 and a sum of 8 appears atleast once is P_2, then $P_1 : P_2 =$

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Options:

A. 4 : 3

B. 3 : 1

C. 1 : 2

D. 1 : 1

Answer: D

Solution:

To find the probability ratio $P_1 : P_2$ where P_1 is the probability of obtaining a sum of 6 at least once in 9 throws of two dice, and P_2 is the probability of obtaining a sum of 8 at least once in the same number of throws, follow these steps:

Probability Calculation

Total Possible Outcomes: Each die has 6 faces, so there are a total of $6 \times 6 = 36$ possible outcomes when throwing two dice.

Outcomes for Sum of 6:

Possible pairs: $(1, 5), (2, 4), (3, 3), (4, 2), (5, 1)$.

Number of outcomes: 5

Probability of not getting a sum of 6 in one throw is:

$\frac{36-5}{36} = \frac{31}{36}$

Probability of Not Getting Sum of 6 in 9 Throws:

$\left(\frac{31}{36}\right)^9$

Probability of Getting Sum of 6 at Least Once (P_1):

$P_1 = 1 - \left(\frac{31}{36}\right)^9$

Outcomes for Sum of 8:

Possible pairs: $(2, 6), (3, 5), (4, 4), (5, 3), (6, 2)$.

Number of outcomes: 5

Probability of not getting a sum of 8 in one throw is:

$\frac{36-5}{36} = \frac{31}{36}$

Probability of Not Getting Sum of 8 in 9 Throws:

$\left(\frac{31}{36}\right)^9$

Probability of Getting Sum of 8 at Least Once (P_2):

$P_2 = 1 - \left(\frac{31}{36}\right)^9$

Ratio Calculation

Since the expressions for P_1 and P_2 are identical:

$P_1 : P_2 = \frac{1-\left(\frac{31}{36}\right)^9}{1-\left(\frac{31}{36}\right)^9} = 1 : 1$

Thus, the probability ratio is $1 : 1$.

Question93

If 7 different balls are distributed among 4 different boxes, then the probability that the first box contains 3 balls is

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Options:

A. $\frac{35}{128}\left(\frac{3}{4}\right)^3$

B. $\frac{35}{64}\left(\frac{3}{4}\right)^4$

C. $\frac{7}{8}\left(\frac{3}{4}\right)^7$

D. $\frac{5}{16}\left(\frac{3}{4}\right)^5$

Answer: B

Solution:

Total number of ways in which 7 balls can be placed in 4 boxes $= 4^7$

Out of 7 balls, 3 balls are choosen for the first box in ${}^7C_3$ ways.

Now, remaining 4 balls can be placed in remaining 3 boxes in 3^4 ways.

$$\therefore \text{ Required probability } = \frac{{}^7C_3 \times 3^4}{4^7}$$
$$= \frac{7 \times 6 \times 5}{1 \times 2 \times 3} \times \frac{3^4}{4^7} = \frac{35}{64}\left(\frac{3}{4}\right)^4$$

Question94

Out of first 5 consecutive natural numbers, if two different numbers x and y are chosen at random, then the probability that $x^4 - y^4$ is divisible by 5 is

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Options:

A. $\frac{2}{5}$

B. $\frac{4}{5}$

C. $\frac{3}{5}$

D. $\frac{1}{5}$

Answer: C

Solution:

Let the first 5 consecutive natural numbers be $1, 2, 3, 4, 5$

Total number of pairs of $(x, y) = {}^5C_2 = 10$

We need to check whether $x^4 - y^4$ is divisible by 5 .

$$\because \quad 1^4 = 1 \equiv 1 \bmod 5$$
$$2^4 = 16 \equiv 1 \bmod 5$$
$$3^4 = 81 \equiv 1 \bmod 5$$
$$4^4 = 256 \equiv 1 \bmod 5$$
$$5^4 = 625 \equiv 0 \bmod 5$$

Both x and y are chosen from $\{1, 2, 3, 4)$.

$\therefore$ Favourable pairs $= {}^4C_2 = 6$

$\therefore$ Required probability

$$= \frac{\text{Number of favourable pairs}}{\text{Total number of pairs}}$$
$$= \frac{6}{10} = \frac{3}{5}$$

Question95

A bag contains 2 white, 3 green and 5 red balls. If three balls are drawn one after the other without replacement, then the probability that the last ball drawn was red is

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Options:

A. $\frac{2}{3}$

B. $\frac{3}{4}$

C. $\frac{5}{9}$

D. $\frac{1}{2}$

Answer: D

Solution:

To find the probability that the last ball drawn from the bag is red, consider the following:

The bag contains 2 white (W), 3 green (G), and 5 red (R) balls.

We need to calculate the probability of different combinations of drawing three balls where the last ball is red.

The possible successful sequences with a red ball at the end are:

Drawing a white, another white, and then a red (WWR)

Drawing two green balls and then a red (GGR)

Drawing a white, then a green, and then a red (WGR)

Drawing a green, then a white, and then a red (GWR)

Drawing one white, then two reds (WRR)

Drawing one green, then two reds (GRR)

Drawing a red first, then a white, then a red (RWR)

Drawing a red first, then a green, then a red (RGR)

All three drawn balls are red (RRR)

The probability calculation is as follows:

$$\begin{aligned} P(\text{last ball is red}) &= P(WWR) + P(GGR) + P(WGR) + P(GWR) \\ &\quad + P(WRR) + P(GRR) + P(RWR) + P(RGR) \\ &\quad + P(RRR) \\ &= \frac{2 \times 1 \times 5}{10 \times 9 \times 8} + \frac{3 \times 2 \times 5}{10 \times 9 \times 8} + \frac{2 \times 3 \times 5}{10 \times 9 \times 8} \\ &\quad + \frac{3 \times 2 \times 5}{10 \times 9 \times 8} + \frac{2 \times 5 \times 4}{10 \times 9 \times 8} + \frac{3 \times 5 \times 4}{10 \times 9 \times 8} \\ &\quad + \frac{5 \times 2 \times 4}{10 \times 9 \times 8} + \frac{5 \times 3 \times 4}{10 \times 9 \times 8} + \frac{5 \times 4 \times 3}{10 \times 9 \times 8} \\ &= \frac{10 + 30 + 30 + 30 + 40 + 60 + 40 + 60 + 60}{10 \times 9 \times 8} \\ &= \frac{360}{720} \\ &= \frac{1}{2} \end{aligned}$$

Therefore, the probability that the last ball drawn is red is $\frac{1}{2}$.

Question96

There are 2 bags each containing 3 white and 5 black balls and 4 bags each containing 6 white and 4 black balls. If a ball drawn randomly from a bag is found to be black, then the probability that this ball is from the first set of bags is

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Options:

A. $\frac{25}{57}$

B. $\frac{25}{41}$

C. $\frac{2}{5}$

D. $\frac{3}{5}$

Answer: B

Solution:

To determine the probability that a black ball is from the first set of bags, let's define the following:

B: Probability of drawing a black ball.

B_1: Probability associated with drawing from the first set of bags, where each bag contains 3 white and 5 black balls.

B_2: Probability associated with drawing from the second set of bags, where each bag contains 6 white and 4 black balls.

Given:

Probability of choosing a bag from the first set ($P(B_1)$) is $\frac{1}{2}$.

Probability of choosing a bag from the second set ($P(B_2)$) is also $\frac{1}{2}$ since there are two bags in the first set and four bags in the second set but we simplify by considering overall probabilities.

Probabilities of drawing a black ball from each type of bag:

$P(B \mid B_1) = \frac{5}{8}$ for Bag 1.

$P(B \mid B_2) = \frac{4}{10} = \frac{2}{5}$ for Bag 2.

Calculation:

The total probability of drawing a black ball ($P(B)$) is calculated by adding the probabilities of drawing a black ball from each type of bag, weighted by the probability of choosing each type of bag:

$$\begin{aligned} P(B) &= P(B_1) \cdot P(B \mid B_1) + P(B_2) \cdot P(B \mid B_2) \\ &= \frac{1}{2} \times \frac{5}{8} + \frac{1}{2} \times \frac{2}{5} \\ &= \frac{5}{16} + \frac{1}{5} \\ &= \frac{41}{80} \end{aligned}$$

Final Probability:

Using Bayes' Theorem, we find the probability that a black ball is from the first set of bags:

$$\begin{aligned} P(B_1 \mid B) &= \frac{P(B \mid B_1) \cdot P(B_1)}{P(B)} \\ &= \frac{\frac{5}{8} \times \frac{1}{2}}{\frac{41}{80}} \\ &= \frac{5}{16} \times \frac{80}{41} \\ &= \frac{25}{41} \end{aligned}$$

Thus, the probability that the black ball is from the first set of bags is $\frac{25}{41}$.

Question97

If two cards are drawn randomly from a pack of 52 playing cards, then the mean of the probability distribution of number of kings is

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Options:

A. $\frac{215}{221}$

B. $\frac{2}{13}$

C. $\frac{188}{221}$

D. $\frac{13}{2}$

Answer: B

Solution:

let X be the random variable representing the number of kings drawn.

$$P(X=0)=\frac{{}^{48}C_2}{{}^{52}C_2}=\frac{48\times 47}{52\times 51}=\frac{188}{221}$$
$$P(X=1)=\frac{{}^{4}C_1\times {}^{48}C_1}{{}^{52}C_2}=\frac{4\times 48\times 2}{52\times 51}=\frac{32}{221}$$
$$P(X=2)=\frac{{}^{4}C_2}{{}^{52}C_2}=\frac{4\times 3}{52\times 51}=\frac{1}{221}$$
$$E(X)=p_i x_i=0+\frac{32}{221}+\frac{2}{221}=\frac{34}{221}=\frac{2}{13}$$

Question98

In a consignment of 15 articles, it is found that 3 are defective. If a sample of 5 articles is chosen at random from it, then the probability of having 2 defective articles is

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Options:

A. $\frac{256}{625}$

B. $\frac{64}{625}$

C. $\frac{128}{625}$

D. $\frac{512}{625}$

Answer: C

Solution:

P(defective articles)

$$=\frac{3}{15}=\frac{1}{5}=p(let)$$
$$q=1-p=1-\frac{1}{5}=\frac{4}{5}$$

Here, $n=5$

$$P(X=2)={}^{5}C_2\left(\frac{1}{5}\right)^2\left(\frac{4}{5}\right)^{5-2}=\frac{10\times 64}{3125}=\frac{128}{625}$$

Question99

If 5 letters are to be placed in 5 -addressed envelopes, then the probability that atleast one letter is placed in the wrongly addressed envelope, is

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Options:

A. $\frac{1}{5}$

B. $\frac{1}{120}$

C. $\frac{4}{5}$

D. $\frac{119}{120}$

Answer: D

Solution:

To determine the probability that at least one letter is placed in the wrong envelope, consider the following:

Total Arrangements: There are 5 letters, each meant for a specific envelope. The total number of ways to place the letters is calculated using permutations because each letter can go into any of the 5 envelopes. This number is given by $5! = 120$.

Correct Arrangement: There is only 1 way to place all letters in the correctly addressed envelopes, which means every letter is in its intended envelope.

At Least One Mistake: To find the probability that at least one letter is in the wrong envelope, we subtract the probability that all letters are correctly placed from 1. The probability that all letters are correctly placed is $\frac{1}{120}$.

Therefore, the probability that at least one letter is placed in the wrong envelope is:

$1 - \frac{1}{120} = \frac{119}{120}$

Question100

A student writes an examination which contains eight true of false questions. If he answers six or more questions correctly, the passes the examination. If the student answers all the questions, then the probability that he fails in the examination, is

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Options:

A. $\frac{37}{256}$

B. $\frac{19}{256}$

C. $\frac{119}{256}$

D. $\frac{219}{256}$

Answer: D

Solution:

Here, $x = 8, P = \frac{1}{2}$ and $q = \frac{1}{2}$

frobabllity that he will pass

$$= FX = \theta + P(X = 7) + P(X = 8$$
$$= {}^8C_4\left(\frac{1}{2}\right)^6\left(\frac{1}{2}\right)^2 + {}^8C_7\left(\frac{1}{2}\right)^3\left(\frac{1}{2}\right) + {}^8C_3\left(\frac{1}{2}\right)^2$$
$$= \left(\frac{1}{2}\right)^2 P^3C_2 + {}^3C_1 + {}^8C_41 = \frac{37}{256}$$

Probability that he will fail is the examination $= 1 - \frac{37}{256} = \frac{219}{256}$

Question101

The probabilities that a person goes to college by car is $\frac{1}{5}$, by bus is $\frac{2}{5}$ and by train is $\frac{3}{5}$, respectively. The probabilities that he reaches the college late if he takes car, bus and train are $\frac{2}{7}$, $\frac{4}{7}$ and $\frac{1}{7}$, respectively, If he reaches the college on time, then probability that he travelled by car is

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Options:

A. $\frac{6}{29}$

B. $\frac{24}{29}$.

C. $\frac{5}{29}$

D. $\frac{23}{29}$

Answer: C

Solution:

To find the probability that a person traveled to college by car, given that they arrived on time, let's denote the events as follows:

E_1: The event that a person travels by car.

E_2: The event that a person travels by bus.

E_3: The event that a person travels by train.

The probabilities for choosing each mode of transport are:

$P(E_1) = \frac{1}{5}, \quad P(E_2) = \frac{2}{5}, \quad P(E_3) = \frac{3}{5}$

Let A be the event of reaching the college on time. The given probabilities of being late for each mode of transport are:

$P(\bar{A} \mid E_1) = \frac{2}{7}$ leading to $P(A \mid E_1) = 1 - \frac{2}{7} = \frac{5}{7}$

$P(\bar{A} \mid E_2) = \frac{4}{7}$ leading to $P(A \mid E_2) = 1 - \frac{4}{7} = \frac{3}{7}$

$P(\bar{A} \mid E_3) = \frac{1}{7}$ leading to $P(A \mid E_3) = 1 - \frac{1}{7} = \frac{6}{7}$

Using Bayes' Theorem, we calculate $P(E_1 \mid A)$, the probability that the person traveled by car, given they arrived on time:

$P(E_1 \mid A) = \frac{P(A|E_1) \cdot P(E_1)}{P(A|E_1) \cdot P(E_1) + P(A|E_2) \cdot P(E_2) + P(A|E_3) \cdot P(E_3)}$

Substituting the known values:

$= \frac{(\frac{5}{7}) \times (\frac{1}{5})}{(\frac{5}{7} \times \frac{1}{5}) + (\frac{3}{7} \times \frac{2}{5}) + (\frac{6}{7} \times \frac{3}{5})}$

Calculate the numerator and the denominator:

$= \frac{\frac{1}{5} \times \frac{5}{7}}{\frac{1}{5} \times \frac{5}{7} + \frac{2}{5} \times \frac{3}{7} + \frac{3}{5} \times \frac{6}{7}}$

Simplify:

$= \frac{\frac{5}{35}}{\frac{5}{35} + \frac{6}{35} + \frac{18}{35}} = \frac{\frac{5}{35}}{\frac{29}{35}} = \frac{5}{29}$

Thus, the probability that the person traveled by car, given they arrived on time, is $\frac{5}{29}$.

Question102

P, Q and R try to hit the same target one after the other. If their probabilities of hitting the target are $\frac{2}{3}, \frac{3}{5}, \frac{5}{7}$ respectively, then the probability that the target is his by P or Q but not by R is

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Options:

A. $\frac{26}{105}$

B. $\frac{79}{105}$

C. 0

D. $\frac{75}{105}$

Answer: A

Solution:

To find the probability that the target is hit by P or Q but not by R, let's define the events:

E_1: P hits the target.

E_2: Q hits the target.

E_3: R hits the target.

The given probabilities are:

$P(E_1) = \frac{2}{3}$

$P(E_2) = \frac{3}{5}$

$P(E_3) = \frac{5}{7}$

These events are independent, so:

The probability that P hits and both Q and R miss is:

$P(E_1 \cap \overline{E_2} \cap \overline{E_3}) = P(E_1) \cdot (1 - P(E_2)) \cdot (1 - P(E_3)) = \frac{2}{3} \cdot \frac{2}{5} \cdot \frac{2}{7}$

The probability that Q hits and both P and R miss is:

$P(\overline{E_1} \cap E_2 \cap \overline{E_3}) = (1 - P(E_1)) \cdot P(E_2) \cdot (1 - P(E_3)) = \frac{1}{3} \cdot \frac{3}{5} \cdot \frac{2}{7}$

The probability that both P and Q hit but R misses is:

$P(E_1 \cap E_2 \cap \overline{E_3}) = P(E_1) \cdot P(E_2) \cdot (1 - P(E_3)) = \frac{2}{3} \cdot \frac{3}{5} \cdot \frac{2}{7}$

Now, summing these probabilities gives the required probability that the target is hit by P or Q, but not by R:

$$\begin{aligned} P(\text{hit by } P \text{ or } Q \text{ but not } R) &= P(E_1 \cap \overline{E_2} \cap \overline{E_3}) + P(\overline{E_1} \cap E_2 \cap \overline{E_3}) + P(E_1 \cap E_2 \cap \overline{E_3}) \\ &= \frac{2}{3} \cdot \frac{2}{5} \cdot \frac{2}{7} + \frac{1}{3} \cdot \frac{3}{5} \cdot \frac{2}{7} + \frac{2}{3} \cdot \frac{3}{5} \cdot \frac{2}{7} \\ &= \frac{8}{105} + \frac{6}{105} + \frac{12}{105} \\ &= \frac{26}{105} \end{aligned}$$

Thus, the probability that the target is hit by P or Q but not by R is $\frac{26}{105}$.

Question103

A box contains 20% defective bulbs. Five bulbs are chosen randomly from this box. Then, the probability that exactly 3 of the chosen bulbs are defective, is

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Options:

A.

$\frac{32}{625}$

B. $\frac{32}{125}$

C. $\frac{16}{625}$

D. $\frac{16}{125}$

Answer: A

Solution:

To solve for the probability that exactly 3 out of 5 bulbs chosen are defective, given that 20% of the bulbs are defective, we can use the binomial probability formula. Here's how it's done:

Define the variables:

Total number of trials, $n = 5$

Probability of a defective bulb, $p = 20\% = \frac{1}{5}$

Probability of a non-defective bulb, $q = 1 - p = 1 - \frac{1}{5} = \frac{4}{5}$

Calculate the probability:

We need to find the probability of exactly 3 defective bulbs, $P(X=3)$.

Apply the binomial probability formula:

$P(X=3)={}^5C_3\left(\frac{1}{5}\right)^3\left(\frac{4}{5}\right)^2$

Calculate the individual components:

The coefficient, ${}^5C_3$, is the number of ways to choose 3 defective bulbs from 5. This is calculated as:

${}^5C_3=\frac{5!}{3!(5-3)!}=\frac{5\times4\times3!}{3!\times2\times1}=10$

Plug in the values:

$\left(\frac{1}{5}\right)^3=\frac{1}{125}$

$\left(\frac{4}{5}\right)^2=\frac{16}{25}$

Calculate the probability:

$P(X=3)=10\times\frac{1}{125}\times\frac{16}{25}=10\times\frac{16}{3125}=\frac{160}{3125}=\frac{32}{625}$

Therefore, the probability that exactly 3 out of the 5 bulbs chosen are defective is $\frac{32}{625}$.

Question104

If a random variable X satisfies poisson distribution with a mean value of 5 , then probability that $X<3$ is

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Options:

A. $\frac{37}{2}e^5$

B. $6e^5$

C. $6e^{-5}$

D. $\frac{37}{2}e^{-5}$

Answer: D

Solution:

To find the probability that a random variable X, which follows a Poisson distribution with a mean (λ) of 5, is less than 3, we calculate $P(X<3)$.

This is equivalent to finding the sum of probabilities $P(X=0)$, $P(X=1)$, and $P(X=2)$:

$$\begin{aligned}P(X<3)&=P(X=0)+P(X=1)+P(X=2)\\&=\frac{\lambda^0e^{-\lambda}}{0!}+\frac{\lambda^1e^{-\lambda}}{1!}+\frac{\lambda^2e^{-\lambda}}{2!}.\end{aligned}$$

Substituting $\lambda=5$, we have:

$$\begin{aligned}P(X<3)&=e^{-5}\left(1+5+\frac{25}{2}\right)\\&=e^{-5}\left(\frac{2}{2}+\frac{10}{2}+\frac{25}{2}\right)\\&=e^{-5}\times\frac{37}{2}\\&=\frac{37}{2}e^{-5}.\end{aligned}$$

Question105

The probability of getting a sum 9 when two dice are thrown is

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Options:

A. $\frac{1}{6}$

B. $\frac{1}{8}$

C. $\frac{1}{9}$

D. $\frac{1}{12}$

Answer: C

Solution:

When two dice are rolled together, then total outcomes are 36 and sample space is
$[(1,1),(1,2),(1,3),(1,4),(1,5)(1,6),(2,1),(2,2),(2,3),(2,4),(2,5),(2,6),(3,1),(3,2),(3,3),(3,4),(3,5),(3,6),(4,1),(4,2),(4,3),(4,4),(4,5),(4,6),(5,1),$

So, pairs with sum 9 are $(3,6)(4,5),(5,4),(6,3)$ i.e total 4 pairs.

Total outcomes $= 36$

Favourable outcomes $= 4$

Probability of getting the sum of 9

$= \frac{4}{36} = \frac{1}{9}$

Question106

If A and B are two events such that $P(B) \neq 0$ and $P(B) \neq 1$, then $P(\bar{A} \mid \bar{B})$ is

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Options:

A. $1 - P(A \mid B)$

B. $1 - P(\bar{A} \mid B)$

C. $\frac{1-P(A \cup B)}{P(\bar{B})}$

D. $\frac{P(\bar{A})}{P(\bar{B})}$

Answer: C

Solution:

To determine $P(\bar{A} \mid \bar{B})$, we need to use the definition of conditional probability and the properties of complements.

By definition, the conditional probability of $\bar{A}$ given $\bar{B}$ is:

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

Now, using De Morgan's law, we know that:

$\bar{A} \cap \bar{B} = \overline{A \cup B}$

So, we can rewrite the probability as:

$P(\bar{A} \mid \bar{B}) = \frac{P(\overline{A \cup B})}{P(\bar{B})}$

From the properties of complements, we know:

$P(\overline{A \cup B}) = 1 - P(A \cup B)$

Thus, the expression for $P(\bar{A} \mid \bar{B})$ becomes:

$P(\bar{A} \mid \bar{B}) = \frac{1-P(A \cup B)}{P(\bar{B})}$

This matches Option C.

Therefore, the correct answer is:

Option C

$\frac{1-P(A \cup B)}{P(\bar{B})}$

Question107

Two brothers X and Y appeared for an exam. Let A be the event that X has passed the exam and B is the event that Y has passed. The probability of A is $\frac{1}{7}$ and of B is $\frac{2}{9}$. Then, the probability that both of them pass the exam is

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Options:

A. $\frac{1}{63}$

B. $\frac{2}{35}$

C. $\frac{2}{63}$

D. $\frac{9}{14}$

Answer: C

Solution:

To find the probability that both brothers X and Y pass the exam, we need to consider the probability of the intersection of events A and B. Assuming the events are independent, the probability of both events occurring is given by the product of their individual probabilities.

Let:

$P(A) = \frac{1}{7}$

$P(B) = \frac{2}{9}$

Since events A and B are independent, the probability of both A and B happening is:

$P(A \cap B) = P(A) \cdot P(B)$

Substituting the given probabilities:

$P(A \cap B) = \frac{1}{7} \cdot \frac{2}{9} = \frac{1 \cdot 2}{7 \cdot 9} = \frac{2}{63}$

Therefore, the probability that both brothers X and Y pass the exam is $\frac{2}{63}$.

The correct answer is:

Option C

Question108

A bag contains 4 red and 3 black balls. A second bag contains 2 red and 3 black balls. One bag is selected at random. If from the selected bag, one ball is drawn at random, then the probability that the ball drawn is red, is

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Options:

A. $\frac{39}{70}$

B. $\frac{41}{70}$

C. $\frac{29}{70}$

D. $\frac{17}{35}$

Answer: D

Solution:

A red ball can be drawn in two mutually exclusive ways.

(i) Selecting bag I and then drawing a red ball from it.

(ii) Selecting bag II and then drawing a red ball from it

Let E_1, E_2 and A denote the events defined as follows

$E_1 =$ Selecting bag I
$E_2 =$ Selecting bag II

Since, one of the two bags is selected randomly.

$\therefore P(E_1) = \frac{1}{2}$ and $P(E_2) = \frac{1}{2}$

Now, $P\left(\frac{A}{E_1}\right) =$ Probability of drawing a red ball when the first bag has been selected $= 4/7$

$P\left(\frac{A}{E_2}\right) =$ Probability of drawing a red ball when the second bag has been selected $= 2/5$

$$\begin{aligned} P(\text{ red ball }) &= P(E_1)P\left(\frac{A}{E_1}\right) + P(E_2)P\left(\frac{A}{E_2}\right) \\ &= \frac{1}{2} \times \frac{4}{7} + \frac{1}{2} \times \frac{2}{5} = \frac{2}{7} + \frac{1}{5} = \frac{17}{35} \end{aligned}$$

Question109

In a Binomial distribution, if 'n' is the number of trials and the mean and variance are 4 and 3 respectively, then $2^{32}p\left(X = \frac{n}{2}\right) =$

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Options:

A. ${}^{16}C_8\left(3^8\right)$

B. ${}^{12}C_6\left(2^6\right)$

C. ${}^{32}C_{16}\left(3^{16}\right)$

D. ${}^{16}C_7\left(3^9\right)$

Answer: A

Solution:

Let X be the binomial variate for which mean $= 4$ and variance $= 3$, then $np = 4$ and $npq = 3$

$\Rightarrow q = \frac{3}{4}$

$\therefore P=(1-q)=\left(1-\frac{3}{4}\right)=\frac{1}{4}$ and $np=4$

$\Rightarrow n=\frac{4}{1}\times 4=16$

Thus, $n=16, p=\frac{1}{4}$ and $q=\frac{3}{4}$

Hence, the binomial distribution

$$2^{32}P\left(X=\frac{n}{2}\right)=2^{32}\cdot{}^{16}C_{\frac{16}{2}}\cdot\left(\frac{1}{4}\right)^{\frac{16}{2}}\left(\frac{3}{4}\right)^{16-\frac{16}{2}}.$$
$$=2^{32}\cdot{}^{16}C_8\left(\frac{1}{4}\right)^8\times\left(\frac{3}{4}\right)^8=2^{32}\cdot{}^{16}C_8\frac{(3)^8}{(4)^{16}}$$
$$={}^{16}C_8(3)^8\quad[\because(4)^{16}=(2)^{32}]$$

Question110

For a Poisson distribution, if mean $=l$, variance $=m$ and $l+m=8$, then $e^4[1-P(X>2)]=$

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Options:

A. 8

B. 13

C. 9

D. 12

Answer: B

Solution:

For Poisson distribution, mean = variance

$l=m=4$

$$\begin{aligned}\text{So, } & e^4[1-PP(X>2)]\\ &=e^4[P\leq 2]\\ &=e^4[P(X=0)+P(X=1)+P(X=2)]\\ &=e^4\left[\frac{e^{-4}\times 4^0}{0!}+\frac{e^{-4}\times 4^1}{1!}+\frac{e^{-4}\times 4^2}{2!}\right]\\ &=e^4\times e^{-4}(1+4+8)=13\end{aligned}$$

Question111

In a box, there are 8 red, 7 blue and 6 green balls. One ball is picked randomly. The probability that it is neither red nor green is

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Options:

A. 1/3

B. 3/4

C. 7/19

D. 8/21

Answer: A

Solution:

Total number of balls $= (8+7+6) = 21$

Let $E =$ Event that the ball drawn is neither red nor green

$=$ Event that the ball drawn is blue

$\therefore n(E) = 7$

$\therefore p(E) = \frac{n(E)}{n(S)} = \frac{7}{21} = \frac{1}{3}$

Question112

For two events A and B, a true statement among the following is

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Options:

A. $P(\bar{A} \cup \bar{B}) = 1 - P(A)P\left(\frac{B}{A}\right)$

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

C. $P(\bar{A} \cup \bar{B}) = P(A \cup B)$

D. $P(\bar{A} \cup \bar{B}) = P(\bar{A}) + P(\bar{B})$

Answer: A

Solution:

We have,

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

$= 1 - P(A \cap B) = 1 - P(A)P\left(\frac{B}{A}\right)$

Thus, $P(\bar{A} \cup \bar{B}) \neq 1 - P(A \cup B)$

and $P(\bar{A} \cup \bar{B}) \neq P(A \cup B) \neq P(\bar{A}) + P(\bar{B})$

Question113

Five digit numbers are formed by using digits $1, 2, 3, 4$ and 5 without repetition. Then, the probability that the randomly chosen number is divisible by 4 is

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Options:

A. $\frac{1}{5}$

B. $\frac{5}{6}$

C. $\frac{4}{5}$

D. $\frac{1}{6}$

Answer: A

Solution:

A number divisible by 4 formed by the digits $1, 2, 3, 4$ and 5 should have the last two digits 12 or 24 or 32 or 52.

In each cases, the five digit number can be formed using the remaining 3 digits in $3! = 6$ waysA number divisible by 4 can be formed in $6 \times 4 = 24$ waysTotal number of 5 -digit numbers that can be formed using the digits $1, 2, 3, 4$ and 5 without repetition $5! = 120$

Thus, required probability $= \frac{24}{120} = \frac{1}{5}$

Question114

A manager decides to distribute ₹ 20000 between two employees X and Y. He knows X deserves more than Y, but does not know how much more. So, he decides to arbitrarily break ₹ 20000 into two parts and give X the bigger part. Then, the chance that X gets twice as much as Y or more is

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Options:

A. $2/5$

B. $1/2$

C. $1/3$

D. $2/3$

Answer: D

Solution:

The bigger part could be any number from 10000 to 20000.

Now, if the bigger part is to be at least twice as much as the smaller part, we have

$$X \geq 2y \text{ or } X \geq 2(20000 - X)$$
$$\text{or} \quad X \geq \frac{40000}{3}$$

We know that X lies between 10000 and 20000, the probability that X lies between $\frac{40000}{3}$ and 20000 is $\frac{20000-\frac{40000}{3}}{20000-10000} = \frac{2}{3}$

Question115

Which of the following is not a property of a Binomial distribution?

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Options:

A. Random experiment consists of a sequence of n identical trials.

B. Each outcome can be referred to as a success or a failure.

C. The probabilities of the two outcomes can change from one trial to the next.

D. The trials are independent.

Answer: C

Solution:

"The probability of two outcomes can change from one trial to the next" which is not a property of Binomial Distribution.

Question116

In a Binomial distribution $B(n, p)$, if the mean and variance are 15 and 10 respectively, then the value of the parameter n is

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Options:

A. 28

B. 16

C. 45

D. 25

Answer: C

Solution:

Given the following information for a Binomial distribution $B(n, p)$:

- The mean is 15.
- The variance is 10.

We need to find the value of the parameter n.

From the mean formula of a Binomial distribution, we have:

$n \cdot p = 15$

From the variance formula of a Binomial distribution, we have:

$n \cdot p \cdot (1 - p) = 10$

Since $n \cdot p = 15$, we substitute 15 for $n \cdot p$ in the variance formula:

$15 \cdot (1 - p) = 10$

Solving for p:

$1 - p = \frac{10}{15} = \frac{2}{3}$

$p = 1 - \frac{2}{3} = \frac{1}{3}$

Now, substituting p back into the mean formula:

$n \cdot \left(\frac{1}{3}\right) = 15$

$n = 15 \times 3 = 45$

Therefore, the value of n is 45.

Question117

A box contains 100 balls, numbered from 1 to 100 . If 3 balls are selected one after the other at random with replacement from the box, then the probability that the sum of the three numbers on the balls selected from the box is an odd number, is

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Options:

A. 1/2

B. 3/4

C. 3/6

D. 1/8

Answer: A

Solution:

Total number of balls $= 100$

odd numbered balls $\rightarrow 50$

Even numbered balls $\rightarrow 50$

Sum of three number will be odd when

(i) two numbers are even and one odd.

(ii) all three numbers are odd.

$$\text{Required probability } = \frac{{}^{50}C_2 \cdot {}^{50}C_1 + {}^{50}C_3}{{}^{100}C_3}$$

$$= \frac{\frac{50 \cdot 49}{2 \cdot 1} \cdot 50 + \frac{50 \cdot 49 \cdot 48}{3 \cdot 2 \cdot 1}}{\frac{100 \cdot 99 \cdot 98}{3 \cdot 2 \cdot 1}}$$

$$= \frac{50 \cdot 49 \cdot 50 \cdot 3 + 50 \cdot 49 \cdot 48}{100 \cdot 99 \cdot 98}$$

$$= \frac{50 \cdot 49[50 \times 3 + 48]}{100 \cdot 99 \cdot 98}$$

$$= \frac{6[25 + 8]}{2 \cdot 99 \cdot 2} = \frac{6 \cdot 33}{2 \cdot 99 \cdot 2} = \frac{1}{2}$$

Question118

In a lottery, containing 35 tickets, exactly 10 tickets bear a prize. If a ticket is drawn at random, then the probability of not getting a prize is

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Options:

A. 1/10

B. 2/5

C. 2/7

D. 5/7

Answer: D

Solution:

Total number of tickets $= 35$

Number of tickets bearing a prize $= 10$

P (not getting a prize) $= 1 - P$ (getting a prize)

$$= 1 - \frac{10}{35} = \frac{25}{35} = \frac{5}{7}$$

Question119

A bag contains 7 green and 5 black balls. 3 balls are drawn at random one after the other. If the balls are not replaced, then the probability of all three balls being green is

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Options:

A. $\frac{343}{1720}$

B. $\frac{21}{36}$

C. $\frac{12}{35}$

D. $\frac{7}{44}$

Answer: D

Solution:

Number of green balls $= 7$

Number of black balls $= 5$

Total number of balls $= 7 + 5 = 12$

While drawing, ball is not replaced.

Required probability

$$= \frac{{}^7C_1 \cdot {}^6C_1 \cdot {}^5C_1}{{}^{12}C_1 {}^{11}C_1 \cdot {}^{10}C_1}$$
$$= \frac{7 \cdot 6 \cdot 5}{12 \cdot 11 \cdot 10} = \frac{7}{44}$$

Question120

If x is chosen at random from the set $\{1, 2, 3, 4\}$ and y is chosen at random from the set $\{5, 6, 7\}$, then the probability that xy will be even is

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Options:

A. $\frac{5}{6}$

B. $\frac{1}{6}$

C. $\frac{1}{2}$

D. $\frac{2}{3}$

Answer: D

Solution:

There are 12 possible values of xy.

$x \in \{1, 2, 3, 4\}, y \in \{5, 6, 7\}$

Values of xy are :

$1 \times 5 = 5$
$1 \times 6 = 6$

$1 \times 7 = 7$
$2 \times 5 = 10$
$2 \times 6 = 12$
$2 \times 7 = 14$
$3 \times 5 = 15$
$3 \times 6 = 18$
$3 \times 7 = 21$
$4 \times 5 = 20$
$4 \times 6 = 24$
$4 \times 7 = 28$

$P(xy \text{ is even }) = \frac{8}{12} = \frac{2}{3}$

Question121

The discrete random variables X and Y are independent from one another and are defined as $X \sim B(16, 0.25)$ and $Y \sim P(2)$. Then, the sum of the variance of X and Y is

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Options:

A. 4

B. 5

C. 6

D. 2

Answer: B

Solution:

Comparing with the standard binomial (n, p)

distribution, variance $= np(1-p)$

$= 16 \times 0.25(1-0.29)$
$= 4 \times 0.75 = 3$

Comparing with the standard poisson (λ) distribution, variance $= \lambda = 2$

$\therefore$ Sum of the variance of X and Y

$= \operatorname{Var}(X) + \operatorname{Var}(Y) = 3 + 2 = 5$

Question122

If 6 is the mean of a Poisson distribution, then $P(X \geq 3) =$

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Options:

A. $1 - 25/e^6$

B. $e^{-6} - 25$

C. $24 - 25e^6$

D. e^{-3}

Answer: A

Solution:

Probability distribution: $P(X=x)=\frac{e^{-\lambda}x^{x}}{x!}$

$\lambda=$ mean $=6$

$$p(X\geq 3)=1-[P(X=0)+p(X=1)+p(X=2)]$$
$$=1-\left[\frac{e^{-6}\cdot 6^{0}}{0!}+\frac{e^{-6}\cdot 6^{1}}{1!}+\frac{e^{-6}\cdot 6^{2}}{2!}\right]$$
$$=1-\frac{1}{e^{6}}[1+6+,18]$$
$$=1-\frac{25}{e^{6}}$$

Question123

A coin is tossed until a head appears or it hasbeen tossed thrice. Given that head doesn'tappear on the first toss, the probability thatcoin tossed thrice is

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Options:

A. $\frac{2}{3}$

B. $\frac{1}{3}$

C. $\frac{3}{4}$

D. $\frac{1}{4}$

Answer: A

Solution:

$$S=\{H,TH,TTH,TTT\}$$
$$P(H)=\frac{1}{2},P(TH)=\frac{1}{4}$$
$$P(TTH)=\frac{1}{8},P(TTT)=\frac{1}{8}$$

Let E be the event "no head on first toss"

$$\therefore E=\{TH,TTH,TTT\}$$
$$\therefore P(E)=\frac{1}{4}+\frac{1}{8}+\frac{1}{8}=\frac{1}{2}$$

Let E' be the event coin is tossed 3 times

$$\therefore E'=\{TTH,TTT\}$$
$$\therefore P\left(E'\right)=\frac{1}{8}+\frac{1}{8}=\frac{1}{4}$$
$$\therefore P\left(E'/E\right)=\frac{P\left(E'\cap E\right)}{P(E)}=\frac{P\left(E'\right)}{P(E)}=\frac{1/4}{1/2}=\frac{1}{2}$$

$\Rightarrow$ No option is correct.

Question124

Box-I contains 3 cards bearing numbers 1, 2, 3 , Box II contains 5 cards bearing numbers 1 , 2, 3, 4, 5 and Box III contains 7 cards bearing numbers 1, 2, 3, 4, 5, 6, 7. One card is drawn at random from each of the boxes. If x_i be the number on the card drawn from the i th box, $i=1,2,3$, then the probability that $x_1+x_2+x_3$ is odd is equal to

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Options:

A. $\frac{23}{105}$

B. $\frac{53}{105}$

C. $\frac{43}{105}$

D. $\frac{33}{105}$

Answer: B

Solution:

$x_1+x_2+x_3$ is odd if

(i) all three are odd

(ii) two even and one odd Now, total number of outcomes $=3\times5\times7=105$

Possible outcomes-

(i) (odd odd odd), then $P(O+O+O)$

Possibility $=\frac{2}{3}\times\frac{3}{5}\times\frac{4}{7}=\frac{24}{105}$

(ii) (odd even even), $P(O+E+E)$

Possibility $=\frac{2}{3}\times\frac{2}{5}\times\frac{3}{7}=\frac{12}{105}$

(iii) (even odd even), $p(E+O+E)$

Possibility $=\frac{1}{3}\times\frac{3}{5}\times\frac{3}{7}=\frac{9}{105}$

(iv) (even even odd), $P(E+E+O\$)$

Possibility $=\frac{1}{2}\times\frac{2}{5}\times\frac{4}{7}=\frac{8}{105}$

Probability that $x_1+x_2+x_3$ is odd is given as

$\frac{24}{105}+\frac{12}{105}+\frac{9}{105}+\frac{8}{105}=\frac{53}{105}$

Question125

The range of a random variable X is $\{1,2,3,\ldots\}$ and $P(X=x)=\frac{C^x}{x!}$. for $x=1,2,3,\ldots$ Then, the value of C is

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Options:

A. 0

B. 1

C. ln (2) (where In - denotes the natural log)

D. ln(3) (where ln - denotes the natural log)

Answer: C

Solution:

We know $\Sigma p(x)=1$

$\Rightarrow \quad \frac{C}{1!}+\frac{C^2}{2!}+\frac{C^3}{3!}+\ldots+=1$

Add 1 on both side

$$1+C+\frac{C^2}{2!}+\frac{C^3}{3!}+\ldots=2$$
$$\Rightarrow \quad e^C=2 \Rightarrow C=\log 2$$

Question126

Tom and Jerry play a game of alternatelythrowing an unfair coin. First one to get headwins. If Tom starts the game, he has 62.5%chance of winning the game. Suppose thiscoin is tossed 5 times, then the probability ofgetting exactly 3 head is

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Options:

A. $\frac{144}{625}$

B. $\frac{124}{625}$

C. $\frac{121}{625}$

D. $\frac{100}{625}$

Answer: A

Solution:

Let probability of getting head $=x$

Then, probability of getting tail $=1-x$

Tom wins if he gets head

H, TTH, TTTTH, ...(alternative through)

Probability of Tom winning game $=62.5\%=\frac{625}{1000}$

$\mathrm{P(H)}+\mathrm{P(TTH)}+\mathrm{P(TTTTH)}+\ldots=\frac{625}{1000}$

$$x+(1-x)(1-x)x+(1-x)^4x+\ldots=\frac{625}{1000}$$
$$x\left[1+(1-x)^2+(1-x)^4+\ldots\right]=\frac{625}{1000}$$
$$x\cdot\frac{1}{1-(1-x)^2}=\frac{625}{100}$$
$$\frac{x}{2x-x^2}=\frac{625}{1000}$$
$$\frac{1}{2-x}=\frac{625}{1000}$$

or $\frac{1}{2-x}=\frac{625}{1000}$

or $x=\frac{2}{5}$(probability of head)

or $1-x=\frac{3}{5}$ (probability of tails)

$\therefore$ Probability of getting exactly 3 heads on tossing a coin or 5 times

$$={}^5C_3x^3(1-x)^2$$
$$=10\times\left(\frac{2}{5}\right)^3\left(\frac{3}{5}\right)^2=\frac{144}{625}$$

Question127

One card is selected at random from 27 cardsnumbered form 1 to 27. What is theprobability that the number on the card iseven or divisible by 5.

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Options:

A. $\frac{15}{27}$

B. $\frac{16}{27}$

C. $\frac{17}{27}$

D. $\frac{18}{27}$

Answer: B

Solution:

Even or divisible by 5

$A:\{2,4,5,6,8,10,12,14,15,16,18,20,22,24,25,26\}$
$n(A)=16$
$\therefore$ Probability $=\frac{n(A)}{n(S)}=\frac{16}{27}$

Question128

Nine balls one drawn simultaneously from a bag containing 5 white and 7 black balls. The probability of drawing 3 white and 6 black balls is

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Options:

A. $\frac{{}^7C_3}{{}^{12}C_9}$

B. $\frac{7}{22}$

C. $\frac{3}{22}$

D. $\frac{7}{11}$

Answer: B

Solution:

$$\text{Probability }=\frac{{}^5C_3\times{}^7C_6}{{}^{12}C_9}$$
$$=\frac{7\times10}{{}^{12}C_9}=\frac{70}{\frac{12\cdot11\cdot10}{6}}=\frac{7}{22}$$

Question129

The probabilities that A and B speak truth are $\frac{4}{5}$ and $\frac{3}{4}$ respectively. The probability that they contradict each other when asked to speak on a fact is

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Options:

A. $\frac{1}{5}$

B. $\frac{3}{20}$

C. $\frac{4}{20}$

D. $\frac{7}{20}$

Answer: D

Solution:

They will contradict each other in two case

Case I $A \rightarrow$ True, $B \rightarrow$ False

Case II $A \rightarrow$ False, $B \rightarrow$ True

Probability $=\frac{4}{5} \times \frac{1}{4}+\frac{1}{5} \times \frac{3}{4}=\frac{7}{20}$

Question130

The mean and variance of a binomial variableX are 2 and 1 respectively. The probabilitythat X takes values greater than 1 is

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Options:

A. $\frac{5}{16}$

B. $\frac{8}{16}$

C. $\frac{11}{16}$

D. $\frac{1}{16}$

Answer: C

Solution:

$$
\begin{aligned}
&\text{Mean } = np = 2 \\
&\text{Variance } = npq = 1 \\
&\Rightarrow \quad q=\frac{1}{2} \text{ and } p=\frac{1}{2} \Rightarrow n\left(\frac{1}{2}\right)=2 \\
&\Rightarrow \quad n=4
\end{aligned}
$$

$$
\begin{aligned}
&P(x>1)=P(x=2)+P(x=3)+P(x=4) \\
&=\left({ }^4 C_2+{ }^4 C_3+{ }^4 C_4\right) \frac{1}{2^4}=\frac{11}{16}
\end{aligned}
$$

Question131

P speaks truth in 70% of the cases and Q in80% of the cases. In what percent of cases arethey likely to agree in stating the same fact

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Options:

A. 38%

B. 48%

C. 52%

D. 62%

Answer: D

Solution:

P speaks truth $= 70\% = 7/10$

Q speaks truth $= 80\% = 8/10$

They agree when both speaks truth or both does not speaks truth

$$= \frac{7}{10} \times \frac{8}{10} + \left(1 - \frac{7}{10}\right)\left(1 - \frac{8}{10}\right)$$
$$= \frac{56}{100} + \left(\frac{3}{10}\right)\left(\frac{2}{10}\right) = \frac{56+6}{100} = \frac{62}{100} = 62\%$$

Question132

If A and B are two events with $P(A \cap B) = \frac{1}{3}, P(A \cup B) = \frac{5}{6}$ and $P\left(A^C\right) = \frac{1}{2}$, then the value of $P\left(B^C\right)$ is

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Options:

A. $\frac{1}{2}$

B. $\frac{1}{3}$

C. $\frac{2}{3}$

D. $\frac{5}{6}$

Answer: B

Solution:

Given,

$$\begin{array}{ll} & P(A \cap B) = \frac{1}{3}, P(A \cup B) = \frac{5}{6}, P\left(A^c\right) = \frac{1}{2} \\ \because & P(A) + P(B) = P(A \cup B) + P(A \cap B) \\ \because & P(A) + P(B) = P(A \cup B) + P(A \cap B) \\ \text{or} & 1 - P\left(A^c\right) + 1 - P\left(B^c\right) = \frac{5}{6} + \frac{1}{3} = \frac{7}{6} \\ \text{or} & P\left(B^c\right) = 2 - \frac{7}{6} - \frac{1}{2} = \frac{1}{3} \end{array}$$

Question133

A coin is tossed 2020 times. The probability of getting head on 1947th toss is

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Options:

A. $\left(\frac{1}{2}\right)^{1947}$

B. $\left(\frac{1}{2}\right)^{2020}$

C. $\frac{1}{2}$

D. $\frac{2}{1947}$

Answer: C

Solution:

Every time we toss, probability of getting head is $1/2$.

So, on tossing n times, probability of getting head at rth toss $= 1/2$

$\therefore$ Probability of getting head on 1947th toss $= 1/2$

Question134

A discrete random variable X takes values 10,20, 30 and 40. with probability 0.3, 0.3, 0.2and 0.2 respectively. Then the expected valueof X is

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Options:

A. 12

B. 22

C. 23

D. 24

Answer: C

Solution:

$X = 10$	20	30	40
$p = 0.3$	0.3	0.2	0.2

Expected value of $X = E(X) = \Sigma px$

$= 10 \times 0.3 + 20 \times 0.3 + 30 \times 0.2 + 40 \times 0.2$

$= 3 + 6 + 6 + 8 = 23$

Question135

Let X be a random variable which takes values $1, 2, 3, 4$ such that $P(X = r) = Kr^3$ where $r = 1, 2, 3, 4$ then

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Options:

A. $K=\frac{1}{100}$ and $P\left(\frac{1}{2}<X<\frac{5}{2} \mid X>1\right)=\frac{8}{97}$

B. $K=\frac{1}{99}$ and $P\left(\frac{1}{2}<X<\frac{5}{2} \mid X>1\right)=\frac{8}{99}$

C. $K=\frac{1}{100}$ and $P\left(\frac{1}{2}<X<\frac{5}{2} \mid X>1\right)=\frac{8}{99}$

D. $K=\frac{1}{100}$ and $P\left(\frac{1}{2}<X<\frac{5}{2} \mid X>1\right)=\frac{10}{99}$

Answer: C

Solution:

X	1	2	3	4
$P(X)$	K	$8K$	$27K$	$64K$

$\therefore \Sigma P=1$

$\Rightarrow K+8K+27K+64K=1$

$\Rightarrow K=\frac{1}{100}$

X	1	2	3	4
$P(X)$	$\frac{1}{100}$	$\frac{8}{100}$	$\frac{27}{100}$	$\frac{64}{100}$

$$\begin{aligned} P\left(\frac{1}{2}<X<\frac{5}{2}X>1\right) &= \frac{P\left(\left(\frac{1}{2}<X<\frac{5}{2}\right)\cap(X>1)\right)}{P(X>1)} \\ &= \frac{P\left(1<X<\frac{5}{2}\right)}{1-P(X\leq 1)}=\frac{P(X=2)}{1-P(X=1)} \\ &= \frac{\frac{8}{100}}{1-\frac{1}{100}}=\frac{8}{99} \end{aligned}$$

Question136

12 balls are distributed among 3 boxes, then the probability that the first box will contain 3 balls is

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Options:

A. $\frac{{}^{12}C_3\times 2^9}{3^{12}}$

B. $\frac{{}^{12}C_3\times 2^9}{3^{10}}$

C. $\frac{{}^{12}C_3}{3^{12}}$

D. $\frac{{}^{12}C_3}{3^{10}}$

Answer: A

Solution:

Total distribution $=3^{12}$

Number of distribution when first box contains three balls $={}^{12}C_3\times 2^9$

Required probability $=\frac{{}^{12}C_3\times 2^9}{3^{12}}$

Question137

A random variable X has the probability distribution

X	1	2	3	4	5	6	7	8
P(X)	0.15	0.23	0.12	0.10	0.20	0.08	0.07	

For the events E = {X is a prime number} and F = {X < 4}, then P(E ∪ F) is

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Options:

A. 0.77

B. 0.87

C. 0.35

D. 0.50

Answer: A

Solution:

$$
\begin{aligned}
&P(E)=P(X=2)+P(X=3)+P(X=5)\\
&+P(X=7)\\
&=0.23+0.12+0.20+0.07=0.62\\
&P(F)=P(X=1)+P(X=2)+P(X=3)\\
&=0.15+0.23+0.12=0.50\\
&P(E\cap F)=P(X=2)+P(X=3)\\
&=0.23+0.12=0.35\\
&P(E\cup F)=P(E)+P(F)-P(E\cap F)\\
&=0.62+0.50-0.35\\
&=0.77
\end{aligned}
$$

Question138

A die is tossed thrice. If event of getting an even number is a success, then the probability of getting at least 2 successes is

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Options:

A. $\frac{7}{8}$

B. $\frac{1}{4}$

C. $\frac{2}{3}$

D. $\frac{1}{2}$

Answer: D

Solution:

Sample space of a dice $S=\{1,2,3,4,5,6\}$

Let $E=$ getting even number $\Rightarrow E=\{2,4,6\}$

$P(E)=\frac{n(E)}{n(S)}=\frac{3}{6}=\frac{1}{2}$

If dice is thrown three times

Let $X=$ success, then

X	$x=0$	$x=1$	$x=2$	$x=3$
$P(X=x)$	${}^3C_0\left(\frac{1}{2}\right)^3$	${}^3C_1\left(\frac{1}{2}\right)^3$	${}^3C_2\left(\frac{1}{2}\right)^3$	${}^3C_3\left(\frac{1}{2}\right)^3$

Probability of getting at least 2 successes

$$=P(X\geq 2)=P(X=2)+P(X=3)$$
$$={}^3C_2\left(\frac{1}{2}\right)^3+{}^3C_3\left(\frac{1}{2}\right)^3=\frac{3}{8}+\frac{1}{8}=\frac{1}{2}$$
