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2] Multiplicative law of Probability :-

Statement :- Probability of simultaneous occurence of two events A_1 and A_2 is given by

$$P(A_1 \cap A_2) = P(A_1 \cdot A_2) = P(A_1) \cdot P(A_2/A_1)$$

$$= P(A_2) \cdot P(A_1/A_2)$$

Draw with replacement :-

If the balls drawn in the first draw was replaced back in the bag before 2nd draw then the event A & B are independent and the required probablity is given by

$P(A \cap B) = P(A)\,P(B)$ A = I draw, B = II draw

Draw without replacement

$P(A \cap B) = P(A) \cdot P(B/A)$

$P(AB) = P(A)\,P(B)$ probablity that first event happens and second fail

$p_1(1-p_1)$.

If both event fail $P(\bar{A})\,P(\bar{B})$

Atleast one of the event $p_1 p_2 + (1-p_1)p_2 + p_1(1-p_2)$

Q] Two marbles are selected from a bag containing 10 Red, 30 white, 20 blue and 15 orange marbles.

(a) With replacement being made after each draw

(i) both are white

(ii) First is red & second is white

(iii) Neither is orange

(b) Solve same without replacement

(a) (i) Total outcomes = $^{75}C_2$

(i) $\frac{^{35}C_1 \times ^{35}C_1}{^{75}C_1 \times ^{75}C_1}$ (ii) $\frac{^{10}C_1 \times ^{30}C_1}{^{75}C_1 \times ^{75}C_1}$ (iii) $1 - \frac{^{15}C_1 \times ^{15}C_1}{^{75}C_1 \times ^{75}C_1}$

(b) (i) $\frac{^{30}C_1 \times ^{29}C_1}{^{75}C_1 \times ^{74}C_1}$ (ii) $\frac{^{10}C_1 \times ^{30}C_1}{^{75}C_1 \times ^{74}C_1}$ (iii) $1 - \frac{^{15}C_1 \times ^{14}C_1}{^{75}C_1 \times ^{74}C_1}$

Q] A box of light bulbs contains 30 bulbs of which 5 bulbs are defective. If 3 of the bulbs are selected at random taken out from the box without replacement, find all three are defective

ans total outcomes $^{30}C_3$

$P = \frac{^{5}C_1}{^{30}C_1} \times \frac{^{4}C_1}{^{29}C_1} \times \frac{^{3}C_1}{^{28}C_1}$

Q] The probablity that a contractor will get a plumbing contract is 2/3 and the probablity that he will not get an electric contract is 5/9. If the probablity of getting atleast one contract is 4/5, what is the probablity that he will get both the contracts

A = plumbing B = electric

$P(A) = 2/3$ $P(\bar{B}) = 5/9$ $P(B) = 4/9$

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

$4/5 = 2/3 + 4/9 - P(A \cap B)$

$P(A \cap B) = 14/45$

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A B

or, either, atleast $A \cup B$

both, and $A \cap B$

given A / B

Q] A can hits a target 4 times in 5 shots, B can hit 3 times in 4 shots, C can hit 2 times in 3 shots what is the probablity that
(i) 2 shots hit (2) atleast two shots hit

sol^n $P(A) = 4/5$ $P(B) = 3/4$ $P(C) = 2/3$

(i) $P(AB\bar{C}) + P(A\bar{B}C) + P(\bar{A}BC)$

$= \frac{4}{5} \times \frac{3}{4} \times \frac{1}{3} + \frac{4}{5} \times \frac{1}{4} \times \frac{2}{3} + \frac{1}{5} \times \frac{3}{4} \times \frac{2}{3} = \frac{26}{60}$

(ii) P(2 shots hit) + P(all shots hits)

$= \frac{26}{60} + P(ABC)$

$= \frac{26}{60} + \frac{4}{5} \times \frac{3}{4} \times \frac{2}{3}$

$= \frac{5}{6}$

Baye's theorem :- observe no. of cases, ref prob, common event

If A_1 and A_2 are mutually exclusive and exhaustive event and B be an event which can occur in combination with A_1 and A_2 then the conditional ~~proba~~ probability for event A_1 and A_2 given the event B is given by

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$$P(A_1|B) = \frac{P(A_1) \cdot P(B/A_1)}{P(A_1) \cdot P(B/A_1) + P(A_2) \cdot P(B/A_2)}$$

or $$P(A_2|B) = \frac{P(A_2) \cdot P(B/A_2)}{P(A_2) \cdot P(B/A_2) + P(A_1) \cdot P(B/A_1)}$$

Q] In a railway reservation office two clerks are engaged in checking reservation forms, the first clerk collect 55% of the forms. the second clerk ~~contains~~ checks the remaining. The first clerk has an error rate of 0.03 and second clerk has an error rate of 0.02. A reservation form is selected at random from all the forms and is found to have an error. Find the probablity that it was the first clerk or second clerk

ans

A ↓

$P(A_1)\ \frac{55}{100}$

$P(B/A_1) = 0.03$

Find $P(A_1|B)$

B ↓

$P(A_2) = 45/100$

$P(B/A_2) = 0.02$

$P(A_2|B)$

$$P(A_1|B) = \frac{\frac{55}{100} \times 0.03}{\frac{55}{100} \times 0.03 + \frac{45}{100} \times 0.02} = \frac{0.0165}{0.0165 + 0.009} = 0.647$$

$$P(A_2|B) = \frac{45/100 \times 0.02}{45/100 \times 0.02 + 55/100 \times 0.03} = 0.353$$

Q] In a class of 75 student, 15 were considered to be very intelligent, 45 as medium and rest below average. The probablity that a very intelligent student fails in a exam is 0.005. The medium students have probablity of 0.05 and below avg is 0.15. It is known to have pass the exam, what's the probability that it's below avg student

75

A	B	C
15/75	45/75	15/75
0.005 Fail	0.05 fail	0.15 fail
0.995 pass	0.95 pass	0.85 pass

$$P = \frac{0.85 \times 15/75}{0.85 \times 15/75 + 15/75 \times 0.995 + 45/75 \times 0.95}$$

$= 0.181$

Formula applied = $\frac{P(C).P(E/C)}{P(A)P(E/A) + P(B)P(E/B) + P(C).P(E/C)}$

Q] An insurance company insured 2000 scooter drivers, 4000 car drivers and 6000 truck drivers. The probability of their accident is 0.1, 0.3, 0.2 resp. One of the insured person meets with an accident. What is the probablity that he is a scooter driver?

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S C T

$P(A)\ 2000/12000 \quad P(B)\ 4000/12000 \quad P(C)\ 6000/1200$

$\downarrow \quad \downarrow \quad \downarrow$

$P\left(\frac{E}{A}\right)\ 0.1 \quad P\left(\frac{E}{B}\right)\ 0.3 \quad P\left(\frac{E}{C}\right)\ 0.2$

$$P(S) = \frac{P(A) \times P(E/A)}{P(A)\,P\left(\frac{E}{A}\right) + P(B)\,P\left(\frac{E}{B}\right) + P(C)\,P\left(\frac{E}{C}\right)}$$

$$= \frac{\frac{1}{6} \times 0.1}{\frac{1}{6} \times 0.1 + \frac{1}{3} \times 0.3 + \frac{1}{2} \times 0.2} = \frac{1}{13}$$