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Refresher Material

Permutations

The number of arrangements of 'n' distinct object into 'n' distinct position is given by n,n-1,n-2,........3,2,1, which is often denoted as n! (read as n 'factorial'). The number of arrangements is also known as “Permutations". Thus number of permutation of n distinct object into n distinct places is denoted as P^n_n, read as permutations of n distinct objects taken n at a time.

The number of Permutations of n distinct objects taken from a group of 'r' distinct objects, in n distinct place is given by $P^n_r = \frac{n!}{(n-r)!}$

The number of Permutations of n object out of which m are of one type, q is of second type etc. Such that n ≠ m ≠q…. is given by $\frac{n!}{m!.q!....}$

The number of Permutation of n distinct objects taken all as times around a circle is given by (n-1)! And $\frac{(n-1)!}{2}$ accordingly as clockwise and anticlockwise arrangements are treated as different or same. This formula is valid for a necklace.

Number of arrangements of n objects, such that any p out of those occur together is given by (n-p+1)! * p!.

Number of arrangements of n distinct things, when any object can be repeated any number of times is given by n^n.

Combinations

Number of combinations of r distinct things taken out of n distinct things is given by

$$C_r^n = \frac{n!}{(n-r)!r!}$$

Please note in case of combinations also known as selections the order in which things are chosen is not important. Thus if we consider 4 distinct alphabets viz. A, B, C & D then no of permutations of any 3 alphabets out of is given by

ABC ABD ACB ADB ACD

ADC, etc whereas no. of selections is ABC, ABD, ACD and BCD i.e. 4 only.

Number of ways of selecting r things out of n distinct things is same as number of ways of selecting n-r things out of n things. i.e.

$$C_r^n = C_{n-r}^n$$

$$C_r^n = C_{r-1}^n + C_{r+1}^n$$

No of ways in which none or some objects can be chosen out of n distinct of objects is given by

$$2^n = C_0^n + C_1^n + C_2^n + \ldots\ldots C_n^n$$

Distribution

The total number of ways in which n identical things can be distributed into r distinct boxes, such that one or more than one box may remain empty, but not all the boxes can be empty is given by

$$C_{r-1}^{n+r-1}$$

If blank boxes are not allowed i.e each box has at least one object then no of ways is given by

Number of non-negative solutions of is given by

$$C_{r-1}^{n-1}$$

Number of Non – negative solution of $x_1 + x_2 \ldots\ldots\ldots\ldots x_r = n$ is given by

$$C_{r-1}^{n+r-1}$$

Solved Example

Question

A 3 digit number is formed using the digits 2, 3 and 4 without repeating any one of them what is the sum of all such possible numbers?

Solution

Let us first find the total number of 3 digit numbers which be formed using the digits 2,3 and 4. The total number of such numbers is 3! = 6 now out of these 6 numbers we notice that number 2 appears in the hundreds place as well as in tens place and units place. So let us see how many numbers are there where 2 appears in the hundreds place we find there are exactly 2! numbers. Similarly numbers 3 and 4 appear 2! times in hundreds place. Hence if split each of the 6 numbers as say for example 234 as

$2\times100+3\times10+4$ then if we add all the numbers we see that numbers 2,3,4appear in hundreds place

2! times each. Sum of hundreds digits of all the numbers – Similarly sum of all the

$(2+3+4)\times2!\times100$ numbers in the tens and units digit is given by $(2+3+4)\times2!\times10$ and

$(2+3+4)\times2!.1$ therefore sum of all the numbers is

$(2+3+4)\times2!\times(100+10+1)$

= $9\times2!\times111$

= 1998.

Question

Atul has 9 friends; 4 males and 5 females. In how many ways can he invite them, if he wants to have exactly 3 females in the invites?

Solution

The 3 girls which are to be invited can be selected in C_3^5 ways. Also the remaining 4 males none, all or some can be invited in 2^4 ways. Hence Total no of ways Atul can invite his friends is

$$C_3^5 \times 2^4 = 10.16 = 160$$

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