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Question 10: Find the number of all 5 digit sequences such that no two are equivalent.

Solution: In this question, it says no two are equivalent and this means, order (arrangement) is not important. So, we should use combination.

We should choose 5 digits out of 10 digits.

$$c(10,5) = \frac{10!}{5!\cdot 5!} = \frac{10\cdot 9\cdot 8\cdot 7\cdot 6}{5\cdot 4\cdot 3\cdot 2\cdot 1} = 36 //$$

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Question 13(b): How many ways can n books be placed on k distinguishable shelves if no two books are the same, and the positions of the books on the shelves matter?

Solution: $\underbrace{\square\square\ldots\square}_{n \text{ books}}\ \underbrace{///\ldots/}_{\substack{k-1 \text{ seperators} \\ \text{for } k \text{ shelves}}}$

$$\Rightarrow \underbrace{C(n+k-1,n)}_{\substack{\text{choosing} \\ n \text{ books} \\ \text{to place.} \\ \text{(According to} \\ \text{the theorem)}}} \cdot \underbrace{n!}_{\substack{\text{Ordering} \\ \text{the books}}}$$

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Question 14(a): $a_n = 2a_{n-1} - a_{n-2}$ for $n \geq 2$ with $a_0 = 4$, $a_1 = 1$.

Solution: $c_1 = 2 \quad c_2 = -1$

$$r^2 - c_1 r - c_2 = 0 \Rightarrow r^2 - 2r + 1 = 0 \Rightarrow (r-1)^2 = 0$$

Characteristic root: $r = 1$.

According to the theorem for only one root:

$$a_n = \alpha_1 \cdot 1^n + \alpha_2 \cdot n \cdot 1^n$$

$$\left.\begin{array}{l} n=0 \longrightarrow a_0 = \alpha_1 = 4 \\ n=1 \longrightarrow a_1 = \alpha_1 + \alpha_2 = 1 \end{array}\right\} \begin{array}{l} \alpha_1 = 4 \\ \alpha_2 = -3 \end{array}$$

Conclusion: $a_n = 4 \cdot 1^n + (-3) \cdot n \cdot 1^n = 4 - 3n$ for $n = 0, 1, \ldots$