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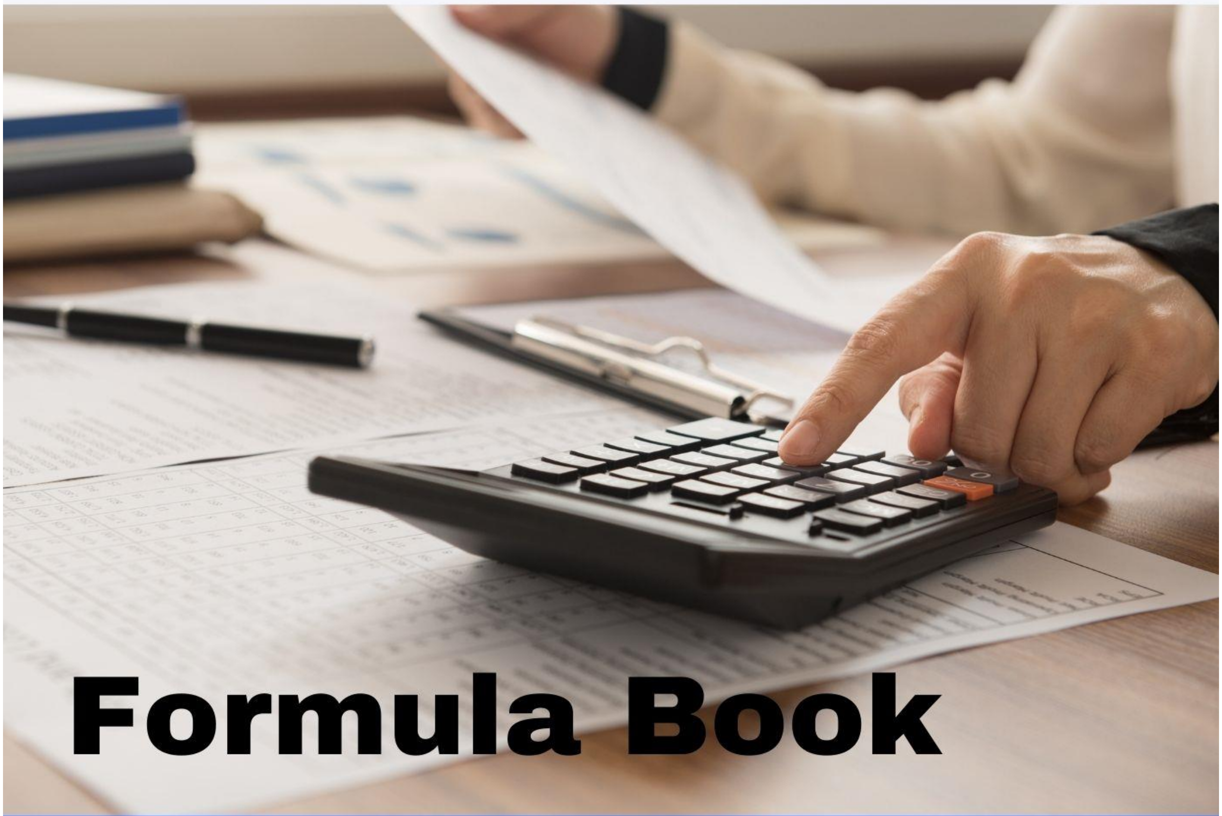
Let's craft the next AIR



Formula Book

YOUR SUCESS IS MY MISSION …..

- **Factor Multiplying Ratio**

  If a quantity increases or decreases in the ratio a:b than

  New quantity $= \frac{b}{a} \times$ **Original Quantity**

The Fraction by which the original quantity is multiplied to get a new quantity is Factor Multiplying Ratio

- **Inverse Ratio:**

One ratio is the inverse of another if their Product is Thus b:a is the inverse of a:b and vice – versa.

- **The ratio Compounded of the two ratios**

  a: b and c: d is ac: bd.

Compound two or more ratios means multiplying **them.**

- **A ratio compound of itself is called its duplicate ratio**

  $a^2: b^2$ is the **duplicate ratio** of a: b

  $a^3: b^3$ is **triplicate ratio** of a: b

  $\sqrt{a} : \sqrt{b}$ Is the **sub-duplicate ratio** of a: b

  $\sqrt[3]{a} : \sqrt[3]{b}$ Is the **sub-triplicate ratio** a: b

- **Continued Ratio:**

  - is the relation or comparison between the magnitudes of three or more quantities of same kind.

- The continued ratio of three similar quantities a, b, c can be written as

  a : b : c

- **Cross Product Rule**:

  If a : b =c : b are in proportion then **ad=bc**

  Product of extremes = Product of means

- **Continues Proportion:**

  Three quantities a, b, c of the same kind (in same units)are said to be in continuous proportion if

  a : b = b : c

  $\frac{a}{b} = \frac{b}{c}$ **b × b = a × c** $\mathbf{b^2 = ac}$

Hear, a=first proportional, c=third proportional and b is mean proportional (because b is GM of a and c)

- **Invertendo**

  If a: b = c: d than

  b : c = d : c

- **Alternendo**

  If a : b = c : d, then

  a : c = b : d

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•Componendo

If a: b = c: d, then

$$a + b : b = c + d : d$$

•Dividendo

If a : b = c : d, then

$$a - b : b = c - d :$$

• Componendoand Dividendo

If a : b = c : d ,than

$$\frac{a+b}{a-b} = \frac{c+d}{c-d} \quad \frac{a-b}{a+b} = \frac{c-d}{c+d}$$

•Addendo

If a : b = c : d = e : f =……=k

Than

$$\frac{a+c+e+\cdots}{b+d+f+\cdots} = k$$

•Subtrahendo

If a : b = c : d = e : f = ….k

Than

$$\frac{a-c-e-\cdots}{b-d-f-\cdots} = k$$

Indices – Standard Results

•Any base raised to the power zero is defined to be 1

$$a^o = 1$$

•Roots can also be expressed in the form of power.

$$\sqrt[r]{a} = a^{\frac{1}{r}}$$

•Law 1

If two or more terms with same base are multiplied, we can make them one term having the same base and power as sum of all powers

$$a^m \times a^n = a^{m+n}$$

•Law 2

If two or more terms with same base are division, we can make them one term having the same base and power as difference of all power.

$$\frac{a^m}{a^n} = a^{m-n}$$

•Law 3

If a term having power is raised to another power, we can do product of power s to simplify the expression

$$(a^m)^n = a^{m\times n}$$

•Law 4

If a product of two or more terms is raised to power, we can split the two terms with same individual power to each one of them

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$$(a \times b)^n = a^n \times b^n$$

- **Calculator Trick for Power**

Base × = = = =

- **Calculator Trick for Reciprocal**

÷ =

- **Calculator Trick for any root**

Base √ √ √ …….. 12 times -1 ÷ n +1 = = = …..12 times

- **Calculator Trick for any power (including non integer)**
  - **Base √ √ √ …….. 12 times -1 ÷ n +1 ×= ×= ×= …**

- ## Log Conditions

The logarithm of a number to a given base is the index or the power to which the base must be raised to produce the number, i.e. to make it equal to the given number.

$$3^4 = 81 \quad \log_3 81 = 4$$

- If $a^x = n$ than $\log_a n = x$

- **Conditions :**

–Number should be positive

–Base should be positive

–Base cannot be equal to one

$$n > 0 , a > 0 , a \neq 1$$

Standard Results of Log

- Log of a number with same base as number is equal to 1

$$\text{Log}_a a = 1$$

- Log of 1 (one) for any base is equal to zero

$$\text{Log}_a 1 = 0$$

Law 1

Logarithm of the product of two numbers is equal to the sum of the logarithms of the number to the same base

$$\text{Log}_a mn = \log_a m + \log_a n$$

Law 2

The logarithm of the quotient of two numbers is equal to the difference of their logarithms to the same base

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$$\log_a \frac{m}{n} = \log_a m - \log_a n$$

Law 3

The logarithm of the number raised to the power is equal to the index of the multiplied by the logarithm of the number to the same base.

$$\log_a m^n = n\log_a m$$

Change of Base Theorem

If the logarithm of a number to any base is given, then the logarithm of the same number to any other base can be determined from the following relation

$$\log_b m = \frac{\log m}{\log b} = \frac{\log_a m}{\log_a b}$$

$$\log_b \times a \times \log_a b = 1$$

- **Base of log**
  - **Common log base**

10

  - **Natural Log's Base**

e

Quadratic Equation

•Equation having degree = 2 is called as Quadratic Equation

•QE will have two roots/ solutions usually denoted by α, β

•Equation Format $ax^2 + bx + c = 0$

Where,

a is coefficient of x2

b is coefficient of x

c is constant

a ≠ *0*

- **Solution of Quadratic Equation**

$$ax^2 + bx + c = 0$$

- **Formula to calculate roots:**

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Where,

a is coefficient of x2

b is coefficient of x

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c is constant
$a \neq 0$

- **Sum and Product of Roots of QE**

$$ax^2 + bx + c = 0$$

- **Sum of roots $\alpha + \beta = -\frac{b}{a}$**
- **Product of roots $\alpha\beta = \frac{c}{a}$**
- **Construction of Quadratic Equation**

If sum of roots and product of roots are given, equation can be constructed in the below manner:

$$x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

Concept of discriminant to get nature of roots

- Discriminant of QE is the mathematical expression which is used to understand nature of of QE is the mathematical expression which is used to understand nature of roots of QE, it is expressed as below:

$$b^2 - 4ac$$

Condition	Nature of Roots
b^2-4ac =0	Real and Equal
b^2-4ac < 0	Imaginary
b^2-4ac > 0	Real and Unequal
b^2 - 4ac > 0 and a perfect square	Real, Unequal and Rational
b^2 - 4ac > 0 and **not a** perfect square	Real, Unequal and Irrational

- **Conjugate Pairs**

–If one root of the equation is

$$m + \sqrt{n}$$

–The other one is surely

$$m - \sqrt{n}$$

–This pair is called as conjugate pairs

- **Simple Equation**
  - Equation of one degree and having one unknown variable is simple.
  - A simple equation has only one root.
  - Form of Equation:

$$ax + b = 0$$

Where,
a is coefficient of x

b is constant
a ≠ *0*

Solution Method –Direct basic algebra

Simultaneous Linear Equations (two unknowns)

- Here we always deal with two equations as it consist of 2 unknowns
- Form:

$$a_1x + b_1 y + c_1 = 0$$
$$a_2 x + b_2y + c_2 = 0$$

Where,
a is coefficient of x
b is coefficient of y
c is constant
a ≠ *0*

- **Methods of Solution Simultaneous Linear Equations**
  - **Elimination Method:** In this method two given linear equations are reduced to a linear equation in one unknown by eliminating one of the unknowns and then solving for the other unknown.
  - **Substitution Method:** equation is written in the form of one variable in LHS and that value is substituted in other equation.
  - **Cross Multiplication Method:** Formula based method

$$a_1 x + b_1 y + c_1 = 0 \qquad \frac{x}{b_1c_2-b_2c_1} = \frac{y}{c_1a_2-c_2a_1} = \frac{1}{a_1b_2-a_2b_1}$$
$$a_2 x + b_2y + c_2 = 0$$

- **Cubic Equation**
  - Form:

$$ax^3 + bx^2 + cx + d = 0$$

Where,
a is coefficient of x^3
b is coefficient of x^2
c is coefficient of x
d is constant
a ≠ *0*
Method of solution: Trial and Error

- **Addition/Subtraction of Matrices**

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- Property

  Commutative Law: A + B = B + A

  Associative Law: (A + B) + C = A + (B+ C)

  Distributive Law: k (A + B) = kA + kB

- **Multiplication of Matrices**
- **Condition**
  - The product A× B of two matrices A and B is defined only if the number of columns in matrix a is equal to the number of rows in matrix B.

$$\mathbf{A_{m\times n} \times B_{n\times p} = AB_{m\times p}}$$

- **Determinant – 2 x 2**
  - If a square matrix of order 2 x 2 is given

$$\mathbf{A} = \begin{bmatrix} \mathbf{a_{11}} & \mathbf{a_{12}} \\ \mathbf{a_{21}} & \mathbf{a_{22}} \end{bmatrix} \quad \mathbf{detA=} \begin{bmatrix} \mathbf{a_{11}} & \mathbf{a_{12}} \\ \mathbf{a_{21}} & \mathbf{a_{22}} \end{bmatrix}$$

$$\mathbf{detA = a_{11} \times a_{22} - a_{12} \times a_{21}}$$

- **Determinant – 3 x 3**
  - If a square matrix of order 3 x 3 is given

$$A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \qquad \mathbf{det\,A} = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix}$$

$$\mathbf{detA = a_{11}} \begin{vmatrix} \mathbf{a_{22}} & \mathbf{a_{23}} \\ \mathbf{a_{32}} & \mathbf{a_{33}} \end{vmatrix} - \mathbf{a_{12}} \begin{vmatrix} \mathbf{a_{21}} & \mathbf{a_{23}} \\ \mathbf{a_{31}} & \mathbf{a_{33}} \end{vmatrix} + \mathbf{a_{13}} \begin{vmatrix} \mathbf{a_{21}} & \mathbf{a_{22}} \\ \mathbf{a_{31}} & \mathbf{a_{32}} \end{vmatrix}$$

- **Minor and cofactors**
  - Minor of the elements of determinate is the determinant of M_{ij} by deleting i^{th} row and j^{th} Colum in which element is existing.

    $C_{ij} = (-1)^{i+j}$ Mij

- **Inverse of Matrix**

$$\mathbf{A^{-1}} = \frac{\mathbf{1}}{\boldsymbol{detA}} \times \boldsymbol{adj.A}$$

- **Cramer's Rules**

$$\boldsymbol{x} = \frac{\triangle\,\mathbf{x}}{\triangle}, \mathbf{y} = \frac{\triangle\,\mathbf{y}}{\triangle}, \mathbf{z} = \frac{\triangle\,\mathbf{z}}{\triangle}$$

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- **Simple Interest**

$$SI = \frac{P.r.t}{100}$$

P = principal value
r = rate of interest per annum
t = time period in years
Amount as per SI

$$A = P + SI = P + \frac{p.r.t}{100} = P(1 + \frac{rt}{100})$$

Conversion Period

Conversion of Period	Description	Number of conversion period of in a year
1 day	Compounded daily	365
1 month	Compounded Monthly	12
3 months	Compounded quarterly	4
6 months	Compounded semi Annually	2
12 months	Compounded annually	1

Compound interest Amount

- Calculation of Accumulated amount under CI denoted by **A**

$$A = P(1 + i)^n$$

Where,
P = Initial Principal
i= adjusted interest rate
n = no. of periods

$$i = \frac{r\%}{nocppy} \qquad n = t \times nocppy$$

Compound Interest Amount by Trick

- **Calculator Tricks for Amount as per CI**

–Example P = 1000, i= 10%, n = 3 then

- Calculator Steps to obtain A:

1000 + 10 % + 10 % + 10 %

Compound Interest

- **Formula for Compound Interest**
  - Calculation of Compound Interest Value denoted by CI

$$CI = P[(1+i)^n - 1]$$

Where,

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P = Initial Principal
i= adjusted interest rate
n = no. of periods

$$i = \frac{r\%}{nocppy} \qquad n = t \times noccpy$$

- **Effective Rate of Interest**

$$E = [(1+i)^n - 1]$$

Where,
i= adjusted interest rate
n = no. of periods in a year

- **Future Value –Single Cash flow**

$$FV = CF\ (1+i)^n$$

Where,
CF = Single Cash flow of which FV is to be calculated
i= adjusted interest rate
n = no. of periods

- **Future Value- Annuity Regular**

$$\text{FVADS} = A_i \times FVAF(n, i)$$

Future Value Annuity Factor: It is a multiplier for Annuity Value to obtain Final Future Value

$$\text{FVAR} = A_i \left\{ \frac{[(1+i)^n - 1]}{i} \right\}$$

Where,
FVAR = Future Value of Annuity Regular
Ai = Annuity Value (Instalment)
FVAF = Future Value Annuity Factor
i= adjusted interest rate
n = no. of periods

- **Future Value –Annuity Due**
  - Formula:

$$\text{FVAD} = A_i \times FVAF(n, i) \times (1+i)$$

Future Value Annuity Factor: It is a multiplier for Annuity Value to obtain Final Future Value

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$$\mathbf{FVAD} = \mathbf{A_i}\left\{\frac{[(\mathbf{1}+\mathbf{i})^{\mathbf{n}}-\mathbf{1}}{\mathbf{i}}\right\} \times (\mathbf{1}+\mathbf{i})$$

Where,
FVAD= Future Value of Annuity Due
Ai = Annuity Value (Instalment)
FVAF = Future Value Annuity Factor
i= adjusted interest rate
n = no. of periods

- **Present Value –Single Cash flow**

$$\mathbf{PV} = \frac{\mathbf{CF}}{(\mathbf{1}+\mathbf{i})^{\mathbf{n}}}$$

Where,
CF = Single Cash flow for which PV is to be calculated
i= adjusted interest rate
n = no. of periods

- **Compounding and Discounting Factor**
  - **Compounding**
  - Finding Future Value of any Cash flow
  - Compounding Factor: $\times\ (\mathbf{1+i})^{\mathbf{n}}$
- **Discounting**

–Finding Present Value of any Cash flow
–Discounting Factor: $\times \frac{\mathbf{1}}{(\mathbf{1+i})^{\mathbf{n}}}$

- **Present Value –Annuity Regular**

$$\mathbf{PVAR = A_i \times PVAF\ (n\ ,\ i)}$$

Present Value Annuity Factor: It is a multiplier for Annuity Value to obtain Final Present Value

$$\mathbf{PVAR = A_i} \times \left[\frac{\mathbf{1}}{i} \times \left\{\mathbf{1} - \frac{\mathbf{1}}{(\mathbf{1}+i)^{n}}\right\}\right]$$

Where,
PVAR = Present Value of Annuity Regular
Ai = Annuity Value (Instalment)
PVAF = Present Value Annuity Factor
i= adjusted interest rate
n = no. of periods

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- **Calculator trick of PVAF**

$$1 + i \quad \div = = = \cdots n - \text{times } GT$$

- **Present Value –Annuity Due**

$$\mathbf{PVAD} = [\mathbf{A_i} \times \mathbf{PVAF\{n-1), i\}}\,] + A_i$$

Where,
PVAD = Present Value of Annuity Due
Ai = Annuity Value (Instalments)
PVAF = Present Value Annuity Factor
i= adjusted interest rate
n = no. of periods
n - 1 = one lesser period

- **Perpetuity**

$$\mathbf{PVP} = \frac{\mathbf{A_i}}{\mathbf{i}}$$

Where,
PVP = Present Value of Perpetuity
Ai = Annuity Value (Instalment)
i= adjusted interest rate

- **Growing Perpetuity**

$$\mathbf{PVGP} = \frac{\mathbf{A_i}}{\mathbf{i - g}}$$

Where,
PVGP = Present Value of Growing Perpetuity
Ai = Annuity Value (Instalment)
i= adjusted interest rate
g = growth rate

- **Net Present Value**
  - **Formula**
  - **NPV = Present Value of Cash Inflows – Present value of cash out flow**

- **Decision Base:**
  - If NPV $\geq$ 0, accept the proposal, If NPV < 0, reject the proposal

- **Real Rate of Return**

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- **Meaning:** The real interest rate is named so to show what a lender or investor receives in real terms after inflation is factored in.
- **Formula:**

Real Rate of Return = Nominal Rate of Return- Rate of Inflation

- **CAGR**
  - Compounded Annual Growth rate is the interest rate we used in Compound Interest.
  - It is used to see returns on investment on yearly basis

Rules of Counting

- **Multiplication Rule**

–If certain thing may be done in ‘m’ different ways and when it has been done, a second thing can be done in ‘n ‘ different ways then total number of ways of doing both things simultaneously is (m ×n) ways

- **Addition Rule**

–It there are two alternative jobs which can be done in ‘m’ ways and in ‘n’ ways respectively then either of two jobs can be done in (m + n) Ways

Word use	**Use**
OR	+ **Plus**
AND	× **Product**

- **Factorial**
  - $n!=n(n-1)\ (n-2)\ldots3.2.1$
  - $n!=1.2.3\ldots(n-2)(n-1)n$
  - $n!=n(n-1)!$
  - $n!=n(n-1)(n-2)!$
  - $0! = 1$

- **Factorial Values**

value of n	**Value of n!**
1	1
2	2
3	6
4	24
5	120
6	720
7	5040

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8	40320
9	362880
10	3628800
11	39916800
12	479001600
13	6227020800
14	871178291200

- **Theorem of Permutations**
  - Number of Permutations when r objects are chosen out of n different objects

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

Few Observations: $n \geq r$

n is a positive integer

- **Particular Case of theorem (n = r)**
  - Number of Permutations when n objects are chosen out of n different objects

$$^{n}P_{r} = n!$$

- **Special Formula of (must Remember)**

$$(n+1)! – n! = n.n!$$

- **Circular Permutations**
  - Theorem:

–The number of circular permutations of n different things chosen at a time is

$(n–1)!$

Note: This theorem applies only when we choose all of n things

- **Circular Permutations (Type II)**
  - number of ways of arranging n persons along a closed curve so that no person has the same two neighbours is

$$\frac{1}{2}(n-1)!$$

Same formula will apply if ask is to find number of different forms of necklaces/ garlands

Permutation with Restriction: Theorem 1

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- Number of permutations of n distinct objects taken r at a time when a particular object is not taken in any arrangement is

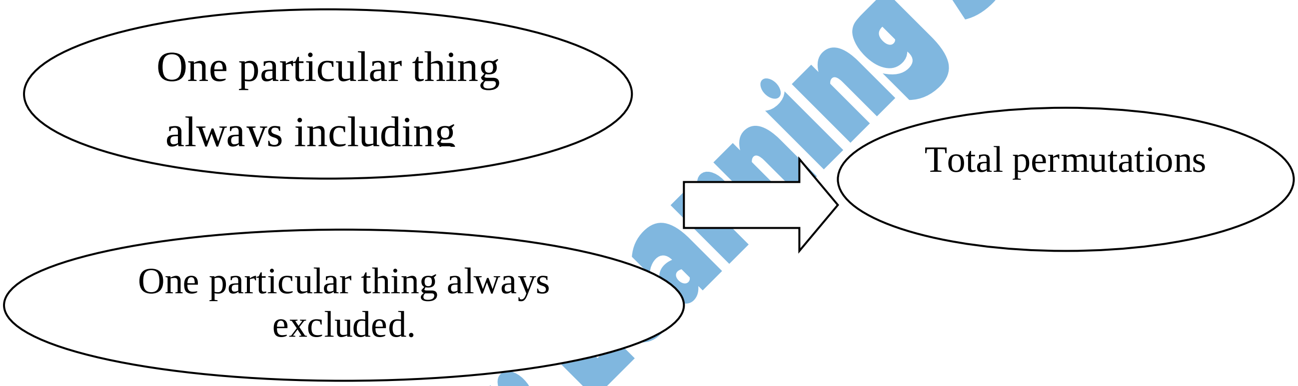
$$^{n-1}\mathbf{P_r}$$

- **Permutations with Restrictions: Theorem 2**
  - Number of permutations of r objects out of n distinct objects when a particular object is always included in any arrangement is

$$\mathbf{r.^{n-1}P_r - 1}$$

Relation between restriction theorems

$$n^{-1}P_r + r.^{n-1}P_{r-1} = {}^{n}P_r$$



- No. of ways when things are never together
  Ways of Never Together = Total ways –Ways of always together

- **Theorem of Combinations**
  - Number of Combinations when $r$objects are chosen out of n different objects

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

- **Few Observations:**
  - $n \geq r$
  - n is a positive integer

- **Linkage of PNC Theorems**

$$^{\mathbf{n}}\mathbf{C_r} = \frac{^{\mathbf{n}}\mathbf{P_r}}{\mathbf{r!}}$$

- **Few Observations:**
  - $n \geq r$

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- n is a positive integer

- **Special Result of Combinations**

$$n_{C_0} = 1$$
$$n_{C_n} = 1$$

- **Complimentary Combinations**

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

- **Special Formula of Combination**

$$^{n+1}C_r = {}^nC_r + {}^nC_{r-1}$$

- **Combinations of one or more**
  - Combinations of n different things taking one or more out of n things at a time

$$2^n - 1$$

- **Geometry in PNC**

Particulars	Tips to Solve
No. of Straight Lines with the given points	$^nC_2$ 2 is used as we need to select two points to make a line
No .of Triangles with the given n points	$^nC_2$ 3 is used as we need to select two points to make a line
Adjustment of collinear points	If there are collinear points in any problem, no of lines or triangles formed using those points should be deducted form to no of line /triangles
No of parallelogram with the given one set of m parallel lines and another set of n parallel lines	$n_{C_2} \times m_{C_2}$ Selecting 2 line from each set of parallel lines
No of Diagonals	$n_{C_2} - n$

- **Common Difference of AP**

$$d = t_2 - t_1 = t_3 - t_2 = \cdots = t_n - t_{n-1}$$

- **General Term of an AP**

$$t_n = a + (n-1)\,d$$

Where,
a = first term

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d = common difference
n = position number of term

- **General Term of an AP**

$$t_n = a + (n-1)d$$

- **Calculator Trick:**

$$a \pm d ===\ldots=$$

$$t_2\ \ t_3\ \ t_4\ \ t_n$$

- **Sum of first n terms of an AP**

$$S_n = \frac{n}{2}(a + t_n) \qquad S_n = \frac{n}{2}\{2a + (n-1)d\}$$

Where,
a = first term
d = common difference
n = position number of term
t_n= nth term of AP

- **Sum of first n terms of an AP**

$$S_n = \frac{n}{2}(a + t_n) \qquad S_n = \frac{n}{2}\{2a + (n-1)d\}$$

- **Calculator Trick**

$$a \pm d ===\ldots.= GT + a$$

$$t_2\ t_3\ t_4\ \ t_n$$

- **Sum of first n natural or counting numbers**

$$S = \frac{n(n+1)}{2}$$

- **Sum of first n odd numbers**

$$S = n^2$$

- **Sum of the squares of first n natural numbers**

$$S = \frac{n(n+1)(2n+1)}{6}$$

- **Sum of the cubes of first n natural numbers**

$$S = \{\frac{n(n+1)}{2}\}^2$$

- **Common Ratio of GP**

$$r = \frac{t_2}{t_1} = \frac{t_3}{t_2} = \frac{t_n}{t_{n-1}}$$

- **General Term of an GP**

$$t_n = ar^{n-1}$$

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Where,
a = first term
r = common ratio
n = position number of term

- **Calculator Trick:**

$$\mathbf{r \times a = \underset{t_2}{=} \underset{t_3}{=} \underset{t_4}{=} \cdots = \underset{t_n}{}}$$

- **Sum of first n terms of a GP**

$$\mathbf{S_n = \frac{a(1-r^n)}{1-r}} \qquad \mathbf{S_n = \frac{a(1-r^n)}{1-r}}$$

Use when r < 1 **Use when r > 1**

Where,
a = first term
r = common ratio
n = position number of term

- **Sum of first n terms of a GP**

$$\mathbf{S_n = \frac{a(1-r^n)}{1-r}} \qquad \mathbf{S_n = \frac{a(r^n-1)}{1-r}}$$

- **Calculator Trick**

$$\mathbf{r \times a \underset{t_2}{=} \underset{t_3}{=} \underset{t_4}{=} \cdots = \underset{t_n}{GT} + a}$$

- **Sum of Infinite Geometric Series**

$$\mathbf{S_\infty = \frac{a}{1-r}}$$

Can be used only if -1 < r < 1

Where,
a = first term
r = common ratio
n = position number of term

- **Subset**
  - No. of possible subset of any set
    Total = 2^n
    Proper= 2^n -1

- **De Morgan's Law**
  - (P∪Q)' = P'∩Q'
  - (P∩Q)' = P'∪ Q'

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2 Set Operations Formulas

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

- **Proof:**
  - Example: A = {6, 2, 4, 1} B = {2, 4, 3}

3 Set Operations Formula

$$n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(A \cap C) + n(A \cap B \cap C)$$

- **Composition of Functions**
  - $fog = fog(x) = f[g(x)]$
  - $gof = gof(x) = g[f(x)]$

- **Step Method of finding inverse of f**
  1. Write your function in the form of y
     $-y = f(x)$
  2. From above expression, find the value of x
     $- x = \boxed{}$
  3. Interchange value of x and y, now the RHS is Inverse function
     - y = $\boxed{}$

- **Differentiation Basic Formulas**

$f(x)$	$f'(x)$
$\frac{d}{dx}(x^n)$	nx^{n-1}
$\frac{d}{dx}(e^x)$	e^x
$\frac{d}{dx}(a^x)$	$a^x log_e a$
$\frac{d}{dx}(constant)$	0
$\frac{d}{dx}(e^{ax})$	ae^{ax}
$\frac{d}{dx}(log\, x)$	$\frac{1}{x}$

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- **Basic Laws of Differentiation**

Function	Derivative of the Function
h(x) = c.f (x) where c is a real constant ,scalar multiplication of function	$\frac{d}{dx}\{h(x)\} = c\frac{d}{dx}\{f(x)\}$
$h(x) = f(x) \pm g(x)$ sum/ difference of function	$\frac{d}{dx}\{h(x)\} = \frac{d}{dx}\{f(x)\} \pm \frac{d}{dx}\{g(x)\}$
$h(x) = f(x).g(x)$ Product of functions	$\frac{d}{dx}\{h(x)\}f(x)\frac{d}{dx}g(x) + g(x)\frac{d}{dx}f(x)$
h(x)=$\frac{f(x)}{g(x)}$ Quotient of Function	$\frac{d}{dx}\{h(x)\} = \frac{g(x)\frac{d}{dx}f(x) - f(x)\frac{d}{dx}g(x)}{\{g(x)\}}$

- **Cost and Revenue Functions**

Cost Function	$y = C(x)$
Average Cost	$A(x) = \frac{C(x)}{x}$
Average Cost is minimum or maximum when	$A'(x) = 0$
Marginal Cost	$M(x) = \frac{dC}{dx}$
Marginal Cost is minimum or maximum when	$M'(x) = 0$
Marginal Revenue	$MR(x) = \frac{dR}{dx}$

- **Integration –Basic Formulas**

1. $\int x^n \, dx = \frac{x^{n+1}}{n+1} + c, n \neq -1$ (if $n = -1, \frac{x^{n+1}}{n+1} = \frac{1}{0}$ which is not defined)
2. $\int dx = x + c$, since $\int 1dx = \int x^0 dx = \frac{x1}{1} = x + c$
3. $\int e^x dx = e^x + c$, since $\frac{d}{dx}e^x = e^x$
4. $\int e^{ax} dx = \frac{e^{ax}}{a} + c$, since $\frac{d}{dx}\left(\frac{e^{ax}}{a}\right) = e^{ax}$
5. $\int \frac{dx}{x} = \log x + c$, since $\frac{d}{dx}\log x = \frac{1}{x}$
6. $\int e^x dx = a^x / \log_e a + c$, since $\frac{d}{dx}\left(\frac{a^x}{\log^a}\right) = a^x$

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- **Integration by Parts –ILATE Rule**

$$\int uvdx = u\int vdx - \int [\frac{d(u)}{dx}\int vdx]dx$$

Where u and v are two different functions of x

Guidelines for Selecting u and dv:
(There are always exceptions, but these are generally helpful.)
"L-I-A-T-E" Choose 'u' to be the function that comes first in this list:
L: Logarithmic Function
I: Inverse Trig Function
A: Algebraic Function
T: Trig Function
E: Exponential Function

Probability

Probability event = - $\frac{\text{Number of outcomes favourable to the event}}{\text{Total number of mutually exclusive,exhaustive likely outcomes}}$

Bayes theorem = P(A/B)= $\frac{P(B|A)\times P(A)}{P(B)}$

Complement rule P (not A) = 1-P(A)

Probability of independent Events:
For independent Events A and B= P(A)×P(B|A)

Law of Total Probability: If events $B_1, B_2, \ldots, B_n$ are mutually exclusive and exhaustive, then P(A)=$\sum_{i=1}^{n} P(A \text{ and } B_i) = \sum_{i=1}^{n} P(A/B_i) \times P(B_i)$

Conditional probability = P(B/A) = $\frac{P(A \text{ and } B)}{P(A)}$

Probability of dependent Events: for dependent Events A and B,P (A and B)= P(A) ×P(B/A)

Index Number

Simple Index number = $\frac{\text{Current Price}}{\text{Base price}} \times 100$

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Weighted price Index = $\left(\frac{\sum(\text{Price} \times \text{Quantity})}{\sum(\text{Base year Price} \times \text{Base year quantity})}\right) \times 100$

Lapspeyres Price index = $\left(\frac{\sum(\text{Base year Price} \times \text{Cureent year Quantity})}{\sum(\text{Base year Price} \times \text{Base year quantity})}\right) \times 100$

Passche price Index = $\left(\frac{\sum(\text{Current year Price} \times \text{current year Quantity})}{\sum(\text{Base year Price} \times \text{Current year quantity})}\right) \times 100$

Time series

Simple moving Average :

SMA= $\frac{\text{Sum of observations in 'n' periods}}{\boldsymbol{n}}$

Weighted Moving Average

WMA= $\frac{w_1 x_1 + w_2 x_2 + \cdots + w_n x_n}{w_1 + w_2 + \cdots + w_n}$

Exponential Smoothing (Single Exponential Smoothing):

Forecast at time t=α×(Actual value at time t)+(1− α)×(Forecast at time t−1)

Where α is the smoothing parameter between 0 and 1.

Seasonal Index = $\frac{\text{Average of observations in a season}}{\text{Overall average}} \times \mathbf{100}$

Trend Analysis (Linear Trend Line) = $Y=a+b_t$

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