Inequalities Formulae

Inequalities:

We usually deal with a lot of equations in the Quant Section equating RHS and LHS. In inequalities, we do have LHS and RHS but these are not equal, any of the following case is possible:

LHS >= RHS; LHS > RHS; LHS < RHS; LHS <= RHS

Basic rules of operations on inequality:

- We can add or subtract same number from both sides with no change in the truth of the inequality. If a > b, then a + k > b + k e.g. If 9 > 7 then 9 + 2 > 7 + 2 and if 4 < 5 then 4 – 3 < 5 – 3

- We can multiply or divide both sides with the same number, however the sign will depend as follows:
  It will not change the sign of the inequality if the number is positive. If a>b, then ak > bk; k > 0 e.g. 7 > 5 ⇒ 7 × 4 > 5 × 4
  It will not change the sign of the inequality if the number is negative. If a > b, then ak < bk; k< 0 e.g. 8 > 4 ⇒ 8 × (-3) < 4 × (-3)

Linear inequalities:

If a > b and c > 0, then

- a + c > b + c
- a - c > b - c
- ac > bc
- a/c > b/c

If a, b ≥ 0, then $a^n > b^n$ and $1/a^n < 1/b^n$, where n is positive.

- a < b and x > 0, then $\frac{a+x}{b+x} > \frac{a}{b}$
- a > b and x > 0, then $\frac{a+x}{b+x} < \frac{a}{b}$

Modular Inequalities:

$|x - y| = |y - x|$

$|x. y| = |x|.|y|$

$|x + y| < |x| + |y|$

$|x + y| > |x| - |y|$

Quadratic Inequalities:

$(x - a) (x - b) > 0$ $\{a < b\}$

$\Rightarrow (x < a) \cup (x > b)$

$(x - a) (x - b) < 0$ $\{a > b\}$

$\Rightarrow a < x < b$

Important points:

- For any set of positive numbers: AM ≥ GM ≥ HM
  $\Rightarrow (a1+a2+ \ldots.+an)/n \geq (a1.a2. \ldots..an)^{1/n}$

- If a and b are positive quantities, then
  $\Rightarrow \frac{a+b}{2} \geq \sqrt{ab}$
- If a, b, c, d are positive quantities, then
  $\Rightarrow \frac{a}{b} + \frac{b}{c} + \frac{c}{d} + \frac{d}{a} \geq 4$

  $\Rightarrow a^4 + b^4 + c^4 + d^4 \geq 4abcd$

- If a > b and both are natural numbers, then
  $a^b < b^a$ $\{$except $3^2 > 2^3$ and $4^2 = 2^4\}$

- $(n!)^2 \geq n^n$

- If the sum of two or more positive quantities is constant, their product is greatest when they are equal and if their product is constant then their sum is the least when the numbers are equal.
  $\Rightarrow$ If $x + y = k$, then xy is greatest when $x = y$
  $\Rightarrow$ If $xy = k$, then $x + y$ is least when $x = y$

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