1 | Cauchy-Schwarz Inequality important

'One of the most important inequalities in mathematics'

Suppose $u, v \in V$ (where V is an inner product space). Then

$$|\langle u, v \rangle| \le ||u|| ||v||$$

The inequality is an equality iff one of u, v is a scalar multiple of the other.

1.1 proof is by the orthogonal decomposition

1.2 | results

1.2.1 | triangle inequality

Suppose $u, v \in V$. Then

$$||u + v|| \le ||u|| + ||v||$$

The inequality is an equality if and only if one of u, v is a non-negative multiple of the other (degenerate triangle)

1.2.2 | Parallelogram Equality

Suppose $u, v \in V$. Then

$$||u + v||^2 + ||u - v||^2 = 2(||u||^2 + ||v||^2)$$

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