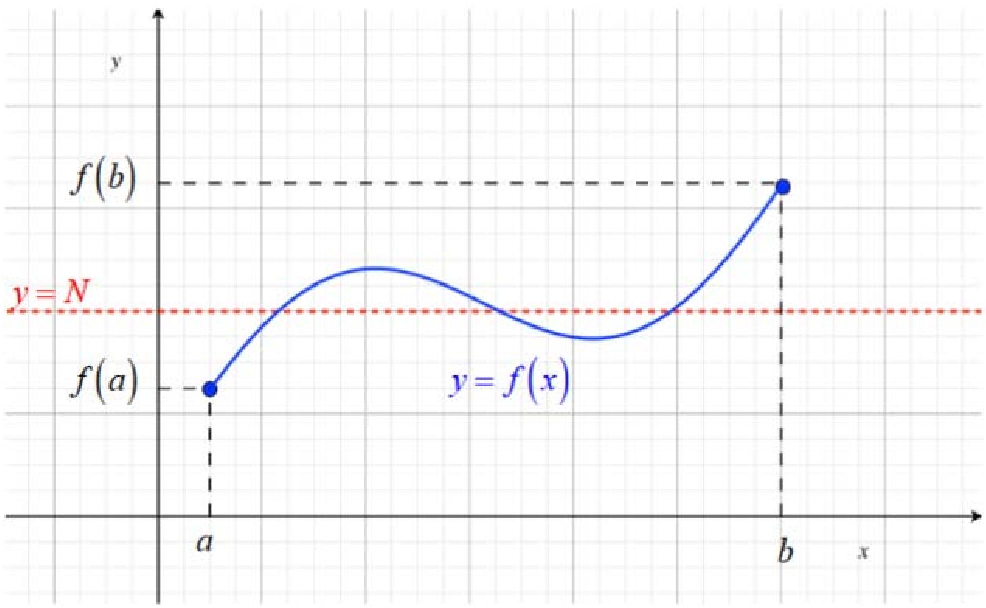
Section 1.5: The Intermediate Value Theorem

If f (x) is continuous on the closed interval [a, b] and N is a real number such that $f(a) \leq N \leq f(b)$, then there is at least one value c in (a, b) so that $f(c) = N$.



Use the intermediate value theorem to show that there is a solution to the given equation in the indicated interval.

Example 1: $x^2 - 4x + 3 = 0$, [2,4]

Example 2: $2\tan x - x = 1$, $\left[0, \frac{1}{4}\right]$

Example 3: Given $f(x) = x^2 - 3x + 1$, the IVT applies to the interval [0, 6] for $f(c) = 5$. Find the value(s) that satisfy the conclusion of the theorem.

Example 4: Does the IVT guarantee at least one solution for $f(x) = 2\sin x - 8\cos x - 3x^2$ on the interval $\left[0, \frac{\pi}{4}\right]$?

Example 5: Does the IVT guarantee at least one solution for $f(x) = \dfrac{x-1}{x-4}$ on the interval $\left[0, \frac{\pi}{4}\right]$?

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The Extreme-Value Theorem

If f is continuous on a bounded interval $[a,b]$, then f takes on both a maximum value and a minimum value.

If the function is not continuous, it may or may not take minimum or maximum value.

Example 5: State whether it is possible to have a function f defined on the indicated interval and meets the given conditions:

f is defined on [3, 6]; f is continuous on [3, 6], takes on the values -3 and 3 but does not take on the value 0.

Example 6: State whether it is possible to have a function f defined on the indicated interval and meets the given conditions:

f is defined on [4, 5]; f is continuous on [4, 5), minimum value $f(5) = 4$, and no maximum value.