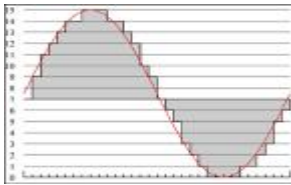


Continuity

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Continuity- Introduction

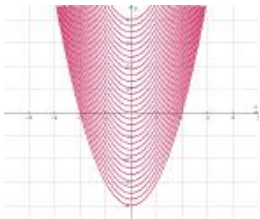
A real valued function is [continuous](#) at a point in its domain if the limit of the function at that equals the value of the function at that point.



Definition 1:- Suppose f be a real function on a [subset](#) of the real numbers and let 'a' be a point in

the domain of 'f'. Then f is continuous at 'a' if

$$\lim_{x \rightarrow a} f(x) = f(a)$$



Definition 2:- A real valued function is said to be continuous if it is continuous at every point in the

domain of f

A function is said to be continuous at $x=a$, if

$$\lim_{x \rightarrow a^-} f(x) = \lim_{x \rightarrow a^+} f(x) = f(a)$$

Domain of a function

Let $f:A \rightarrow B$ be a function then the set of first components in the ordered pair of the function is said to be the domain. In other words, first set A is the [domain of the function](#). B is called the co-domain of the function.

- For example: The domain of the modulus function, $f(x)=|x|$ is \mathbb{R}

The domain of the [greatest integer function](#) is also \mathbb{R}

Real Valued Function

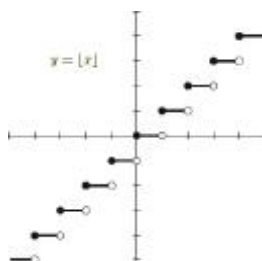
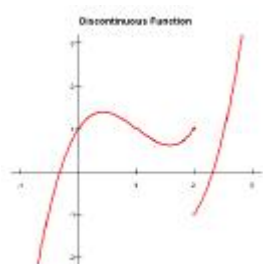
A function which has either \mathbb{R} or one of its subsets as its range is called real valued function. Further, if its domain is also either \mathbb{R} or a subset of \mathbb{R} , it is called a real function.

Discontinuous function

A function which is not continuous is called discontinuous function.

For a discontinuous function, $\lim_{x \rightarrow a} f(x) \neq f(a)$

Graph of a discontinuous functions:



Algebra of continuous function

Theorem 1:-

Suppose f and g be two real functions continuous at a real number ' c ', then

- 1) $f + g$ is continuous at c
- 2) $f - g$ is continuous at c
- 3) $f \cdot g$ is continuous at c
- 4) $\left(\frac{f}{g} \right)$ is continuous at c , provided $g(c) \neq 0$

Theorem 2:-

Suppose f and g are real valued functions such that $(f \circ g)$ is defined at c . If g is continuous at c and if f is continuous at $g(c)$, then $(f \circ g)$ is continuous at c .

For example: Let $f(x) = \sin(x^2)$

Take $g(x) = \sin x$ and $h(x) = x^2$, both the functions are continuous, so that $g \circ h = g[h(x)] = \sin(x^2)$ is also continuous.

Example 2: Find all the points of discontinuity of the function f defined by

$$f(x) = \begin{cases} x+2, & \text{if } x < 1 \\ 0, & \text{if } x = 1 \\ x-2, & \text{if } x > 1 \end{cases}$$

Solution: Left hand limit, $\lim_{x \rightarrow 1^-} f(x) = \lim_{x \rightarrow 1^-} x+2 = 1+2=3$

Right hand limit, $\lim_{x \rightarrow 1^+} f(x) = \lim_{x \rightarrow 1^+} x-2 = 1-2=-1$

Since, the left hand limit is not equal to right hand limit at $x=1$, the only point of discontinuity is $x=1$.

Now try it yourself! Should you still need any help, [click here](#) to schedule live online session with e Tutor!

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Reference Links:

- http://en.wikipedia.org/wiki/Continuous_function
- <http://en.wikipedia.org/wiki/Subset>
- <http://en.wikibooks.org/wiki/Algebra/Functions>
- http://en.wikipedia.org/wiki/Domain_of_a_function
- http://www.wordiq.com/definition/Greatest_integer_function

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