Calculus

Limits and Continuity

Limits

Limit (Wikipedia) | Thomas' Calculus (2.2–2.6)

- **Limit** $\lim_{x \to c}$: the value of a function (or sequence) approaches as the input (or index) approaches some value (informal definition)
  - Limits are used to define continuity, derivatives, and integrals

Limits of a Functions and Sequences

Limit of a function (Wikipedia) | Limit of a sequence (Wikipedia)

- **Limit of a function**: a fundament concept in calculus and analysis concerning the behavior L of a function near a particular input p, i.e.,

$$\lim_{x \to p} f(x) = L$$

  - Reads as "f of x tends to L as x tends to p"
- Functions do not have a limit when the function:
  - has a unit step, i.e., it "jumps" at a point;
  - is not bounded, i.e., it approaches tends towards infinity;
  - or does not stay close to any single number, i.e., it oscillates too much.
- **Limit of a sequence**: the value that the terms of a sequence "tends to" as n approaches infinity (or some point), i.e.,

$$\lim_{n \to \infty} a_n x_n = c$$

  - **Convergent**: when a limit of a sequence exists.
  - **Divergent**: a sequence that does not converge.
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Limit Laws and Theorems

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Continuity

- Sources:

Continuity at a Point

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Continuous Functions

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Intermediate Value Theorem

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Limits Involving Infinity

- Sources:

Limits at Infinity

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Infinite Limits

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Derivatives

Applications of Derivatives

Integrals

Applications of Integrals

Transcendental Functions

Techniques of Integration

Infinite Sequences and Series

First-Order Differential Equations

Parametric Equations and Polar Coordinates

Vectors and Vector-Valued Functions

Partial Derivatives

Multiple Integrals

Vector Calculus

Second-Order Differential Equations