Infinitesimal Encyclopedia Article

Infinitesimal

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Infinitesimal

An infinitesimal is a numerical quantity small enough that its limit in some condition is **zero**. Infinitesimals are widely used in **calculus**, where the formal, limit-based **definition** of a derivative depends upon an arbitrary additive quantity going to zero. In **integral calculus**, the **definite integral** can be thought of as the sum of infinitesimal slices of the area. In fact, calculus was originally thought to be infeasible because it required the use of infinitesimals, which were then thought to be mathematically sketchy at best. Calculus proofs were worked out in epsilon-delta notation, but the intuitive explanations of calculus were most commonly used with infinitesimal rectangles, infinitely small straight lines making up a curve, and other such infinitesimal-related imagery.

In the 1960s, Abraham Robinson founded nonstandard **analysis**, a branch of mathematics that constructs a hyperreal set of numbers, or a set of numbers that is an extension to the usual set of **real numbers** and does not follow all of the same axioms. These numbers can be used to construct mathematically viable infinitesimals, and the system thus constructed can be used to write calculus proofs using the same intuitive ideas as Leibniz, Newton, and Cauchy.

The term infinitesimal is used somewhat more colloquially, even in math circles, to mean "exceptionally small" or "so small that it may be neglected." The **distance** between real numbers can be called infinitesimal in this usage, and a term in a series can be so comparably small with respect to the other terms that it is "practically infinitesimal." However, this non-rigorous usage of the word is not recommended for composing mathematical proofs.