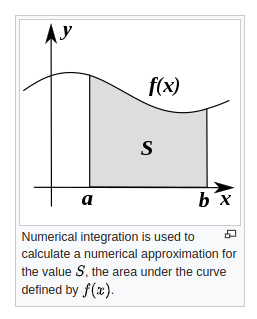
**Numerical integration**

**Numerical integration** comprises a broad family of [algorithms](https://en.wikipedia.org/wiki/Algorithm) for calculating the numerical value of a definite [integral](https://en.wikipedia.org/wiki/Integral), and by extension, the term is also sometimes used to describe the [numerical solution of differential equations](https://en.wikipedia.org/wiki/Numerical_ordinary_differential_equations). This article focuses on calculation of definite integrals.

[Numerical integration is the **approximate computation of an integral using numerical techniques**](https://www.bing.com/ck/a?!&&p=a1b6287da374aa0dJmltdHM9MTY5MDQxNjAwMCZpZ3VpZD0xZGU0OTAzNC02NTk3LTY4ODMtMGU1MS04MjljNjQ5NjY5YjImaW5zaWQ9NTY0MA&ptn=3&hsh=3&fclid=1de49034-6597-6883-0e51-829c649669b2&psq=define+numerical+intgration&u=a1aHR0cHM6Ly9tYXRod29ybGQud29sZnJhbS5jb20vTnVtZXJpY2FsSW50ZWdyYXRpb24uaHRtbA&ntb=1).[It is sometimes called quadrature](https://www.bing.com/ck/a?!&&p=f0f1381aed8e95fbJmltdHM9MTY5MDQxNjAwMCZpZ3VpZD0xZGU0OTAzNC02NTk3LTY4ODMtMGU1MS04MjljNjQ5NjY5YjImaW5zaWQ9NTY0Mg&ptn=3&hsh=3&fclid=1de49034-6597-6883-0e51-829c649669b2&psq=define+numerical+intgration&u=a1aHR0cHM6Ly9tYXRod29ybGQud29sZnJhbS5jb20vTnVtZXJpY2FsSW50ZWdyYXRpb24uaHRtbA&ntb=1).[Numerical integration comprises a broad family of algorithms for calculating the numerical value of a definite integral](https://www.bing.com/ck/a?!&&p=c533b14d3ff30f66JmltdHM9MTY5MDQxNjAwMCZpZ3VpZD0xZGU0OTAzNC02NTk3LTY4ODMtMGU1MS04MjljNjQ5NjY5YjImaW5zaWQ9NTY0NA&ptn=3&hsh=3&fclid=1de49034-6597-6883-0e51-829c649669b2&psq=define+numerical+intgration&u=a1aHR0cHM6Ly9lbi53aWtpcGVkaWEub3JnL3dpa2kvTnVtZXJpY2FsX2ludGVncmF0aW9u&ntb=1). [The term is also sometimes used to describe the numerical solution of differential equations](https://www.bing.com/ck/a?!&&p=169ae80e26565e46JmltdHM9MTY5MDQxNjAwMCZpZ3VpZD0xZGU0OTAzNC02NTk3LTY4ODMtMGU1MS04MjljNjQ5NjY5YjImaW5zaWQ9NTY0Ng&ptn=3&hsh=3&fclid=1de49034-6597-6883-0e51-829c649669b2&psq=define+numerical+intgration&u=a1aHR0cHM6Ly9lbi53aWtpcGVkaWEub3JnL3dpa2kvTnVtZXJpY2FsX2ludGVncmF0aW9u&ntb=1)

The term **numerical quadrature** (often abbreviated to[*quadrature*](https://en.wikipedia.org/wiki/Quadrature_(mathematics))) is more or less a synonym for *numerical integration*, especially as applied to one-dimensional integrals. Some authors refer to numerical integration over more than one dimension as **cubature**; others take *quadrature* to include higher-dimensional integration.

The basic problem in numerical integration is to compute an approximate solution to a definite integral





{\displaystyle \int _{a}^{b}f(x)\,dx}

to a given degree of accuracy. If *f*(*x*) is a smooth function integrated over a small number of dimensions, and the domain of integration is bounded, there are many methods for approximating the integral to the desired precision.

**Methods to solve Numerical integration:**

1.Trapezoidal Rule

2.Simpson’s Rule

3.Midpoint Rule

## **Reasons for numerical integration**

There are several reasons for carrying out numerical integration, as opposed to analytical integration by finding the [antiderivative](https://en.wikipedia.org/wiki/Antiderivative):

1. The integrand *f*(*x*) may be known only at certain points, such as obtained by [sampling](https://en.wikipedia.org/wiki/Sampling_(statistics)). Some embeded systems and other computer applications may need numerical integration for this reason.

2. A formula for the integrand may be known, but it may be difficult or impossible to find an antiderivative that is an [elementary function](https://en.wikipedia.org/wiki/Elementary_function). An example of such an integrand is *f*(*x*) = exp(−*x2*), the antiderivative of which (the [error function](https://en.wikipedia.org/wiki/Error_function), times a constant) cannot be written in [elementary form](https://en.wikipedia.org/wiki/Elementary_form).

3. It may be possible to find an antiderivative symbolically, but it may be easier to compute a numerical approximation than to compute the antiderivative. That may be the case if the antiderivative is given as an infinite series or product, or if its evaluation requires a special function that is not available.