Sinc function

"Sinc" redirects here. For the designation used in the United Kingdom for areas of wildlife interest, see Site of Importance for Nature Conservation.

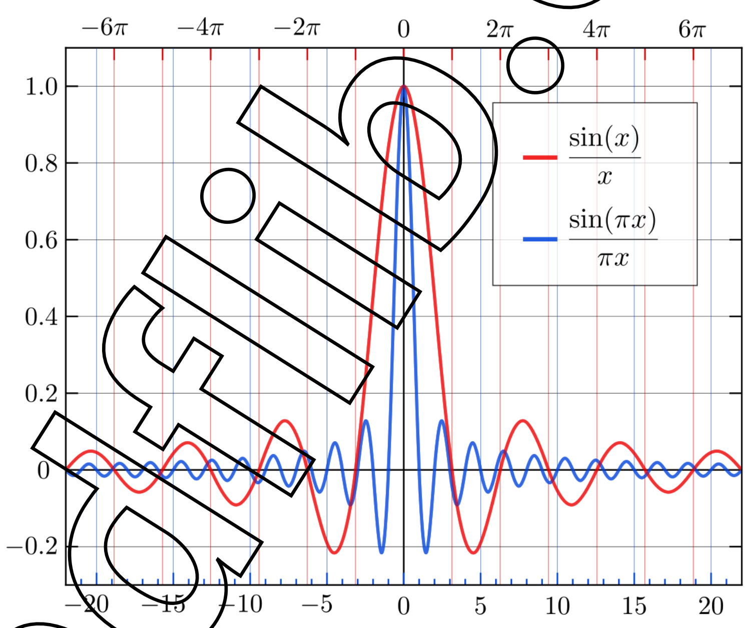
In mathematics, physics and engineering, the **cardinal sine function** or **sinc function**, denoted by sinc(x), has two slightly different definitions.

In mathematics, the historical **unnormalized sinc function** is defined by

$$\operatorname{sinc}(x) = \frac{\sin(x)}{x}.$$

In digital signal processing and information theory, the **normalized sinc function** is commonly defined by

$$\operatorname{sinc}(x) = \frac{\sin(\pi x)}{\pi x}.$$



The normalized sinc (blue) and unnormalized sinc function (red) shown on the same scale.

In either case, the value at $x = 0$ is defined to be the limiting value: $\operatorname{sinc}(0) = 1$.

The normalization causes the definite integral of the function over the real numbers to equal 1 (whereas the same integral of the unnormalized sinc function has a value of π). As a further useful property, all of the zeros of the normalized sinc function are integer values of x. The normalized sinc function is the Fourier transform of the rectangular function with no scaling. This function is fundamental in the concept of reconstructing the original continuous bandlimited signal from uniformly spaced samples of that signal.

The only difference between the two definitions is in the scaling of the independent variable (the x-axis) by a factor of π. In both cases, the value of the function at the removable singularity at zero is understood to be the limit value 1. The sinc function is analytic everywhere.

The term "sinc" /ˈsɪŋk/ is a contraction of the function's full Latin name, the *sinus cardinalis* (cardinal sine). It was introduced by Phillip M. Woodward in his 1952 paper "Information theory and inverse probability in telecommunication" in which he said the function "occurs so often in Fourier analysis and its applications that it does seem to merit some notation of its own" and his 1953 book "Probability and Information Theory, with Applications to Radar".

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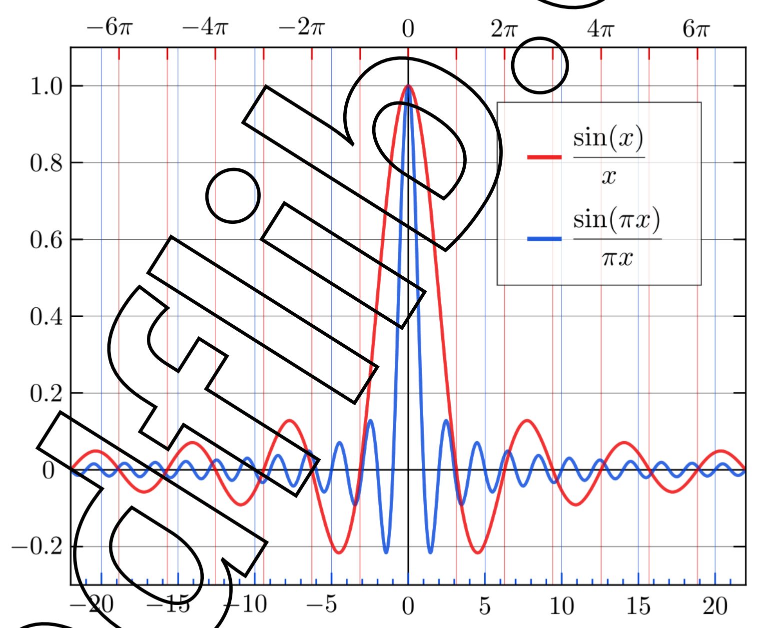

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