Gamma Function Encyclopedia Article

Gamma Function

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Gamma Function

A gamma function is the solution to a specific integral. It is useful for physical applications and has very little theoretical interest value for mathematicians. It is occasionally also related to the "error functions." Its simplest expression is at positive integer values, where it is the same as the **factorial** function. The factorial function is the product of the integer in question with all positive **integers** smaller than that integer. Many of its other forms are recursive as well.

The infinite or Euler limit defines the gamma function of z in terms of a limit as n approaches **infinity** of the quantity n^z (1*2*3*...*n)/[z(z+1)(z+2)...(z+n)]. This can be consolidated into a recursion relation, where the gamma function of z+1 is simply z times the gamma function of z. Since we know that the value of this function at **zero** and at one is one, this **definition** reduces to the factorial definition for integers. The integral definition is that the gamma function is the integral from zero to infinity of $e^{-t}t^{z-1}dt$. There are alternate forms of this definition, one of which is over the finite **interval** zero to one and integrates over $[\ln(1/t)]^{z-1}$ instead of over the quantity above. There is also a Weierstrass infinite product definition of the gamma function, which utilizes the Euler-Mascheroni constant, but it is hardly ever used in practical applications. These definitions allow for convenient calculations in widely varying situations.