Parameter

The term "parameter" is used in a number of ways in mathematics. In general, mathematical functions may have a number of arguments. Arguments that are typically varied when plotting, performing mathematical operations, etc., are termed "variables," while those that are not explicitly varied in situations of interest are termed "parameters." For example, in the standard equation of an ellipse

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1, \tag{1}$$

x and y are generally considered variables and a and b are considered parameters. The decision on which arguments to consider variables and which to consider parameters may be historical or may be based on the application under consideration. However, the nature of a mathematical function may change depending on which choice is made. For example, the above equation is quadratic in x and y, but if a and b are instead considered as variables, the resulting equation

$$b^2\,x^2+a^2\,y^2=a^2\,b^2 \tag{2}$$

is quartic in a and b.

In the theory of elliptic integrals, "the" parameter is denoted m and is defined to be

$$m\equiv k^2, \tag{3}$$

where k is the elliptic modulus. An elliptic integral is written $I\,(\phi\,|\,m)$ when the parameter is used, whereas it is usually written $I\,(\phi,\,k)$ where the elliptic modulus is used. The elliptic modulus tends to be more commonly used than the parameter (Abramowitz and Stegun 1972, p. 337; Whittaker and Watson 1990, p. 479), although *most* of Abramowitz and Stegun (1972, pp. 587-607), i.e., the entire chapter on elliptic integrals, and the Wolfram Language's EllipticE, EllipticF, EllipticK, EllipticPi, etc., use the parameter.

The complementary parameter is defined by

$$m'\equiv 1-m, \tag{4}$$

where m is the parameter.

Let q be the nome, k the elliptic modulus, where $m\equiv k^2$. Then

$$q\,(m)=e^{-\pi\,K'\,(m)/K\,(m)} \tag{5}$$

inverse of $q(m)$ is given by

$$m(q) = \frac{\vartheta_2^4(q)}{\vartheta_3^4(q)}, \tag{6}$$

where $\vartheta_i(q)$ is a Jacobi theta function.

SEE ALSO

Elliptic Characteristic, Elliptic Integral, Elliptic Integral of the First Kind, Elliptic Modulus, Half-Period Ratio, Jacobi Amplitude, Jacobi Theta Functions, Modular Angle, Nome, Parametric Equations, Parametric Curve, Parametric Surface, Quadric Parameter, Variable

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WolframAlpha modular angle

More things to try:

= modular angle

= elliptic integrals

= focal parameter of an ellipse with semiaxes 4,3

REFERENCES

Abramowitz, M. and Stegun, I. A. (Eds.). *Handbook of Mathematical Functions with Formulas, Graphs, and Mathematical Tables, 9th printing.* New York: Dover, 1972.

Whittaker, E. T. and Watson, G. N. *A Course in Modern Analysis, 4th ed.* Cambridge, England: Cambridge University Press, 1990.

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Weisstein, Eric W. "Parameter." From *MathWorld*--A Wolfram Web Resource. https://mathworld.wolfram.com/Parameter.html

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