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[Main page](#)

[Contents](#)

[Featured content](#)

[Current events](#)

[Random article](#)

[Donate to Wikipedia](#)

[Wikipedia store](#)

Interaction

[Help](#)

[About Wikipedia](#)

[Community portal](#)

[Recent changes](#)

[Contact page](#)

Tools

[What links here](#)

[Related changes](#)

[Upload file](#)

[Special pages](#)

[Permanent link](#)

[Page information](#)

[Wikidata item](#)

[Cite this page](#)

Print/export

[Create a book](#)

[Download as PDF](#)

[Printable version](#)

Languages

[Nederlands](#)

[Polski](#)

[Edit links](#)

[Create account](#) [Log in](#)

Article [Talk](#)

[Read](#) [Edit](#) [View history](#)

Search

Ridders' method

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(Redirected from [Ridder's method](#))

In [numerical analysis](#), **Ridders' method** is a [root-finding algorithm](#) based on the [false position method](#) and the use of an [exponential function](#) to successively approximate a [root](#) of a [function](#) *f*. The method is due to C. Ridders.^{[1][2]}

Ridders' method is simpler than [Muller's method](#) or [Brent's method](#) but with similar performance.^[3] The formula below converges quadratically when the function is well-behaved, which implies that the number of additional significant digits found at each step approximately doubles; but the function has to be evaluated twice for each step, so the overall [order of convergence](#) of the method is $\sqrt{2}$. If the function is not well-behaved, the root remains bracketed and the length of the bracketing interval at least halves on each iteration, so convergence is guaranteed. The algorithm also makes use of square roots, which are slower than basic floating point operations.

Method [\[edit\]](#)

Press et al. (2007) describe the method as follows. Given two values of the independent variable, *x*₁ and *x*₂, which are on two different sides of the root being sought, the method begins by evaluating the function at the midpoint *x*₃ between the two points. One then finds the unique exponential function of the form *e*^{*ax*} which, when multiplied by *f*, transforms the function at the three points into a straight line. The false position method is then applied to the transformed values, leading to a new value *x*₄, between *x*₁ and *x*₂, which can be used as one of the two bracketing values in the next step of the iteration. The other bracketing value is taken to be *x*₃ if *f*(*x*₃) has the opposite sign to *f*(*x*₄), or otherwise whichever of *x*₁ and *x*₂ has *f*(*x*) of opposite sign to *f*(*x*₄).

The method can be summarized by the formula (equation 9.2.4 from Press et al.)

$$x_4 = x_3 + (x_3 - x_1) \frac{\operatorname{sign}[f(x_1) - f(x_2)]f(x_3)}{\sqrt{f(x_3)^2 - f(x_1)f(x_2)}}.$$

References [\[edit\]](#)

- ↑ Ridders, C. (1979). "A new algorithm for computing a single root of a real continuous function". *IEEE Transactions on Circuits and Systems* **26**: 979–980. doi:10.1109/TCS.1979.1084580.
- ↑ Kiusalaas, Jaan (2010). *Numerical Methods in Engineering with Python* (2nd ed.). Cambridge University Press. pp. 146–150. ISBN 978-0-521-19132-6.
- ↑ Press, WH; Teukolsky, SA; Vetterling, WT; Flannery, BP (2007). "Section 9.2.1. Ridders' Method" . *Numerical Recipes: The Art of Scientific Computing* (3rd ed.). New York: Cambridge University Press. ISBN 978-0-521-88068-8.

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