E1-21: Newton's root finding algorithm in the absence of the derivative

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Newton's method is the most widely used numerical scheme to find roots of a nonlinear equation. The major drawback of this scheme is the necessity to differentiate the function (which sometimes could be very cumbersome) and to feed it into the algorithm.

In this paper, it is shown that the derivative can be replaced by a finite difference approximation yet retaining the second order convergence of the Newton iterates.

The new algorithm was tested for several functions. It was seen that the iterations converge to the root at an equal or faster rate than Newton's method.

The new algorithm also gave options to select forward or backward difference formula and the step size to accelerate the rate of convergence.