THE UNIVERSITY OF AKRON
Theoretical and Applied Mathematics

Solving Equations Numerically by Newton's Method

D. P. Story

Last Revision Date: April 16, 2002 Version 1.0

1. Instructions

- Use `+`, `-`, `/` for addition, subtraction and division, respectively. Thus $3 + \frac{x}{2}$ is typed as `3 + x/2`. Use parentheses to delimit the scope of your operations, type `x/(2+x)` to mean $\frac{x}{2+x}$. Without the parentheses, the computer would interpret `x/2 + x` as $\frac{x}{2} + x$.

- Multiplication can be denoted either by `*` or by juxtaposition: Type `4*x` or `4x` for $4x$.

- Use `^` to indicate powers: Type `4x^3` for $4x^3$; `12x^-6` for $12x^{-6}$. For more complex exponents, use parentheses to characterize the exponent, type `4^(x+1)` to mean 4^{x+1}.

- Use parentheses to delimit the argument of a function; i.e., type `sin(x)` rather than `sin x`.

- Use parentheses to define the *scope* of an operation: For example, type `4x(x^2+1)^3` for $4x(x^2+1)^3$; `4^(2x+1)` for 4^{2x+1}.

- To raise a function to a power, such as $\sin^2(x)$, type either `(sin(x))^2` *or* `sin^2(x)`.

- You can also use brackets `[ ]` or braces `{ }` to delimit a mathematics expression.
- Functions you may use:
  - Trig: `sin`, `cos`, `tan`, `cot`, `sec`, `csc`;
  - Inverse Trig: `asin`, `acos`, `atan`;
  - Log: `ln` (natural log), or use `log`; e.g. `ln(x)` or `log(x)`, both of these refer to the natural logarithm.
  - Exponential: The natural exponential function, e^x, can be entered as `exp(x)` or as `e^x`.
  - The absolute function, `abs(·)` can also be written in the usual way `|·|`; thus, you can type either `abs(x)` or `|x|`.
  - Misc.: `sqrt`, usage `sqrt(x)` for $\sqrt{x}$ (or, use exponential notation: `x^(1/2)`).
- Spaces in answers are ignored, e.g., `4 x` is the same as `4x`; use spacing, however, to improve readability.

When you enter your response, some attempt will be made to determine whether the response is a valid one. For example, if you say `san(x)`, the function '`san`' will not be recognized as a valid mathematical function; an error message is generated, and the user is not penalized for a possible typing error. The JavaScript routines will also check for unbalanced parentheses; thus, `((x^4+1) + sin(x)^2` will be flagged as a syntax error.

Newton's Method: Instructions. We want to solve the equation $f(x) = 0$ by specifying an initial value of x_0. As you know, Newton's Method is based on the following formula:

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)} \quad n = 0, 1, 2, 3, \ldots$$

On the next page, enter the function $f(x)$, its derivative $f'(x)$ and an initial guess, x_0, then click on the "Solve!" button.

▶ ▶ ▶ Turn to next page, please. ▶ ▶ ▶ ▶

Solving Equations Numerically by Newton's Method

Enter: $f(x) =$

Enter: $f'(x) =$

Initial Guess: $x_0 =$ Solve! Clear

$n =$

$x \approx$