

## Higher Order Derivatives

### Part 1: Higher Order Derivatives

**Example 1:** Find the second derivative of  $f(x) = 2x^{10} - 18x^5 - 12x^3 + 4$

**Example 2:** Find the second derivative of  $y = 3x^2 - \sqrt[3]{x^2 + 1}$

**Example 3:** Find the second derivative of  $z = \sqrt{y^3 + y^2 - 2}$

**Example 4:** Find  $f''(x)$  if  $f(x) = x^5 - x^{1/2}$

**Example 5:** Find  $\frac{d^2 y}{dx^2}$  if  $y = \sqrt{x+1}$

**Example 6:** Find  $g^{(4)}(x)$  if  $g(x) = x^6 - 15x^3$

**Example 7:** Find  $h^{(3)}(x)$  if  $h(x) = \frac{x^2}{x^2+1}$  (this is a pain)

**Part 2: nDeriv and *Mathematica***

**Example 8:** Use the numerical derivative to find  $f''(x)$  if  $f(x) = \frac{1}{\sqrt{x^2+7}}$

Calculator notes: To find the derivative of  $y_1$ , you need to use:

$$y_2 = \text{nDeriv}(y_1(x), x, x)$$

and to find the second derivative:

$$y_3 = \text{nDeriv}(\text{nDeriv}(y_1, x, x), x, x)$$

To find the `nDeriv` command, choose `MATH` → `8` and to find  $y_2$  (or  $y_3$ ), choose `VARS` → `Y-VARS` → `Function` → `2`

**Example 9:** There is a *Mathematica* example on the webpage.