Numerical Differentiation of Continuous Functions Second Derivative: Example

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Example of central divided difference to find $f''(x)$

For $f(x) = 7x^4$ and a step size of $h = 0.64$, use the central divided difference formula to find

a) the approximate value of $f''(2)$

b) the true value of $f''(2)$

c) the true error for part (a)

$$f''(x) \simeq \frac{f(x+h) - 2f(x) + f(x-h)}{h^2}$$

$$x = 2, \; h = 0.64$$

$$f''(2) = \frac{f(2+0.64) - 2f(2) + f(2-0.64)}{0.64^2}$$

$$= \frac{f(2.64) - 2f(2) + f(1.36)}{0.64^2}$$

$$= \frac{7(2.64)^4 - 2*7(2)^4 + 7(1.36)^4}{0.64^2}$$

$$= 341.7344$$

b) Exact value of $f''(2)$

$$f(x) = 7x^4$$

$$f'(x) = 7 * 4x^{4-1} = 28x^3$$

$$f''(x) = 28(3)x^{3-1}$$

$$= 84x^2$$

$$f''(2) = 84(2)^2 = 336$$

c) E_t = Exact value − Approx. value

$$= 336 - 341.7344$$

$$= -5.7344$$

END

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