

# Engineering Analysis

## Homework 5

May 8, 2017

1. A certain calculation requires an approximation formula for  $f'(x) + f''(x)$ . How well does the expression

$$\left(\frac{2+h}{2h^2}\right)f(x+h) - \left(\frac{2}{h^2}\right)f(x) + \left(\frac{2-h}{2h^2}\right)f(x-h)$$

serve? Derive this approximation and its error term.

2. Compute

$$\int_0^1 (1+x^2)^{-1} dx$$

by the basic Simpson's rule, using the three partition points  $x = 0, 0.5$ , and  $1$ . Compare with the true solution.

3. Derive the Gaussian quadrature rule of the form

$$\int_{-1}^1 f(x)x^2 dx \approx af(-\alpha) + bf(0) + cf(\alpha)$$

that is exact for all polynomials of as high a degree as possible; that is, determine  $\alpha$ ,  $a$ ,  $b$ , and  $c$ .

4. Using the conjugate gradient method, find the minimum of the function  $x^2 + 2y^2 + 3z^2 + 4w^2 + (x + y + z + w)^4$ . Start at  $(1, -1, 1, 1)$ .