Composite Trapezoidal Rule: Example

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The following integral is given:

$$\int_{0.1}^{1.3} 5xe^{-2x}dx$$

a) Use the composite trapezoidal rule to estimate the value of this integral. Use three segments.

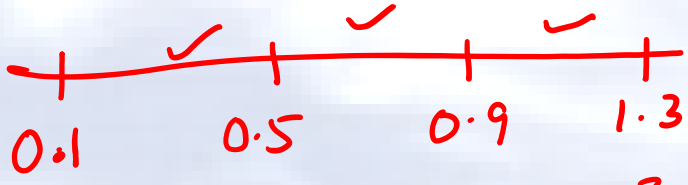
b) Find the true error E_t for part (a).

c) Find the absolute relative true error $|\varepsilon_t|$ for part (a).

$$\int_a^b f(x)\,dx \simeq \frac{b-a}{2n}\left[f(a) + 2\sum_{i=1}^{n-1} f(a+ih) + f(b)\right]$$

$$h = \frac{b-a}{n}.$$

$$h = \frac{b-c}{n} = \frac{1.3-0.1}{3} = 0.4$$



$$\int_{0.1}^{1.3} f(x)\,dx \simeq \frac{1.3-0.1}{2(3)}\left[f(0.1) + 2\sum_{i=1}^{3-1} f(0.1+i\,0.4) + f(1.3)\right]$$

$$= \frac{1.2}{6}\left[f(0.1) + 2\sum_{i=1}^{2} f(0.1+i\,0.4) + f(1.3)\right]$$

$$= \frac{1.2}{6}\left[f(0.1) + 2\sum_{} f(0.1+(1)0.4) + 2f(0.1+(2)0.4) + f(1.3)\right]$$

$$= 0.2\left[f(0.1) + 2f(0.5) + 2f(0.9) + f(1.3)\right]$$

$$= 0.2\left[5(0.1)e^{-2(0.1)} + 2(5)(0.5)e^{-2(0.5)} + 2(5)(0.9)e^{-2(0.9)} + 5(1.3)e^{-2(1.3)}\right]$$

$$= 0.84385$$

b) $\int_{0.1}^{1.3} 5xe^{-2x}\,dx = 0.89387$

$$E_t = 0.89387 - 0.84385$$

$$= 0.05002$$

c) $$|\epsilon_t| = \left|\frac{0.89387 - 0.84385}{0.89387}\right| * 100$$

$$= 5.5959\%$$

END

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