# Integrate Functions Given at Discrete Points: Trapezoidal Rule with Unequal Segments

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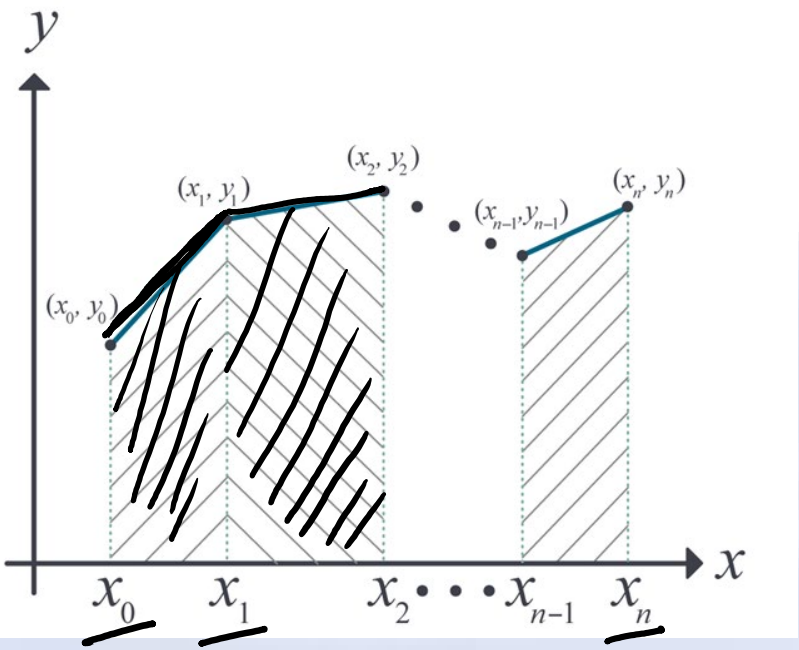


$$\int_{x_0}^{x_n} f(x)\,dx$$

$$= \int_{x_0}^{x_1} f(x)\,dx + \cdots + \int_{x_{n-1}}^{x_n} f(x)\,dx$$

$$\approx (x_1 - x_0)\left(\frac{f(x_0)+f(x_1)}{2}\right) + \cdots + (x_n - x_{n-1})\left(\frac{f(x_{n-1})+f(x_n)}{2}\right)$$

$$= \sum_{i=1}^{n} (x_i - x_{i-1})\left(\frac{f(x_{i-1}) + f(x_i)}{2}\right)$$

The upward velocity of a rocket is given as a function of time in the table. Using the trapezoidal rule with unequal segments, determine the displacement $s$ of the rocket from $t = 11$ to $t = 16$ seconds.

| $t(s)$ | $v(t)(m/s)$ |
|---|---|
| 0 | 0 |
| 10 | 227.04 ✓ |
| 15 | 362.78 ✓ |
| 20 | 517.35 ✓ |
| 22.5 | 602.97 |
| 30 | 901.67 |

$$s = \int_{11}^{16} v(t)\,dt$$

$$= \int_{11}^{15} v(t)\,dt + \int_{15}^{16} v(t)\,dt$$

$$\approx (15-11)\left(\frac{v(15)+v(11)}{2}\right) + (16-15)\left(\frac{v(15)+v(16)}{2}\right)$$

$$v(t) = v_0 + \frac{v_1 - v_0}{t_1 - t_0}(t - t_0), \quad t_0 \le t \le t_1$$

$$V(t) = v(10) + \frac{v(15) - v(10)}{15 - 10}(t - 10), \quad 10 \le t \le 15$$

$$V(11) = 227.04 + \frac{362.78 - 227.04}{15 - 10}(11 - 10)$$

$$= 254.19 \text{ m/s}$$

$$V(t) = V(15) + \frac{V(20) - V(15)}{20 - 15}(t - 15)$$

$$15 \le t \le 20$$

$$V(16) = 362.78 + \frac{517.35 - 362.78}{20 - 15}(16 - 15)$$

$$= 393.69 \text{ m/s}$$

$$\int_{11}^{16} v(t)\,dt \approx \frac{15-11}{2}\left(v(11)+v(15)\right) + \frac{16-15}{2}\left(v(15)+v(16)\right)$$

$$= \frac{15-11}{2}\left(254.19+362.78\right) + \frac{16-15}{2}\left(362.78+393.69\right)$$

$$= 1612.2 \text{ m}$$

END

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