

6.1. Estimating Areas Under Curves

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Rectangular Approximation Method (RAM)

LRAM Left Rectangular Approximation Method

MRAM \equiv Midpoint — " — — " — — " —

RRAM \equiv Right — " — — " — — " —

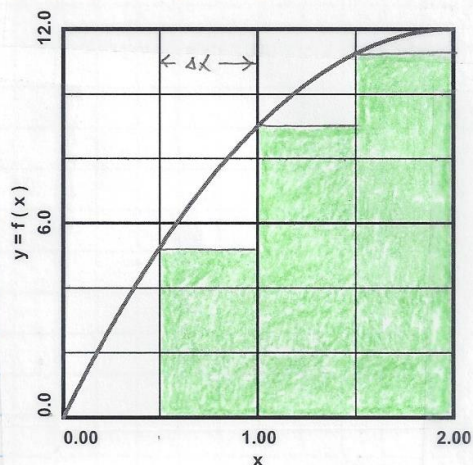
Example. Estimate the area under $f(x) = 12x - 3x^2$ on $x \in [0, 2]$ using four equal subdivisions with

(a) LRAM (b) MRAM (c) RRAM.

Draw the rectangle used on the graph of $y = f(x)$.

Solution:

(a)



$\Delta x = 0.5 \equiv$ subdivision size

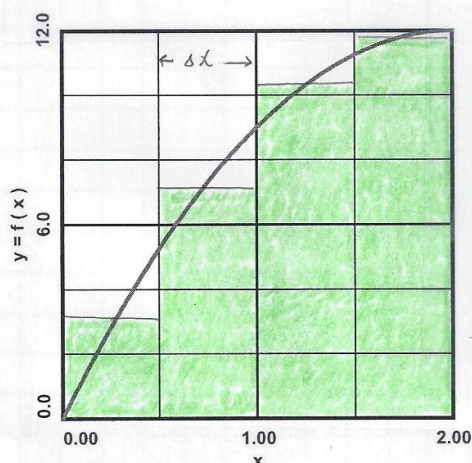
$$\text{area} \approx f(0)\Delta x + f(0.5)\Delta x + f(1)\Delta x + f(1.5)\Delta x$$

$$= [f(0) + f(0.5) + f(1) + f(1.5)]\Delta x$$

$$= 12.75 \leftarrow$$

Note that the area is underestimated.

(b)



area \approx

$$\approx f(0.25)\Delta x + f(0.75)\Delta x + f(1.25)\Delta x + f(1.75)\Delta x$$

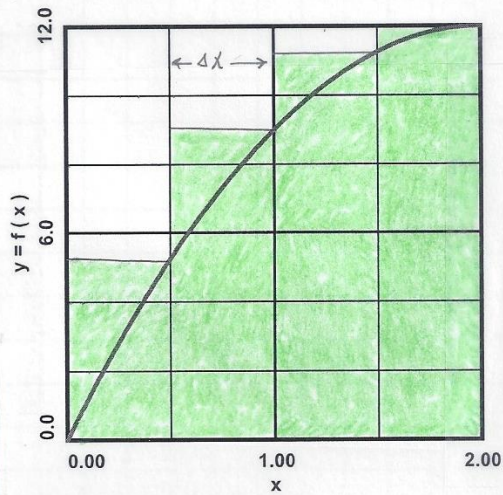
$$= [f(0.25) + f(0.75) + f(1.25) + f(1.75)]\Delta x =$$

$$= 16.125 \leftarrow$$

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(c)



area \approx

$$f(0.5)\Delta x + f(1)\Delta x + f(1.5)\Delta x + f(2)\Delta x \\ = [f(0.5) + f(1) + f(1.5) + f(2)]\Delta x$$

$$= 18.75 \quad \blacktriangleleft$$

Note that the area is
overestimated