# Challenge #7

Suppose Ada wants to cut 15 butcher-paper banners, each 5 meters in length. She measures the first, cuts it, then uses that one to cut the next, uses the second to cut the third, and so on.

What are the possible lengths of the 25th banner if each time she cuts, there is a maximum error of ± 1cm?

What are the possible lengths of the 25th banner if each time she cuts there is a maximum error of ±0.1%?

Challenge #7 Solution

Suppose Ada wants to cut 15 butcher-paper banners, each 5 meters in length. She measures the first, cuts it, then uses that one to cut the next, uses the second to cut the third, and so on.

① What are the possible lengths of the 25th banner if each time she cuts, there is a maximum error of ± 1cm? $1\text{ cm} = 0.01\text{m}$

② What are the possible lengths of the 25th banner if each time she cuts there is a maximum error of ±0.1%? $0.1\% = 0.001$

① $\ell_0 = 5\text{m}$

$5 - 0.01\text{ m} \le \ell_1 \le 5 + 0.01\text{ m}$

$5 - 2(0.01) \le \ell_2 \le 5 + 0.01 + 0.01$

$= 5 + 2(0.01)$

$5 - 3(0.01) \le \ell_3 \le 5 + 3(0.01)$

$\vdots$

$5 - 25(0.01) \le \ell_{25} \le 5 + 25(0.01)$

$\Updownarrow$

$4.75\text{ m} \le \ell_{25} \le 5.25\text{ m}$

② $\ell_0 = 5\text{m}$

$5(1-0.001) \le \ell_1 \le 5(1+0.001)$

$= 5(0.999) \qquad = 5(1.001)$

$5(0.999)^2 \le \ell_2 \le 5(1.001)^2$

$5(0.999)^3 \le \ell_3 \le 5(1.001)^3$

$\vdots \qquad\qquad \vdots$

$5(0.999)^{25} \le \ell_{25} \le 5(1.001)^{25}$

$\Updownarrow$

$4.876\text{ m} \le \ell_{25} \le 5.127\text{ m}$