Data Visualization
W9-1

Logarithm

Where is 1,000?

Where is 1,000?

(if linear scale)

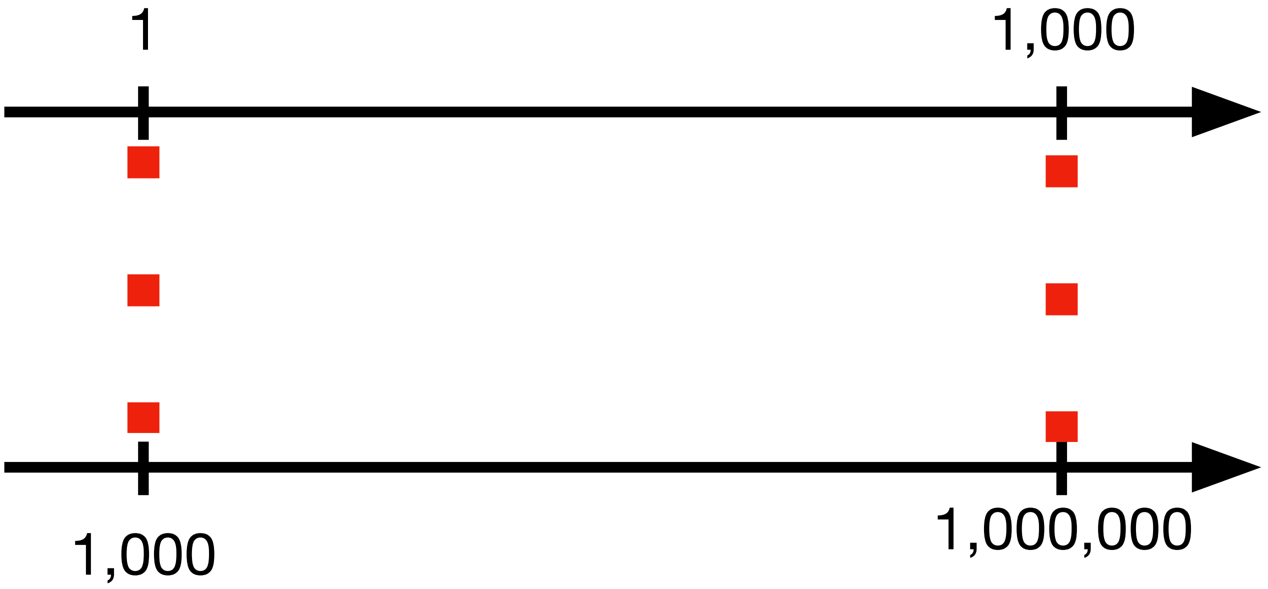
Where is 1,000?

How about in **log scale**?

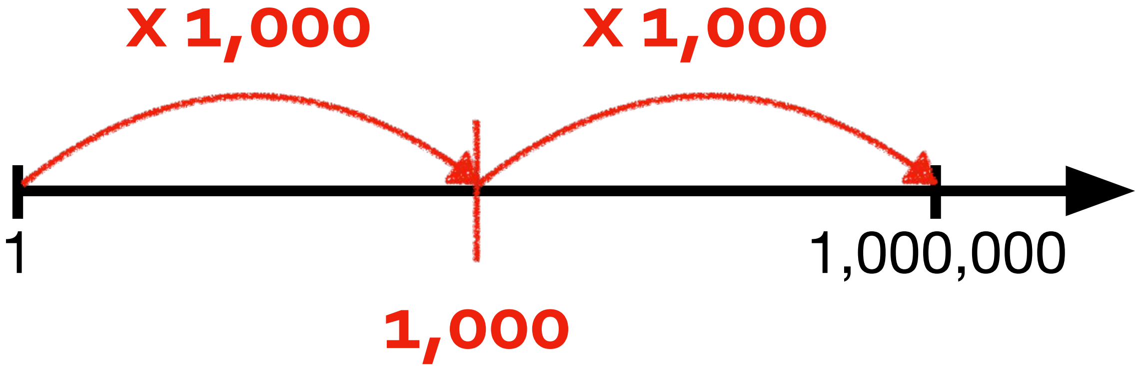
1,000 / 1 = **1,000**

1,000,000 / 1,000 = **1,000**

In log-scale,

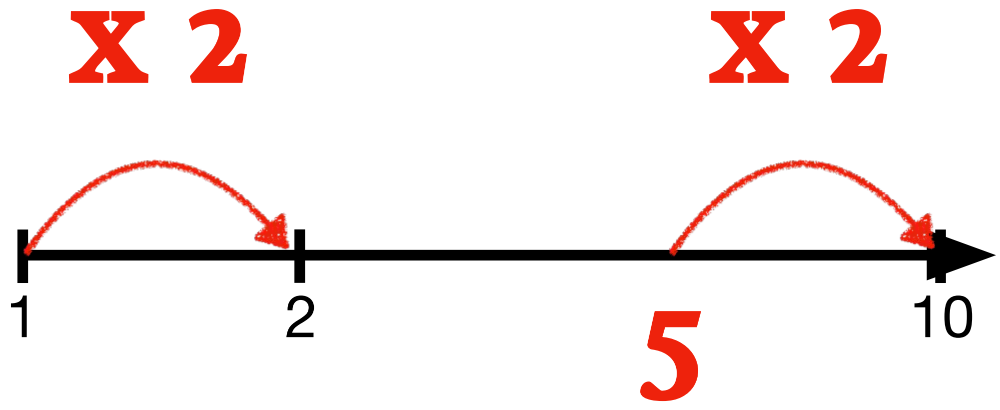


Where is 1,000?

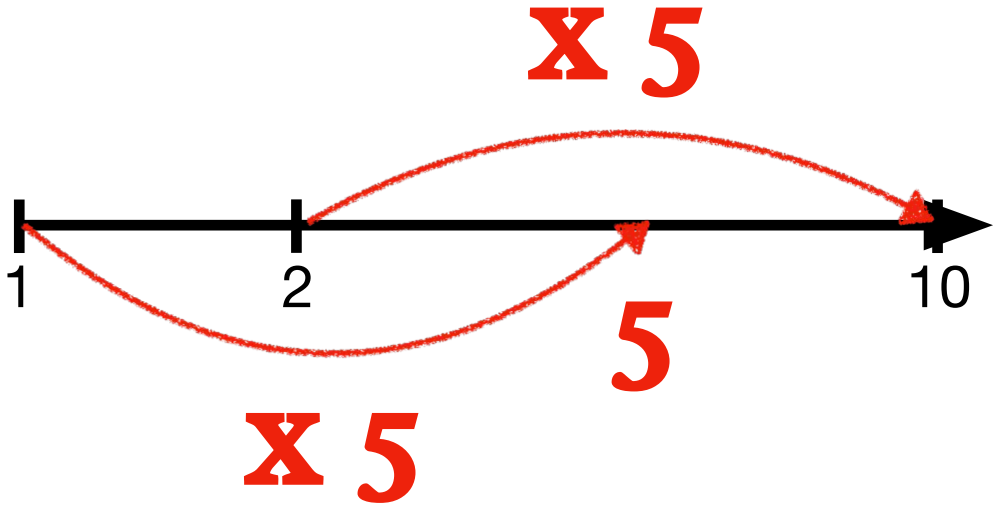


Where is 5?

Where is 5?

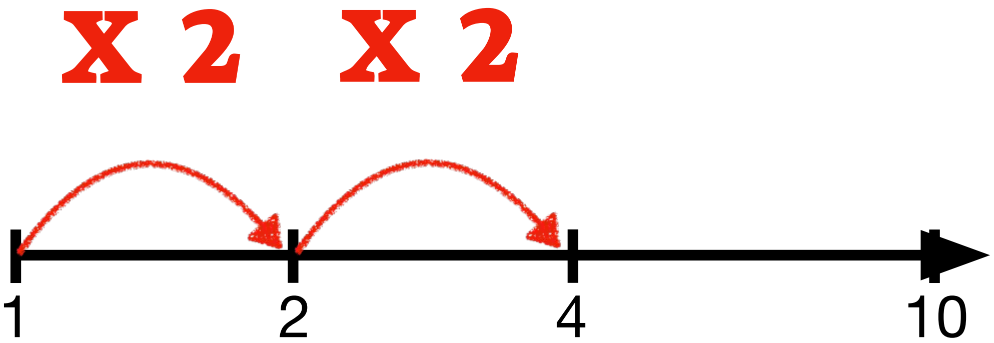


Where is 5?

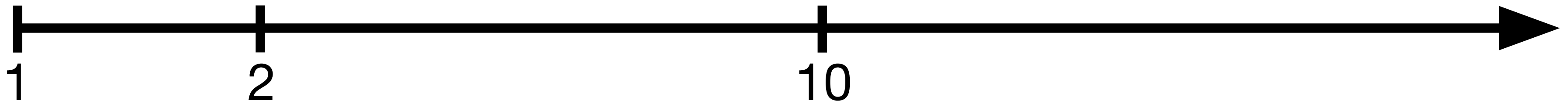


Distance ~ **multiplication**

Where is 4?



Where is 25?




1
3
?
?

Why do we care about log-scale?

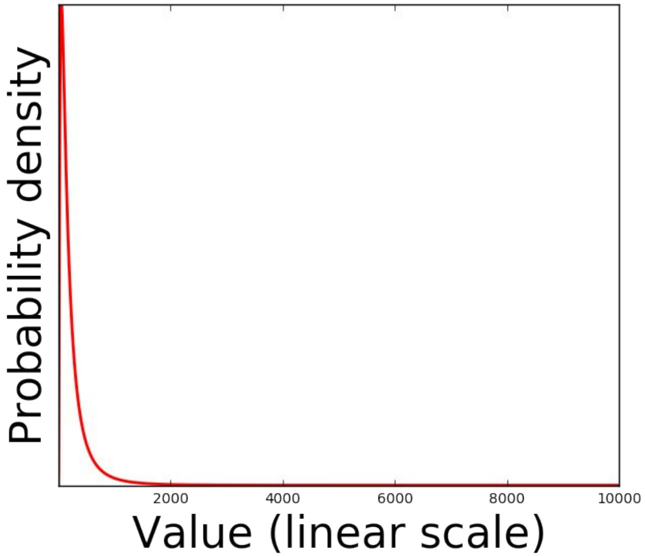
- We need to use log-scale for certain data types (e.g., ratios).
- There are lots of dataset where the quantity spans many orders of magnitude and logscale provides a more ‘natural’ scale.

Multiplicative process in linear scale
= Additive process in log-scale

Log-normal distribution

$$\frac{1}{x\sigma\sqrt{2\pi}}\exp\left(-\frac{(\boxed{\ln x} - \mu)^2}{2\sigma^2}\right)$$

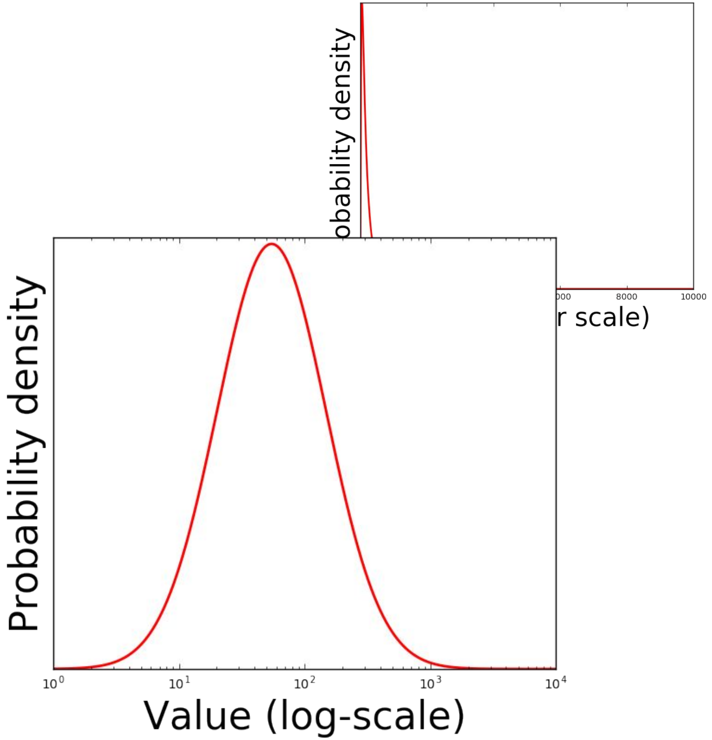
c.f. $$\frac{1}{\sigma\sqrt{2\pi}}\exp\left(-\frac{(\boxed{x} - \mu)^2}{2\sigma^2}\right)$$



Log-normal distribution

$$\frac{1}{x\sigma\sqrt{2\pi}}\ \exp\left(-\frac{(\boxed{\ln x}-\mu)^2}{2\sigma^2}\right)$$

c.f. $$\frac{1}{\sigma\sqrt{2\pi}}\exp\left(-\frac{(\boxed{x}-\mu)^2}{2\sigma^2}\right)$$



'Power-law' distributions

$$f(x) = cx^{-\alpha}$$

$$\begin{aligned}\log f(x) &= \log\left(cx^{-\alpha}\right)\\ &= \log c - \alpha \log x\end{aligned}$$