A **logarithmic scale** (or **log scale**) is a way of displaying numerical data over a very wide range of values in a compact way—typically the largest numbers in the data are hundreds or even thousands of times larger than the smallest numbers. Such a scale is nonlinear: the numbers 10 and 20, and 90 and 100, are not the same distance apart on a log scale. Rather, the numbers 10 and 100, and 100 and 1000 are equally spaced. Thus moving a set distance along the scale means the number has been *multiplied* by 10 (or some other fixed factor). Often exponential growth curves are displayed on a log scale, otherwise they would increase too quickly to fit within a small graph. Another way to think about it is that the *number of digits* of the data grows at a constant rate. The numbers 10, 100, 1000, and 10000 are equally spaced on a log scale, but the number of digits is going up by 1 each time: 2, 3, 4, and 5 digits. In this way, adding two digits *multiplies* the quantity measured on the log scale by a factor of 100.

The following are examples of commonly used logarithmic scales, where a larger quantity results in a higher value:

- Richter magnitude scale and moment magnitude scale (MMS) for strength of earthquakes and movement in the Earth
- Sound level, with units bel and decibel
- Neper for amplitude, field and power quantities
- Frequency level, with units cent, minor second, major second, and octave for the relative pitch of notes in music
- Logit for odds in statistics
- Palermo Technical Impact Hazard Scale
- Logarithmic timeline
- Counting f-stops for ratios of photographic exposure
- The rule of 'nines' used for rating low probabilities
- Entropy in thermodynamics
- Information in information theory
- Particle size distribution curves of soil

The following are examples of commonly used logarithmic scales, where a larger quantity results in a lower (or negative) value:

- pH for acidity
- Stellar magnitude scale for brightness of stars
- Krumbein scale for particle size in geology
- Absorbance of light by transparent samples

Graphic representation

Log–log plots

Semi-logarithmic plots

A **logarithmic scale** is a nonlinear scale often used when analyzing a large range of quantities. Instead of increasing in equal increments, each interval is increased by a **factor of the base of the logarithm**. Typically, a **base ten** and **base *e*** scale are used.

A basic equation for a base ten logarithmic plot is

which can be rearranged to

What this means is that for every *one* value of y, the value of x will increase by a factor of *ten*, and vice versa. Using a logarithmic scale can be useful when creating graphs to compress the scale and make the data easier to comprehend. When plotted on a semi-log plot, seen in Figure 1, the exponential 10^x function appears linear, when it would normally diverge quickly on a linear graph.

This is useful for many applications, some of which will be seen below.

Examples

- **The pH scale** - A commonly used logarithmic scale is the pH scale, used when analyzing acids and bases. What the pH scale is doing is measuring the concentration of hydrogen ions (H^+) in a substance, and is given by the equation

  By this, for every *one* decrease (due to the negative sign) in the pH, the acidity increases by a factor of *ten* (A pH of 3 is 10 times more acidic than a pH of 4, and is 100 times more acidic than a pH of 5).

- **Sound** - The way sound is picked up by one's ears is of logarithmic nature. The **decibel** (dB) system of sound intensity is a measure of how loud a sound is to one's ears. It is represented by the equation where is the threshold of hearing and is the intensity of the sound.[3] A conversation is roughly 1 million times more intense than the threshold value. The corresponding decibel value is then

Now, if two people are talking at once, that only raises the dB to 63 dB. So a *doubling* of sound intensity just leads to *+3dB*. The threshold of pain is about 120 dB and that causes hearing loss.

- **The Richter Scale** - Earthquakes are measured on the Richter Scale, which is a base 10 logarithmic scale. This scale measures the magnitude of an earthquake, which is the amount of energy released by it. For every single increase on this scale, the magnitude is increased by a factor of 10.

natural scale

The ratio between the linear dimensions of a chart or drawing and the actual dimensions represented, expressed as a proportion; for example, 1 inch on a chart of natural scale 1:2,000,000 represents 2,000,000 inches on the earth. Also known as representative fraction.

In math, the term scale is used to represent the relationship between a measurement on a model and the corresponding measurement on the actual object. Without scales, maps and blueprints would be pretty useless.

REFER ASISH SARKAR