Rounding and spacing algorithms

Daniel Farrell

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1 Axis Definitions

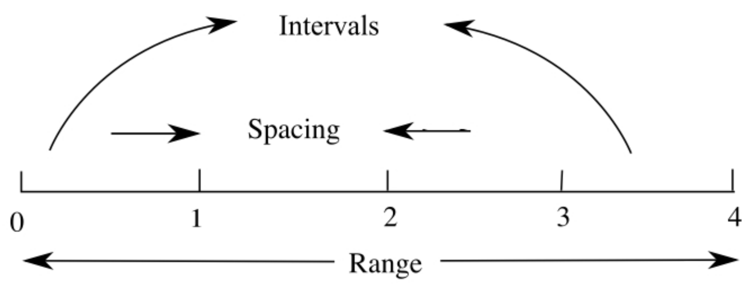

Figure 1: Example axis with the three parameters: spacing, intervals and range; with values of 1, 5 and 4 respectively.

The range of an axis has the obvious definition,

$$r = b - a \tag{1}$$

where a and b are the lowest and highest point on the axis respectively. These numbers and can have any real value. The spacing can be calculated from,

$$s = \frac{r}{i-1} \tag{2}$$

The spacing, s is a function of the range, r and the total number of intervals, i. Therefore the number of intervals can be defined as,

$$i = \frac{r}{s} + 1 \tag{3}$$

It is undesirable to use this equation directly in the calculation of axis spacings because, for the spacing to be at aesthetically pleasing value r must be exactly divisible by s. In general this is not always the case, for example, if r is calculated from experimental data this condition will almost certainly not hold. Therefore the range and/or spacing must be rounded to near values, denoted as r_r and s_r.

2 Rounding

The standard library functions `floor()`, `ceil()` and `round()` can be used to round the values, to the nearest interger. The first two, when one wants to round in a particular direction and the latter when one want to round to the nearest integer. We need a more general rounding scheme, as we would like to round to the nearest multiple of some particular value.

In the case of rounding a and b this becomes,

$$a_r = \mathtt{floor}(\frac{a}{s_r}) \times s_r \tag{4}$$

$$b_r = \mathtt{ceil}(\frac{b}{s_r}) \times s_r. \tag{5}$$

where all symbol have there previously defined meaning and the subscript r defines a 'rounded' value.

Moreover, a number can be rounded up or down to the nearest multiple of other number using the methods shown above. The solution finding a nice axis spacing is based on these rounding techniques, along with contrains on the range of the intervals.

3 Algorithm to find s_r and i pairs

Let i be any integer in the range $4, 5 \ldots 10, 11$ and let s_r be proportional to the rounded value guess values contained in the vector, $\mu = [0.1, 0.2, 0.5, 1, 2, 5]$. To get μ to span the correct decade it is scaled according to the power of the axis range via equation 7. Here two decades are traversed to make sure all possible solutions are found. Using equation 3 and rounding the term that contains non-rounded values, we arrive at an expression that will calculate i as a function of r,

$$i = \mathtt{round}(\frac{r}{\mu \times 10^n}) + 1; \tag{6}$$

where,

$$n = \mathtt{floor}(\mathtt{log10}(r)) \tag{7}$$

The solutions are, $s_r = \mu_j \times 10^n$ where the subscript j denotes index for μ that produced i values in the specified range. From knowledge of the s_r and i pair all other rounded quantities can be calculated and the axis can have a more human representation.