

Quantitative similarity measures

In addition to Bray-Curtis S_{17} , and its zero-adjusted modification, PRIMER 7 also calculates:

$S_{15} = 100 \frac{1}{p} \sum_i \left[1 - \frac{1}{R_i} |y_{i1} - y_{i2}| \right]$
 \text{, where } $R_i = \max_j |y_{ij}| - \min_j |y_{ij}|$ \text{ } Gower's coefficient,

where standardisation is by the range R_i of values for the i th species over all samples (effectively by the maximum since the minimum will usually be zero), and thus shares with χ^2 distance the (generally undesirable) property that adding further samples can change existing similarities;

$S_{18} = 100 \frac{\sum_i \min(|y_{i1}|, |y_{i2}|)}{\left(\frac{1}{\sum_i |y_{i1}|} + \frac{1}{\sum_i |y_{i2}|} \right)}$ \text{ } Kulczynski similarity,

which can be seen from the second form of S_{17} to be related to Bray-Curtis, replacing the arithmetic mean of the sample totals in the denominator of S_{17} with a harmonic mean;

$S_{19} = 100 \frac{1}{p_{12}} \sum_i \left[1 - \frac{1}{R_i} |y_{i1} - y_{i2}| \right]$
 \text{ } Gower (excluding double zeros),

which is S_{15} with the fixed total number of species in the matrix (p) being replaced by p_{12} , the number of non-jointly absent species in the two samples being compared – an important difference;

$S^{\text{Can}} = 100 \left(1 - \frac{1}{p_{12}} \sum_i \frac{|y_{i1} - y_{i2}|}{|y_{i1}| + |y_{i2}|} \right)$ \text{ } Canberra similarity,

in the form used by Stephenson W, Williams WT, Cook SD 1972, *Ecol Monogr* 42: 387-415, not numbered by L&L but of more use for species data than its distance form (Canberra metric) D_{10} , because of the division by the variable species numbers p_{12} (i.e. excluding double zeroes);

$S^{\text{M-H}} = 100 \left(1 - \frac{D_1^{\prime 2}}{\sum_i y_i^{\prime 2} + \sum_i y_i^{\prime 2}} \right)$ \text{ } Morisita-Horn similarity,

where y^{\prime} denotes that y 's are sample-standardised before D_1 and the denominator are calculated; and

$S^{\text{Och}} = 100 \frac{\sum_i \min(|y_{i1}|, |y_{i2}|)}{\sqrt{\sum_i |y_{i1}| \sum_i |y_{i2}|}}$ \text{ } quantitative Ochiai similarity,

not defined by Ochiai as such, but it reduces to Ochiai's coefficient (S_{14}) when applied to P/A data. Clarke *et al* 2006 (see above for reference) construct this coefficient – which is an intermediate form between Bray-Curtis and Kulczynski, because it replaces the denominator with a geometric rather than arithmetic or harmonic mean – to illustrate that measures with reasonable properties are not difficult to invent, explaining the plethora of coefficients available in the

literature!

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