

# Quantitative similarity measures

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

$D_{15} = 100 \frac{1}{p} \sum_i \left[ 1 - \frac{|y_{i1} - y_{i2}|}{R_i} \right]$   
 \text{, where }  $R_i = \max_j |y_{ij}| - \min_j |y_{ij}|$  \text{ \hspace{1mm} }  
 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  $\chi^2$  distance the (generally undesirable) property that adding further samples can change existing similarities;

$S_{18} = 100 \frac{\sum_i \min(|y_{i1}|, |y_{i2}|)}{2 \left[ \left( 1 / \sum_i |y_{i1}| \right) + \left( 1 / \sum_i |y_{i2}| \right) \right]}$  \text{ \hspace{12mm} } 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;

$D_{19} = 100 \frac{1}{p_{12}} \sum_i \left[ 1 - \frac{|y_{i1} - y_{i2}|}{R_i} \right]$   
 \text{ \hspace{13mm} } 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{ \hspace{10mm} } 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);

$S^{\text{M-H}} = 100 \left( 1 - D^{\prime 2} / \left[ \sum_i y^{\prime 2}_{i1} + \sum_i y^{\prime 2}_{i2} \right] \right)$  \text{ \hspace{10mm} } Morisita-Horn similarity, }

where  $y^{\prime}$  denotes that  $y$ 's are sample-standardised before  $D_{10}$  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{ \hspace{30mm} } 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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