1.24 Exchangeable units

The denominator mean square of the pseudo-*F* ratio for any particular term in the analysis is important not just because it isolates the component of interest in the numerator for the test: it also identifies the exchangeable units needed to obtain a correct test by permutation (Anderson & ter Braak (2003)). In the one-way case, it is clear that the units that are exchangeable under a true null hypothesis are the individual samples. These can be shuffled randomly among the groups (or, alternatively, the group labels can be randomly shuffled across all samples) if the groups have no effect and the null hypothesis is true. In fact, whenever a term has a pseudo-*F* ratio with the residual mean square as its denominator, then the exchangeable units for the test are the individual samples themselves (regardless of which of the three methods of permutation offered by PERMANOVA is to be employed).

For more complex designs, the correct exchangeable units for a given test are identified by the term used as the denominator mean square of that particular term. This is sensible from the perspective that the denominator identifies what constitute the “errors” for a given null hypothesis. Thus, in the Tasmanian meiofauna example, the pseudo-*F* ratio for the test of the main effect of treatments (‘Tr’) is $F _ {Tr} = MS _ {Tr} / MS _ {Tr \times Bl}$. As the denominator here is the interaction term ‘TrxBl’, the exchangeable units for this test are the 8 cells that correspond to the 2 × 4 combinations of treatments by blocks. The samples within each of those 8 cells will be kept together as a unit under permutation. This yields 8! / [(2!)^4 × 4!] = 105 unique values of the numerator and 8! / [4! × 2!] = 840 unique values for the denominator and, thus, 840 unique values of the whole pseudo-*F* statistic under permutation (as shown in the ‘Unique perms’ column for the term ‘Tr’ in Fig. 1.23 above). For more details concerning exchangeable units for permutation tests in ANOVA designs, see Anderson & ter Braak (2003) .

Revision #4
Created 7 August 2022 16:31:33 by Arden
Updated 1 September 2022 13:18:32 by Arden