Status of region estimates

Ordination means plots are therefore a vital tool for interpretation but, in relation to their univariate counterparts, they lack one useful feature – the ability to get an approximate feel for the uncertainty in our knowledge of position of each mean point on that plot. In the univariate case, this is provided by 95% confidence intervals, or error bars of $\pm$1 or 2 standard errors (i.e. standard deviations of the mean). These do not reflect primarily the variability in individual replicates from a group but (in a way that is rather precisely defined but rather loosely understood!) the uncertainty in knowledge of the true mean, and this is largely dictated by the number of replicates. Of course, such interval estimates, and the confidence values, are based on parametric assumptions about the distributional form of the observations. This can be carried over into, for example, a concept of 95% confidence *regions* within an (*x*,*y*) plot of groups for a two-variable matrix, but increasingly inflexible and unrealistic assumptions need to be made (the standard multivariate normal MANOVA model). It is realistic, for biological assemblage matrices typically in high-d space and with complex and largely non-identifiable parametric dependencies among the species variables, to set our sights lower and seek to display approximate regions around each group mean, e.g. on a 2-d ordination, which give a 'feel' for the uncertainty in that mean's position. The regions do not have the status of confidence intervals therefore, and should not be used as tests – that is the role of ANOSIM etc.

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