4.1 Final cautionary notes

The purpose of this exposé has been to highlight some important pros and cons associated with using PRIMER and R in routine analytical work. It is clear that both R and PRIMER have great capabilities and using them both should be encouraged.

A genuine question about 'which one to use' really only arises when it is perceived that both PRIMER and R each have a specific routine that will (purportedly) do the same thing. For example, both adonis2 (in the vegan package) in R and PERMANOVA for PRIMER assert the ability to implement a dissimilarity-based permutational multivariate analysis of variance. At the current time, PERMANOVA in PRIMER has a far greater scope and capacity than adonis2 to achieve this, and (unlike adonis2) its results are correct and reliable for *any* design.

In Chapter 3 above, we compared the results of a PERMANOVA obtained using PRIMER *vs* R for a specific dataset. We showed that using an R routine outside its limits is a dangerous and flawed enterprise. It turns out there are a lot of other routines in R like the adonis2 function in this respect: they allegedly perform a certain analysis, but may in fact have an inherent weakness in their design, or limitations that are not obvious from a casual (or even a detailed) glance at the available documentation. It becomes clear upon inspection that a broad range of specialised methods available in PRIMER (such as PERMANOVA, PERMDISP, CAP, multi-way ANOSIM, BEST, etc.) are not able to be replicated using any available R packages at the present time.

A lot of R packages (or freely available R code) may look, on the face of it, to be able to do an analysis you want to do. Please bear in mind that there may be:

- problematic assumptions that can lead (unexpectedly) to incorrect results; or
- important limitations (not necessarily obvious) on their correct use.

When using a given R routine, here are some questions you should probably ask yourself:

- How will you know if the results are reliable?
- Can you check it by programming it independently yourself?
- What will it do for your particular use-case at this particular time?
- Are you prepared to re-check a given R routine again when you use it at a different time and for every new use-case you wish to throw at it?

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