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Dear Sir Ronald,

I wonder if you could answer a query arising from your paper of 1953 "Dispersion on a Sphere". Is it possible without too much difficulty to generalise the relation

$$P = \left(\frac{N-R}{N-R_c}\right)^{N-1}$$

from a sphere in 3 dimensions to a hypersphere in N-space?

Some time ago you very kindly directed my attention to Bhattacharyya's angular distance function for multinomial data, in connection with geological problems involving counts of micro-fossils, mineral grains and the like. I have since been using it regularly on such problems as came my way, and have usually found (as one might expect) that multinomial variance represents only a small fraction of the dispersion within a group of sample counts from the same geological formation. One naturally wants in such cases to know how to estimate the dispersion and use it to test between-group values of the angular distance.

For the case of 3 components (either 3 mineral species, say, or else 2 species plus the remainder) one could evidently use the spherical model. It seems a much more natural choice than the Euclidean model of conventional multivariate analysis which could presumably be used instead in conjunction with the inverse sine transformation of the data expressed as percentages.

Our practical problem involves the relative proportions of six different detrital mineral species occurring in Coal Measure strata. We find a beautifully regular pattern in the between-stratum angular distances calculated in 6-space, but at present we have to take the minerals two at a time and lump the remaining four in order to calculate radii of confidence and test significance.

The hypersphere model seems very attractive - at any rate intuitively - assuming that the mathematics of the distribution does not become too difficult in more than 3 dimensions. At the back of my mind is the thought that it might, by analogy with the multinomial standard error of Bhattacharyya's distance function, turn out to be independent of the number of dimensions, but this no doubt is too naive a hope.

Yours sincerely,

T. P. Burnaby