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A Correction for the $\tilde{\epsilon}$ Approximate Test in Repeated Measures Designs With Two or More Independent Groups

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The routine $\tilde{\epsilon}$ approximate test procedure in repeated measures designs when the condition of circularity is not fulfilled uses an erroneous formula in the case of two or more groups. This may lead to a substantial underestimation of the deviation from circularity when the total number of subjects is small.

An error has occurred in the generalization of the $\tilde{\epsilon}$ approximate test procedure in repeated measurements designs to the case of $g \geq 2$ groups. For a design with N subjects nested into g groups and k treatments, the formulas given in Huynh and Feldt (1976, p. 76) for the particular case of a single repeated factor and in Huynh (1978, p. 164) for the more general case of several repeated factors are, respectively:

$$\tilde{\epsilon} = \frac{N(k-1)\hat{\epsilon} - 2}{(k-1)(N-g-(k-1)\hat{\epsilon})} \quad \text{and} \quad \tilde{\epsilon} = \frac{Nr\hat{\epsilon} - 2}{r(N-g-r\hat{\epsilon})}.$$

They should be corrected, when $g \geq 2$, by substituting $N - g + 1$ for N in the numerator. Hence, the correct formula should be in the general case:

$$\tilde{\epsilon} = \frac{(N-g+1)r\hat{\epsilon} - 2}{r(N-g-r\hat{\epsilon})}.$$

The above incorrect $\tilde{\epsilon}$ is mentioned in many recent textbooks and is apparently used in a number of standard statistical packages. It is at the present time a routine solution when the condition of circularity (or sphericity) is not fulfilled. It gives an underestimation of the deviation from circularity, which may be substantial when the total number of subject N is small.

References

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