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Robust bootstraped h and k Mandel's statistics for outlier detection in Interlaboratory Studies

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A new methodology based on bootstrap resampling techniques is proposed to estimate the distribution of the h and k Mandel's statistics, commonly applied to identify laboratories that supply inconsistent results usually utilized to detect those outlier laboratories by testing the hypothesis of reproducibility and repeatability (R & R), in the framework of Interlaboratory Studies (ILS).

Traditionally, the statistical tests involved in the ILS have been developed under theoretical assumptions of normality in the study variables. Then, if the variable measured by the laboratories is far from being assumed normal distributed, the application of nonparametric techniques could be very useful to estimate more accurately the distribution of these statistics and consequently those critic values.

For the validation of the proposed algorithm, several scenarios were created in a simulation study where the statistics h and k were generated from different distributions such as Normal, Laplace, and Skew Normal where sample size and the number of laboratories are considered. Also, emphasize on the power of the test to verify the capacity of the methodology for detect inconsistencies.

As general result, the new bootstrap methodology presents better results than those obtained using the parametric traditional methodology, essentially when the data is generated by a Skew distribution and the sample size is small. Finally, this methodology was applied to a real case study of data obtained through a computational technique of hematic biometry between clinical laboratories and a dataset corresponding to serum glucose testing implemented on ILS R package.

Keywords

ILS, Outlier detection, Bootstrap, Simulation Studies

Special/invited session

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