

Correlation paradox of binary classification system

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Qualitative analysis often uses a simple classification scale that measures (classifies) the analyzed property value into one of two comprehensive and exclusive classes/categories – a binary scale (e.g., Type 1/Type 2, go/no go). Commonly, the performance of a binary sorting (classification) machine (SM) is assessed by Type I error (false positive rate) and Type II error (false negative rate). The usual way to check the repeatability (or accuracy) of a SM is to conduct sequential sorting processes. In this paper, for simplicity reason, we used only two sequential sorting processes and evaluated SM repeatability through the following measures: (1) the correlation coefficient between the random variables denoting the number of items that were classified as Type 1 (for example) in two sequential sorting processes and (2) the probability of equality between these random variables. It is shown that the naïve hypotheses are violated; i.e., even for small classification errors, the correlation coefficient/the probability of equality is much less than 1. So, the conclusion is that these two measures are not suitable for measuring repeatability and other methods of repeatability checking must be considered for cases when the sorting is based on an ordinal or nominal scale. This paradox accords with the recent growing awareness of the difference between the quality of modeling a phenomenon (i.e., explaining a phenomenon) and the ability to predict it.

Key Words: Sorting machine (SM), correlation coefficient, repeatability, joint probability distribution function