

Abstract of thesis entitled:

New Statistics to Compare Two Groups with Heterogeneous Skewness

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A new bivariant statistics, namely the weighted distance test, for comparing two groups were introduced. The test aims at providing reliable type I error control and reasonable statistical power across different types of skewed data. It corrects the skewness of the data by applying power transformation with power index ranged between 0 to 1. I also proposed in this thesis a possible way of deciding the power index by considering the skewness difference between the two groups under comparison.

I reviewed 4 commonly used inferential statistics for two-group comparison and compared their performances with the weighted distance test under 1) normal distribution, 2) skewed distribution with equal skewness across groups, and 3) skewed distribution with unequal skewness across groups. Monte Carlo simulations were ran to evaluate the 5 tests. Results showed that the weighted distance test was not the best test in any particular situation, but was the most stable test in the sense that 1) it provided accurate type I error control and 2) it did not produce catastrophically small power in any scenario. All other 4 tests failed in some of the simulated scenario for either inflated type I error, or unsatisfactory power. Therefore, I suggested that the weighted distance test could be one easy-to-use test that works fairly well across a wide range of situation.

Keywords: inferential statistics, psychometrics, power transformation, power, type I error

筆者在論文中引入一個名為加權距離檢驗的雙變項統計。此檢驗方法用於比較兩個隨機變數的集中趨勢。其優勢在於在有偏度的數據中，仍能穩定地控制第一型錯誤，並同時提供可觀的統計檢力。加權距離檢驗利用冪函數修正在偏度數據中的不對稱現象。與一般的冪函數轉換法不同，加權距離檢驗將冪值限制在 0 和 1 之間。文中亦提供了一個有效決定冪值的方法，以方便在實際運算中使用。

筆者總結了四個主流的雙變項統計方法，並利用蒙地卡羅模擬法在正態分佈、同程度偏度分佈以及不同程度偏度分佈三個情況中比較了它們與加權距離檢驗的表現。結果顯示，加權距離檢驗雖然沒有在每一個情況中勝出，但卻於兩方面表現了其優勢。首先，它在任何情況下都能把第一型錯誤控制在合理水平之下；其次，它在任何情況下都不至於表現得太差。反觀其他四個檢驗方法總會在某些情況下表現失敗。由此可見，加權距離檢驗比起其他檢驗方法更能提供一個穩定而簡單的方法去比較集中趨勢。