Available online at www.sciencedirect.com
ScienceDirect
Mathematics and Computers in Simulation 81 (2011) 1153–1160
MATHEMATICS AND COMPUTERS IN SIMULATION
www.elsevier.com/locate/matcom

Original article

A trinomial test for paired data when there are many ties

Guorui Bian [a], Michael McAleer [b,c,d], Wing-Keung Wong [e,*]

[a] *Department of Statistics, East China Normal University, China*
[b] *Econometric Institute, Erasmus School of Economics, Erasmus University Rotterdam, The Netherlands*
[c] *Tinbergen Institute, The Netherlands*
[d] *Institute of Economic Research, Kyoto University, Japan*
[e] *Department of Economics and Institute for Computational Mathematics, Hong Kong Baptist University, Hong Kong*

Received 29 May 2010; received in revised form 28 October 2010; accepted 15 November 2010
Available online 7 December 2010

Abstract

This paper develops a new test, the trinomial test, for pairwise ordinal data samples to improve the power of the sign test by modifying its treatment of zero differences between observations, thereby increasing the use of sample information. Simulations demonstrate the power superiority of the proposed trinomial test statistic over the sign test in small samples in the presence of tie observations. We also show that the proposed trinomial test has substantially higher power than the sign test in large samples and also in the presence of tie observations, as the sign test ignores information from observations resulting in ties.

JEL classification: C12; C14; C15

Keywords: Sign test; Trinomial test; Non-parametric test; Ties; Test statistics

1. Introduction

Estimating the parameters of distributions is one the most important issues in statistics. Parametric tests make rather stringent assumptions regarding the nature of the population from which the observations were drawn (Siegel [15]). On the other hand, non-parametric methods are popular for practitioners as they do not require strong assumptions for their validity, as are required by their parametric counterparts. Non-parametric approaches based on signs and ranks form a substantial body of statistical techniques that provide alternatives to classical parametric methods. For example, most non-parametric tests require the assumption of a population from which subjects are obtained by random sampling, whereas for most non-parametric methods, treatments being compared are assumed to have been randomly assigned to subjects. A bibliography of non-parametric statistics by Savage [14] lists about 3000 items. Among them, the sign test is one of the most widely used, and is regarded as the oldest non-parametric test procedure. The sign test was used in applications as early as 1710 in an article by Arbuthnott. The test derives its name from the procedure of converting data into plus and minus signs.

Dixon and Mood [7] and Mackinnon [12] have published tables of critical values for the sign test. On the other hand, Wilcoxon [17] indicates, for the first time, the possibility of using ranking methods in order to obtain a rapid

* Corresponding author. Tel.: +852 3411 7542; fax: +852 3411 5580.
E-mail address: awong@hkbu.edu.hk (W.-K. Wong).

0378-4754/$36.00
doi:10.1016/j.matcom.2010.11.002