WINSORIZED MODIFIED ONE STEP M-ESTIMATOR IN ALEXANDER-GOVERN TEST

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Abstrak

Kajian ini tertumpu kepada ujian kumpulan bebas bagi membandingkan dua atau lebih min menggunakan kaedah berparameter iaitu ujian Alexander-Govern (*AG*). Ujian ini menggunakan min sebagai sukatan kecenderungan memusat dan dianggap sebagai alternatif yang lebih baik berbanding *ANOVA*, ujian Welch dan ujian James. Walaupun ujian *AG* mempunyai kawalan yang baik terhadap kadar ralat Jenis I dan menghasilkan kuasa yang tinggi pada varians heterogen, ujian ini tidak teguh pada data yang tidak normal. Justeru, min terpangkas telah dicadangkan dalam ujian tersebut untuk menangani masalah ketaknormalan dan kemudiannya, satu penganggar yang lebih teguh dikenali sebagai penganggar *M* satu langkah terubahsuai telah diperkenalkan. Penganggar berkenaan adalah tidak dipengaruhi oleh bilangan kumpulan, namun telah gagal untuk menghasilkan kawalan yang baik terhadap kawalan ralat Jenis I, dalam keadaan kepencongan dan kurtosis yang ekstrim. Kajian ini mencadangkan penganggar *MOM* ter*Winsor* (*WMOM*) sebagai sukatan kecenderungan memusat dalam usaha untuk meneguhkan ujian *AG*. Ujian *AG* yang ditambah baik ini, *AGWMOM* mampu menyingkirkan kewujudan data terpencil daripada taburan data. Satu kajian simulasi terhadap 5,000 set data telah dilaksanakan untuk membandingkan prestasi ujian: *AG*, *AGMOM* (ujian *AG* menggunakan penganggar *MOM*), *AGWMOM*, ujian-*t* dan *ANOVA*. Keputusan menunjukkan bahawa ujian *AGWMOM* telah meningkatkan bilangan kondisi teguh pada taburan terpencong dengan hujung normal dan taburan terpencong dengan hujung berat berbanding ujian yang lain.

Sebagai tambahan, ujian ini telah menghasilkan kuasa yang tinggi dalam kebanyakan kondisi pada empat kumpulan dengan saiz sampel tidak seimbang. Dapatan kajian mendorong untuk ujian ini menjadi paling sesuai apabila taburan data adalah berhujung berat.

Kata kunci: ujian Alexander-Govern, penganggar *MOM*, kadar ralat Jenis I, Kuasa ujian, ujian *AGWMOM*

Abstract

This research centres on independent group test of comparing two or more means by using the parametric method, namely the Alexander-Govern (*AG*) test. It uses mean as its central tendency measure and is considered as a better alternative to the *ANOVA*, the Welch test and the James test. Although the *AG* test has a good control of Type I error rate and produces a high power under variance heterogeneity, it is not robust to non-normal data. Thus, trimmed mean was proposed in the test to handle the problem of non-normality and later, a more robust estimator called modified one step *M* (*MOM*) estimator was introduced. These estimators are not influenced by the number of groups, but failed to give a good control of Type I error rate, under extreme conditions of skewness and kurtosis. This research proposes the Winsorized *MOM* (*WMOM*) estimator as a measure of central tendency in attempt to robustify the AG test. This enhanced *AG* test, *AGWMOM* is able to remove the appearance of outliers from the data distribution. A simulation study of 5,000 data sets was conducted to compare the performance of the tests: *AG*, *AGMOM* (*AG* test using *MOM* estimator), *AGWMOM*, *t*-test and *ANOVA*. The results show that the *AGWMOM* test has improved the number of robust conditions under skewed normal tailed and skewed heavy tailed distributions compared to the other tests. Additionally, the test produced high power in most conditions under four groups with unbalanced sample size. It leads that this test is convenient specifically when the data distribution is heavy tailed.

Keywords: Alexander-Govern test, *MOM* estimator, Type I error rate, power of test, *AGWMOM* test

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List of Abbreviations

AG	Alexander-Govern Test
MOM	Modified One Step *M*-estimator
AGMOM	Modified One Step *M*-estimator in the Alexander-Govern Test
WMOM	Winsorized Modified One Step *M*-estimator
AGWMOM	Winsorized Modified One Step *M*-estimator in the Alexander-Govern Test
ANOVA	Analysis of Variance

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

This research makes comparison of the performances of the Type I error rate and power of five different tests. These tests are (i) Alexander-Govern test (*AG* test), (ii) Modified One Step *M*-estimator (*MOM*) estimator in the Alexander-Govern test (*AGMOM test*), (iii) Winsorized Modified One Step *M*-estimator (*WMOM*) estimator in the Alexander-Govern test (*AGWMOM* test), (iv) *t-test* (v) Analysis of Variances (*ANOVA*). Each test is performed under two, four and six groups conditions, with the combination of both balanced and unbalanced sample sizes, equal and unequal variances respectively, with each of the *g- and h-* distributions. The *g-* and *h-* distribution is used to determine the level of skewness and kurtosis respectively in a data distribution.

The best among the five tests will produce the best control of Type I error rate and also produce high power, under skewed heavy tailed distribution. The independent group tests such as the *ANOVA* have been applied in different field of life, for example in medicine, economics, sociology and agriculture, as discussed by Pardo, Pardo, Vincente and Esteban (1997). Three main assumptions have to be fulfilled before the *ANOVA* can work effectively, namely: (i) homogeneity of the variance (ii) normality of the data and (iii) independent observations of the data distribution.

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