ASU School of Mathematical and Statistical Sciences
Arizona State University

M E M O R A N D U M

DATE: 10/11/2022

TO: Faculty and Students

FROM: Professor(s)   Mark Reiser
             Chair/Co-Chairs of   Jinhui Xu
             Defense for the   PhD   in Statistics
             Committee Members
                                            Jeffrey Wilson
                                            Mike Edwards
                                            Ming-Hung Kao
                                            Yi Zheng

DEFENSE ANNOUNCEMENT

Candidate: Jinhui Xu

Defense Date: October 25, 2022

Defense Time: 1:30 PM

Virtual Meeting Link: https://asu.zoom.us/j/87255028252

Title: Advances in Directional Goodness-of-fit Testing of Binary Data under Model Misspecification in Case of Sparseness

Please share this information with colleagues and other students, especially those studying in similar fields. Faculty and students are encouraged to attend. The defending candidate will give a 40 minute talk, after which the committee members will ask questions. There may be time for questions from those in attendance. But, guests are primarily invited to attend as observers and will be excused when the committee begins its deliberations or if the committee wishes to question the candidate privately.

ABSTRACT
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Goodness-of-fit test is a hypothesis test used to test whether a given model fit the data well. It is extremely difficult to find a universal goodness-of-fit test that can test all types of statistical models. Moreover, traditional Pearson's chi-square goodness- of-fit test is sometimes considered to be an omnibus test but not a directional test so it is hard to find the source of poor fit when the null hypothesis is rejected and it will lose its validity and effectiveness in some of the special conditions. Sparseness is such an abnormal condition. One effective way to overcome the adverse effects of sparseness is to use limited-information statistics. In this dissertation, two topics about constructing and using limited-information statistics to overcome sparseness for binary data will be included. In the first topic, the theoretical framework of pairwise concordance and the transformation matrix which is used to extract the corresponding marginals and their generalizations are provided. Then a series of new chi-square test statistics and corresponding orthogonal components are proposed, which are used to detect the model misspecification for longitudinal binary data. One of the important

conclusions is, the test statistic $X?c$ can be taken as an extension of X&i, the second-order marginals of traditional Pearson's chi-square statistic. In the second topic, the research interest is to investigate the effect caused by different intercept patterns when using Lagrange multiplier (LM) test to find the source of misfit for two items in 2-PL IRT model. Several other directional chi-square test statistics are taken into comparison. The simulation results showed that the intercept pattern does affect the performance of goodness-of-fit test, especially the power to find the source of misfit if the source of misfit does exist. More specifically, the power is directly affected by the 'intercept distance' between two misfit variables. Another discovery is, the LM test statistic has the best balance between the accurate Type I error rates and high empirical power, which indicates the LM test is a robust test.