# ATTITUDES & BELIEFS IN STATISTICS LEARNING
# FOR SOCIAL SCIENCE GRADUATE STUDENTS

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*This study is designed to explore social science graduate students' attitudes toward statistics learning with a qualitative approach. Findings suggest that the graduate students have more positive attitudes and less anxiety toward statistics, high confidence in dealing with statistical challenges, and a strong willingness to learn statistics well. Four activities were generalized from the comments to reduce statistics anxiety and make statistics learning enjoyable. These four activities are 1) emphasizing the basic concepts to ensure mastery, 2) making more time for statistics learning, 3) focusing on fewer materials each time to increase learning, and 4) relating statistics learning to students' research areas. These findings are important for institutions to consider in developing effective instructional and policy approaches to helping specific populations of students.*

## INTRODUCTION

Studies revealed that undergraduates' statistics anxiety levels become more serious from the pre-test to post-test (Ramirez & Bond, 2014; Swanson, VanderStoep, & Tintle, 2014). Researchers focused on actions that could reduce statistics anxiety. Dillon (1982) demonstrated that students' statistics anxiety could be alleviated by talking about their fears. Schacht and Stewart (1990) suggested that collecting real data from students and having students perform simple calculations (obtaining the mean, etc.) aids in reducing anxiety levels and increasing motivation with the end result becoming involved in the class. Teachers may contribute to the reduction of statistics or mathematics anxiety and thus enhance learning by integrating more efficient instructional strategies into their teaching (Smith, 2000; Pan & Tang, 2005). Chiou, Wang, and Lee (2014) found that a one-minute paper strategy could reduce students' statistics anxiety significantly and thereby improve students' statistics achievement.

Literature signifies that it is important to have students talk, share, and discuss their experiences in the statistics learning process, including their concerns regarding statistics anxiety, and actions to reduce anxiety. Most studies focus on students' statistics anxiety, and actions to reduce anxiety levels, conducted with a quantitative approach. Yet too little qualitative research (or mixed method research) exists in this area. Moreover, the difference between undergraduate and graduate students in statistics learning are even less discussed, which may lead to a big bias in statistics education since undergraduate and graduate students are very different regarding to their backgrounds, learning motivations, learning habits, etc. As a result, very limited mixed research method is available on social sciences adult learners' statistics anxiety conditions before and after the introductory statistics course, and the actions that could be taken to release statistics anxiety.

## THE PROBELM

The target population for this study is graduate students in the social sciences. These individuals need statistics skills to read academic reports and papers, design experiments, and analyze quantitative data collected from surveys or test results. In analyzing data, these students usually encounter significant problems, due to the lack of familiarity with statistical techniques such as the analysis of variance, the analysis of covariance, regression, exploratory data analysis, multivariate analysis techniques, etc. (Gould, 2010). In addition, this study focuses on adult learners, defined as graduate students ranging in age from 25 to 64 years.

This target population, by combining social sciences and adult learners, provides a basis for statistics education to be viewed as unique and worthy of emphasis. Since most students from the social sciences tend to have limited background in statistics or mathematics; such a lack of background knowledge makes statistics comprehension difficult. Further, statistics itself is not an easy subject. The inherent mathematical difficulties of statistical language and abstract statistical

concepts lend to make statistics learning even more of a challenge. Moreover, graduate students tend to have both different limitations and strong points compared to undergraduates in learning. For example, adult learners usually have part- or full-time jobs, or are teaching assistants, and often need to deal with the issues of a family. In fact, the primary limitation in statistics learning for the adult students could be a shortage of time, which is rarely a problem for undergraduate students. However, graduate students usually have strong self-motivation, high expectations, strong willingness to learn statistics, and they have confidence in dealing with statistical challenges.

RESEARCH QUESTIONS

This study was conducted to discuss the following questions:
1. Did students' anxiety levels diminish after the introductory statistics course?
2. If yes, what actions could be taken to release the statistics anxiety?

METHODOLOGY

In this study, the mixed method research with both quantitative and qualitative methods are utilized in this study, while the qualitative portion plays a major role in this study. The quantitative research in this study focused on comparing the difference between students' anxiety levels before and after the introductory statistics course. The qualitative portion played the role to further explore students' experience of their statistics learning process.

For the quantitative part, the quantitative data from two survey items were collected. The Mann-Whitney U test was used to analyze the quantitative data. The Mann-Whitney U test is the nonparametric counterpart for the independent two-sample t-test. First, this is appropriate since the total number of participants for this study is thirteen, and the sample size for each group is even smaller. In addition, the Likert items from the surveys were collected for this study. The response values were ordinal with 5-point scales from "strongly disagree" through to "strongly agree." Therefore, the dependent variables were ordinal, which was not appropriate for the parametric test of independent two-sample t-test. Moreover, the assumptions of normality and equality of variance required for the parametric tests were not met. Considering these various conditions, the quantitative nonparametric Mann-Whitney U test was a good fit for this study. In addition, since two hypotheses (two items) were being performed simultaneously on a single factor, the Bonferroni adjustment was made to the P value to keep the desired alpha value to .05 for the whole family of hypotheses tests. The familywise error rate was .05/number of hypotheses tests. In contrast to the parametric test, the mean rank instead of mean value was compared between the two groups.

*Data Collection*

Thirteen volunteers were involved in the quantitative part, which constituted male and female students with ages ranging from 30 to 55 years. Students reported the following for race/ethnicity: Asian, Brazilian, and white. Each participant held a master's degree and was pursuing a doctoral degree. Their majors are within social sciences. The various time demands of their jobs include part-time and full-time jobs. Some have no background in statistics, and some have minimal statistics knowledge from a basic level statistics course. The quantitative data from the two survey items were collected from the thirteen students. The two items were (1) I am scared of statistics, and (2) I get nervous going to statistics class. The Mann-Whitney U tests were conducted to students from the before-course and the after-course groups. The Bonferroni adjustment was made to the P value to keep the desired alpha value to .05. The familywise error rate was .05/2=.025 for this study.

The qualitative data from a series of interviews were collected from the ten students, with five students interviewed from each of the two groups. Before the interviews with participants in the study, the researcher conducted a pilot interview with an acquaintance, who relates to this study as well. The purpose of the pilot interview was to ascertain whether these questions made sense, and whether the participant would respond in expected ways. After this pilot interview, small changes were applied to the questions.

When conducting the interview, the researcher combined both semi-structured and in-depth interviews. With the semi-structured interview, the interviews are conducted on the basis of a loose

structure, which is guided by different topics and open-ended questions. The guiding topics include demographic information, previous statistics background, attitudes toward statistics, experiences in statistics classroom, group study versus study alone, and online versus in-class courses. With the in-depth interviews, the researcher sought to explore participants' perceptions and experiences in greater details.

RESULTS

Social Sciences Adult Learners' Statistics Anxiety Before and After the Introductory Statistics Course

The Mann-Whitney U test results from Table 1 indicated that one of the two items was significantly different between students from the two groups, with Asymp. 2-tailed Sig. value of .004 less than the familywise error rate of .025. More details from Table 2 demonstrated that students from the after-course group had comparatively lower levels of statistics anxiety for both items. Concerning Item 1, the mean value for students from the after-course group was 2.40, indicating that students held a disagreeing to neutral attitude to the statement that they were scared of statistics, while the mean value for students from the before-course group was 4, indicating that the students agreed with this statement. Concerning Item 2, the mean value for students from the after-course group was 1.2, showing that students tended to disagree with the statement that they got nervous at the thought of going to statistics class. The mean value for students from the before-course group was 3.75, indicating that the students held a neutral to agreeing attitude to this statement.

To conclude, students' attitudes differed between the two groups. At the beginning of the course, students had comparatively higher levels of statistics anxiety, with mean values of 4 and 3.75 out of 5 regarding the statement of (1) I am scared of statistics, and (2) I get nervous going to statistics class. However, students' attitudes diminished after the introductory statistics course, being against to the statements with mean values of 2.4 and 1.2, respectively.

Follow-up interviews were conducted to five students from each of the two groups to explore deeper about their statistics learning experience. The interview responses indicated that all students, interviewed at the beginning of the course, had high levels of statistics anxiety. Most of them took this statistics course since it was required, while almost all of them did not plan to take any higher-level statistics courses at that moment if not needed. However, all of the five students from the after-course group also had serious statistics anxiety at the beginning of their statistics course, but after they completed the course, they were not anxious about statistics so much, and all of them planned to take some higher-level statistics courses. The interview findings are consistent with the quantitative survey results that before taking the statistics course, the social sciences adult learners had much higher levels of statistics anxiety, while students' statistics anxiety levels were relinquished after they completed the introductory statistics course, and the students became somewhat interested in statistics.

Actions to Release Statistics Anxiety of Social Sciences Adult Learners

Students interviewed at the end of the statistics course indicated that their statistics anxiety levels released, even thought they were anxious about statistics at the very beginning of the course. Most of them planned to take some higher-level statistics courses. The experiences of these students were generalized into four actions that help release their statistics anxiety: (1) emphasize the basic concepts to ensure mastery, (2) make more time for statistics learning, (3) focus on fewer materials at a time to increase learning, and (4) relate statistics to students' research areas.

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