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ABSTRACT

A team of researchers at the University of South Florida is developing a multimedia program to identify and help students with statistics anxiety. This program, EncStat, includes tests that provide information about a student's level of anxiety and negative attitudes toward statistics, computer anxiety, and study skills, and it contains instruction on how statistics anxiety affects learning, with guidance on modifying counterproductive behaviors, thoughts, and feelings resulting from statistics anxiety. Research has suggested that the Survey of Attitudes Towards Statistics (SATS; Schau, Stevens, Dauphinee, and Del Vecchio, 1995) and the Statistical Anxiety Rating Scale (STARS; R. Cruise, R. Cash, and D. Bolton, 1985) would be useful in the computerized version of EncStat, but combining these scales would result in duplication. This pilot study assessed and compared results for both measures and their subscales as an initial effort toward eliminating duplicative items. Data came from 69 graduate students who took both measures, 1 focus group, and questionnaire responses of 30 of the students. In general, data support the psychometric integrity of both the STARS and SATS, both of which had excellent internal consistency reliability in total and subscale scores. Findings also suggest the instruments sample overlapping domains and point to some options that might be used in EncStat. Student response data show the need for a program like EncStat. (Contains 3 tables and 12 references.) (SLD)

# Breaking Ground for EncStat:

# A Statistics Anxiety Intervention Program



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## Breaking Ground for EncStat: A Statistics Anxiety Intervention Program

### Rationale and Background

McLeod (1992, p. 575) observed:

> "Efforts to reform the mathematics curriculum place special importance on the role of affect. The National Council of Teachers of Mathematics has reaffirmed the centrality of affective issues...If research on learning and instruction is to maximize its impact on students and teachers, affective issues need to occupy a more central position in the minds of researchers. .. "

Although the reference was to mathematics education, the focus on affect applies to statistics education as well. Similarly, Gal, Ginsburg, and Schau (1994, p. 40) state, "The extensive body of research on affective issues in mathematics education can be used to guide a discussion of affective responses to statistics education."

In his introduction to *The Assessment Challenge in Statistics Education*, Gal (1997) observes, "Statistics has gained recognition as an important component of the precollege mathematics and science curriculum" (p. 1). New instructional materials are being developed, and more attention is being devoted to statistics education at all levels, including graduate level statistics.

However, as Garfield and Ahlgren (1988, p. 210) note: "Extensive research shows that statistics and probability concepts are difficult to teach and often poorly understood" Of the several reasons cited by Gal and Garfield (1997, p. 6) two in particular make learning statistics, for some students, an obstacle Everest in scale: (1) the '...messiness' or context boundedness of statistics is markedly different from the more precise, finite nature characterizing traditional learning in other mathematical domains..." and (2) ...the need for "... students to be able to render reasons, descriptions, judgments, inferences, and opinions about data..."

Judgment and inferences are at the highest levels of Bloom's taxonomy of learning (Bloom, 1981). For most of the time allotted for one week's classroom lecture, the instructor must quickly lead students through application, analysis, synthesis and evaluation while students are still struggling to recall simple definitions and comprehend their meaning. To adequately cover the curriculum, such treatment must happen consistently, week after week. Compounding this problem, the process of learning statistics is as hierarchical as are the processes of learning mathematics or a foreign language. The statistics student must acquire a new vocabulary and a new way of thinking, a fact implicitly recognized in that some graduate programs allow the substitution of one course in graduate level statistics for one course in a foreign language.

Even under optimal learning conditions, the challenge is difficult. For the anxious learner, the obstacle truly does assume Everest proportions.

Zeidner (1990), p. 319) defined statistics anxiety as:

> "...a performance [anxiety] characterized by extensive worry, intrusive thoughts, mental disorganization, tension, and physiological arousal...when exposed to statistics content, problems, instructional situations, or evaluative contexts, and is commonly claimed to debilitate performance in a wide variety of academic situations by interfering with the manipulation of statistics data and solution of statistics problems."

Substituting "statistics' for "math" in Kitchens' (1995, p. 6) definition of math anxiety provides a simplistic definition: "[statistics] anxiety is an uneasy feeling accompanied by thoughts and feelings that keep one from doing one's best when working on [statistics] ..."

Some researchers (Onwuegbuzie & Wilson 2000) estimate the percentage of graduate students who are uncomfortably anxious about statistics to be as high as between 66% and 80%. Add the test and computer anxiety that students often transfer to statistics courses and the would-be learner finds himself/herself in possession of the blank or frozen mind one student aptly labeled "the deer in the headlights syndrome." Statistics anxiety (Onwuegbuzie & Wilson, 2000 ) has been found to be especially prevalent among women and minorities, and some researchers believe statistics anxiety may, in part, prevent some graduate students from completing their degree programs. However, most of the recent increase in research activity concerning statistics anxiety has been directed toward undergraduate students.

Other researchers (Perney & Ravid, 1991) share the view that students often delay taking required statistics courses as long as possible. Graduate students in statistics are dealing with a form of math that is highly non-routine and they know they have to pass the course to obtain their doctorates, even if, sadly, some plan to pay others to "do the stats" in their dissertations. Attitude heavily influences such behaviors: students either do not think they are able or do not want to complete their own data analyses.

Attitudes play a key role in anxiety. As McLeod (1992) pointed out when conceptualizing the affective domain of mathematics education, Gal et al. (1997), asserted that assessments in statistics education "...focus on beliefs and attitudes rather than on emotions, which are transient and hard to measure but important in that they can be intense and serve as the source for the development of attitudes." Ormrod (1995, p. 430) confirms the importance of attitude in math anxiety "...anxiety has two components: Negative emotional reactions ...'fear and dislike'...and the firm belief that ...[one is] incapable of succeeding."

### The EncStat Program

In an effort to begin addressing these needs, a team of researchers at the University of South Florida is developing a multimedia program to identify and help students with statistics anxiety (SA). EncStat includes test that provide information about a student's level of SA and/or negative attitudes toward statistics (NAS), computer anxiety, study skills, etc.; instruction on how SA affects learning; guidance on how to modify counterproductive behaviors, thoughts, and feelings resulting from SA. Future plans include development of a concept and skill support component as well as a program to enhance instructor knowledge about and skill in dealing with SA and NAS.

### Measurement of Statistics Anxiety

Two of the scales most frequently used in measuring SA and NAS, the Survey of Attitude Towards Statistics (SATS) and the STARS (Statistical Anxiety Rating Scale), were deemed appropriate for this study. Major elements of EncStat include identification of students with statistics anxiety, amelioration of that anxiety using cognitive behavior therapy techniques, and assisting students to achieve more positive attitudes about statistics. Because student attitude, as well as anxiety, is believed to play a crucial role in statistics achievement and frequency and quality of statistics use by alumni, information provided by both scales was considered essential.

In the computerized version of EncStat, this information will be used to tailor the intervention for each student, an accommodation that would be impossible without information provided by the SATS and STARS subscales. For example, if the STARS and SATs results show a student highly values statistics but has poor study skills and a previous history of negative experiences with math, the EncStat program for that student would include only brief statements on the worth of statistics but significant detail about improving study habits and overcoming the effects of a negative past history with math. Feinberg and Halperin (1988) suggest ". . . individual diagnostic profiles . . .may be useful in establishing prescriptive treatments specifically designed to help students who are likely to experience difficulty in statistics" (p. 11)

## Purpose of the Study

Previous research suggests that both the STARS and the SATS may provide valid and reliable scores for the assessment of SA and NAS. However, combining these two existing scales, plus nine questions on math past history and study skills, creates a 99-item assessment instrument. This pilot study was considered essential to assess and compare results for the SATS and STARS and their respective subscales as an initial effort toward eliminating duplicative items.

A second major effort of this pilot study was to collect qualitative information about SA and NAS. As Gal and Ginsburg (1994) observe, much of the research on attitude toward statistics [which, in their conceptualization, includes statistics anxiety] has used Likert-type response scales that, although convenient for generating broad descriptions and for reporting, produces little diagnostic information about individual students, information that is critical to guide intervention and inform changes in pedagogy. One component of the arsenal of assessment Gal and Ginsburg (1994) recommend is the use of structured interviews or focus groups. Krueger and Casey (2000, p. 9) assert that focus groups work because "...people self-disclose...and say what they really think and feel... when they feel comfortable and when the environment is permissive and nonjudgmental." That's more likely to happen, needless to say, away from the classroom.

## Data Source and Method

The first data source consisted of survey responses from 69 graduate students enrolled in three sections of a quantitative educational research course, one section of Statistical Analysis for Educational Research I (Statistics I) and two sections of Statistical Analysis for Educational Research II (Statistics II). Students were attending a Research I urban university in the southeast. The majority were doctoral students, for whom Statistics I and II were required components of their program of study. The students represented a variety of educational disciplines, such as early childhood education, educational leadership, and secondary education. Participation was voluntary, informed consent was obtained, and extra credit points were given to Statistics I students for completing the surveys. Each participant completed the STARS and the SATS as well as five questions each on study skills and past experiences with math. Two forms were used, with order of administration for the STARS and SATS counterbalanced, to control for order effects.

Demographic information on the participants suggests that the average student was just under 40 years of age (M = 39, SD = 9.21, range = 24 to 63 years). The number of graduate credit hours earned at the time of the statistics course ranged from 0 to 84 with a mean of 29.75 and a SD of 21.70. Grade Point Average (GPA) was high, as expected with doctoral courses, with a mean of 3.83 and a SD of 0.23. GPA values ranged from 0 to 4.0. Years of high school mathematics ranged 1 to 6 years (grades 7 –

12th) with a mean of 3.40 and a SD of 0.93, and the number of college math or statistics courses (CC) ranged from 0 to 12 with a mean of 3.8 and a SD of 0.93.

The second data source was focus groups. One traditional, in-person discussion group was conducted. Because of substantial similarity between information obtained from this initial group and findings from the literature, time constraints, and the need to offer participation to all students (and, for Statistics I students, extra credit), 30 students supplied written responses to the same questions answered in the in-person focus group.

## Results

### Psychometric Properties of STARS

The STARS (Cruise, Cash and Bolton, 1985) consists of six subscales. The 51 items in this instrument all use a 5-point response scale. The values range from "No Anxiety" (1) to "Very Much Anxiety" (5) for Part One of the instrument. Part Two also uses a five point Likert scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). The STARS was developed to measure statistics anxiety, which the authors define as "feelings of anxiety encountered when taking a statistical course or doing statistical analysis."(Cruise, et al. p.92) A high score on the STARS indicates either a high level of anxiety and/or a negative attitude towards statistics. The instrument level Cronbach's alpha was estimated to be .94.

Worth of Statistics (Worth). This subscale is comprised of 16 items that address the student's perceived importance of statistics. Higher scores reflect a lower level of personal importance placed on statistics by the individual. Cronbach's alpha was estimated to be .94.

Interpretation Anxiety (Interp). This set of 11 items was designed to measure anxiety as a result of interpreting or making a decision utilizing statistical data. A high score on this subscale indicates an inability to effectively use statistical procedures and strategies in the course of daily life. Cronbach's alpha was estimated to be .89.

Test and Class Anxiety (Tstclss). The eight items comprising this subscale focus on anxiety exhibited as a result of class or test participation. As with the two previous subscales, a high score is synonymous with increased levels of anxiety. Cronbach's alpha was estimated to be .90.

Computational Self-Concept (Compute). This subscale contains seven items focusing on anxiety related to one's perceived knowledge and ability to use statistics and to complete computations of mathematical procedures. Cronbach's alpha was estimated to be .88. A high score reflects a greater level of anxiety related to performing mathematical computations within statistical procedures as opposed to statistics itself.

Fear of Asking for Help (Fearhlp). The four items comprising this subscale address anxiety related to asking for help. High scores reflect greater amounts of anxiety perceived by the individual as a result of asking either teachers or fellow students for help in understanding materials of a statistical nature. Cronbach's alpha was estimated to be .83.

Fear of Statistical Teachers (Feartch). This set of five items was developed to address an individual's perception of the statistics teacher. The Cronbach's alpha was estimated to be .64. High scores reflect an individual's perception that the instructor lacks sufficient understanding to relate to the individual's predicament and as a result the instructor should be feared.

## Psychometric Properties of SATS

The SATS was developed by Schau, Stevens, Dauphinee and Del Vecchio (1995) and consists of 4 sub-sections containing a total of 28 items. The items utilize a seven point Likert scale. A high score on the SATS reflects a positive attitude or view towards statistics. The instrument level Cronbach's alpha was estimated to be .92.

Affect (Affect). This subscale contains six items and its focus is on feelings towards statistics. A high score reflects a positive view of statistics. Cronbach's alpha was estimated to be .88.

Cognitive Competence (CogComp). The six items in this subscale evaluate an individual's attitudes and intellectual knowledge relating to statistics. A high score reflects a positive attitude and knowledge level. Cronbach's alpha was estimated to be .83.

Value (Value). This subscale reflects attitudes regarding the relevance and usefulness of statistics. This subscale contains nine items. Cronbach's alpha was estimated to be .82.

Difficulty (Diff). The seven items in this subscale address perceived difficulty of statistics materials. Higher scores reflect a more positive attitude towards the field of statistics. Cronbach's alpha was estimated to be .75.

## Psychometric Properties of Additional Scales

The authors developed two additional scales in an attempt to learn more about participants' study skills and past math history. Both of these instruments use a 5-point Likert response scale.

Study Skills (Study). This subscale consists of 5 items that focus on the individual's study habits. A high score reflect better study habits as reported by the individual. Cronbach's alpha was estimated to be .63.

Past Math History (MathPH). The four items making up this subscale evaluate the individual's perceptions of their past experiences with mathematics. A high score indicates a positive history with the field of mathematics. Cronbach's alpha was estimated to be .86.

**Relationships Between Scales**

The relationships between subscale and total instrument scores for the STARS and SATS were examined first, to investigate the extent of commonality between the instruments. The correlation matrix for the instrument and subscales is presented in Table 1. The large negative correlation (r = -.89) between the two total instrument scores is expected because a high score on the SATS reflects a positive attitude towards statistics while a high score on the STARS reflects a negative attitude towards statistics. The moderate to large correlations within and between the two instrument's subscales provide evidence of convergent validity. Similarly, the moderate negative correlation (r = -.66) between MathPH and Compute was expected because a high score on MathPH reflects a positive experience in the past with mathematics and a high score on Compute measures anxiety experienced when working math problems as well as perceived ability to understand and calculate statistics. The moderate correlation between MathPH and Compute supports theoretical expectations.

With the exception of the small correlations and between Study Skills and CogComp (r = .29) and Study Skills and Affect (r = .22), the remainder of the correlations for Study Skills were in essence zero. The subscale Affect in general correlates highly with the STARS subscales, which address feelings related to statistics as opposed to Feartch and Fearhlp which reflect specific components of anxiety related to fear.

Correlation analysis also provides some evidence of possible areas to explore in an attempt to reduce the number of items. Specifically, correlations between Value and Worth and between CogComp and Compute were both 0.77; it seems likely one of each pair could be eliminated.

**Relationships with Demographic Variables**

Correlations were used to explore the relationship between responses on the instruments and demographic factors (Table 2). Moderately positive relationships were observed for the subscales Study with age ($r = .43$) and MathPH with CC of ($r = .47$). These suggest that as one matures their study habits improve and as students take more courses in statistics and math they have a more positive outlook on past courses.

Finally correlations between the subscales and students final grades were used to explore relationships between classroom performance and instrument scores. The correlation matrix for achievement and subscales is presented in Table 3. A small negative relationship($r = -.29$) was observed between Study Skills and students' Achievement, but correlations with the total instrument scores were essentially zero.

In addition to completing the attitude scales, students were asked to predict the grade they would receive in their current statistics course (options were letter grades A through F). Because only three participants selected a grade of C or less, the responses were collapsed into two groups, those expecting an A (57% of the sample) and those expecting less than an A (43% of the participants). To investigate differences between these two groups of students on the SATS, STARS, Study Skills and Path Math History, t –tests were conducted, using a Bonferroni approach to maintain familywise alpha at .05 (i.e., each test was conducted at the alpha value of 0.0125).

The results suggested a statistically significant difference between the two groups on the SATS (t(67)= -4.76), p<.01). Participants who anticipated a grade of A had a significantly higher mean score on the SATS than those who anticipated a grade less than A. For the 'A group', $\bar{X}$ =4.67, SD =0.95; for the 'less than A' group, $\bar{X}$ = 3.64, SD=0.78. The 'A' students mean of 4.67 suggest that they reported slightly positive attitude towards statistics and the 'less then A' group reported slightly negative attitudes towards statistics. A mean of 4 on this scale could be interpreted as a neutral value.

Similarly, a statistically significant difference was obtained between the two groups on the STARS (t(67)= 5.15), p<.01). This suggests that participants who anticipated a grade of A had a significantly higher mean score on the STARS than those who anticipated a grade less than A. For the A group, $\bar{X}$ =2.02, SD =0.59; for the less than A group, $\bar{X}$ = 2.77, SD=0.61. These scores would suggest that participants who selected the grade of A are reporting low levels of anxiety while those who selected a 'grade less then A' are reporting higher levels of anxiety than the 'A' students.

Despite differences between the two groups on STARS and SATS scores, no statistically significant difference was obtained on Study Skills (t(66)= -2.26), p<.03). For the 'A' group, $\bar{X}$ =3.83, SD =0.77; for the 'less than A' group, $\bar{X}$ = 3.43, SD=0.64. Both groups are reporting above average (3) study skills with the 'A' group having a higher score then the 'less than A' group.

Similarly, no differences were obtained on past math history (t(65)= -2.50, p= .015). For the 'A' group, $\bar{X}$ =4.22, SD =0.84; for the 'less than A' group, $\bar{X}$ = 3.62, SD=1.14. The 'A' group approached the maximum value (5) while the 'less than A' group reported values above neutral and positive.

Gender differences were also investigated using independent-means t-tests. As with the Expected Grade variable, the comparisonwise alpha was set at 0.0125 to keep the experimentwise alpha at 0.05. The sample contained 36% males and 64% females.

No statistically significant difference between males and females was obtained on the SATS (t(67)= 0.82), p<.41). For Males, $\bar{X}$ =4.37, SD =0.99; for Females, $\bar{X}$ = 4.16, SD=1.03. Similarly, no difference was obtained on the STARS (t(67)= -0.27), p<.79). For Male, $\bar{X}$ =2.31, SD =0.72; for Females, $\bar{X}$ = 2.36, SD=0.70.

Further, the male and female students showed no significant differences on study skills (t(65)= -2.20), p<.03). For Male, $\bar{X}$ =3.44, SD =0.70; for Females, $\bar{X}$ = 3.82, SD=0.67. Finally, no gender differences were obtained on past math history (t(66)= -0.31), p= .76. For Males, $\bar{X}$ =3.86, SD =1.02; for Females, $\bar{X}$ = 3.94, SD=1.11.

Differences among racial/ethnic groups were also investigated. This item originally asked participants to select from White, Native, Hispanic, Asian or Other American and Foreign Student. Due to the small numbers in the various minority categories this item was collapsed into three categories: White, Non-White and Foreign Students. These categories had sample sizes of 47, 13, and 9 respectively. One factor ANOVAs were conducted for these 3 groups.

The analysis of the SATS instrument revealed a statistically significant difference between the racial/ethnic group (F(2,61) = 10.83; p < .0001). Pairwise contrasts with a Bonferroni adjustment were used to determine differences between the groups and keep the familywise alpha at .05. Contrasts showed that white students scored significantly lower on the SATS than either foreign students (p = .001) or non-white students (p = .004). White $\bar{X}$ = 3.83, SD = .78; Non-white $\bar{X}$ = 4.62, SD = .64; Foreign student $\bar{X}$ = 5.07, SD = 1.16. This suggests that foreign students and non-white students evidence a more positive attitude towards statistics than white students.

The analysis of the STARS instrument revealed no statistically significant difference among the racial/ethnic groups (F(2,66) = 3.05; p=.054). White $\bar{X}$ = 2.48, SD = .67; Non-white $\bar{X}$ = 2.07, SD = .63; Foreign $\bar{X}$ = 2.01, SD = .78. These values would suggest that the groups reported neutral to slightly positive attitudes towards statistics.

Similarly, no significant differences were obtained between racial/ethnic groups on the self-reported study skills (F(2,65) = 1.85; p=.1659). The means and standard deviation are as follows: White $\bar{X}$ = 3.73, SD = .74; Non-white $\bar{X}$ = 3.31, SD = .65; Foreign $\bar{X}$ = 3.78, SD = .77. Finally, no significant differences were obtained for past history in mathematics (F( 2,65) = 1.85, p= .1652). White $\bar{X}$ = 3.76, SD = 1.08; Non-white $\bar{X}$ = 4.37, SD = .58; Foreign $\bar{X}$ = 4.11, SD = 1.41.

## Discussion

In general, the data obtained in this initial investigation support the psychometric integrity of both the STARS and SATS. Both instruments evidenced excellent internal consistency reliability both in their total scores ($r_{xx}$ = .94 and .92 for the STARS and SATS, respectively) and in their subscale scores (with subscale reliability estimates ranging from .64 to .94). Further, the correlations between subscales both within and across instruments support the anticipated multidimensional structure of statistics anxiety and suggest that the instruments sample overlapping domains.

Many relationships with variables external to the two scales are in the theoretically anticipated direction and are of sufficient magnitude to provide initial evidence supporting the validity of scores on these instruments. For example, individuals' perceptions of past math history were found to be inversely related to STARS scores and directly related to SATS scores, students who reported higher levels of statistics anxiety evidenced lower achievement *expectations* (but, interesting, did not evidence lower performance in statistics), and statistics anxiety scores were not appreciably related to either study skills or overall GPA in graduate work.

Demographically, statistics anxiety scores were not related to student gender, but were related to student racial/ethnic classification. Interestingly, white students reported statistically significantly higher levels of anxiety than either non-white or foreign students. Although previous research suggests higher anxiety scores should be anticipated for minority students, such research was based on samples of undergraduate students. Research on statistics anxiety among doctoral students is just beginning and the generalizability of results from undergraduate samples has yet to be determined.

Focus group data were subjected to thematic analysis and, in general, yielded results confirming findings previously suggested in the literature, such as that students had no idea many of their classmates also had distressingly high levels of anxiety and discomfort, were very nervous during class and could not think clearly, or were afraid to ask questions for fear of looking foolish.

Themes that emerged regarding causes and effects of SA were: negative previous experiences with math; length of time since exposure to math; similarity to a new language; the hierarchical nature of statistics and the lack of "incubation" time to absorb multiple new terms and concepts. In-person focus group participants and respondents to written questions expanded at length on the panic (the "deer in the headlights syndrome") they experience during class, the disconcerting feeling that one's mind has left the scene, and the difficulty working through problems alone due, primarily, to lack of confidence.

Among the suggestions given to make students less anxious were having a longer time span to cover the material, doing less in any one class session, and reducing the percentage of the final grade determined by exams. It should be noted that both instructors teaching the classes from which the sample was drawn include many of the suggestions students made as well as those referenced in the literature such as allowing take-home examinations and including take-home assignments and projects in the final grade. That might help explain why a statistically significant relationship between statistics anxiety and achievement was not found for these students.

Related to that was the fact that in-person focus group participants quickly generated a list of approximately twenty qualities other teachers should emulate that had helped reduce their anxiety, such as: being courteous, observant, calm, gentle, accepting, speaking slowly and rephrasing often, demonstrating respect for students and the desire to see them succeed, and being available to students.

## Limitations and implications

The most notable limitation of this study is that the tests were administered near the end of term, and no pre-course data were obtained. Additionally, two different instructors were involved The data clearly indicate a need for a program such as EncStat to provide support for graduate students with statistics anxiety. Further, the initial information suggests that the instrumentation targeted for EncStat will support reliable decisions within the program without undue burden on students. Methodologically, a review of results indicated that administration of sentence completion and/or open-ended items suggested by Schau et al. would likely provide some of the information obtained by written focus group answers, but in a form more amenable to analysis.

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Table 1

Correlations Between Instrument Subscales.

| | STARS | SATS | Affect | Cog Comp | Value | Diff | Study | Math PH | Worth | Interp | Tstclss | Compte | Fearhlp | Feartch |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (STARS) | 1.00 | | | | | | | | | | | | | |
| (SATS) | -0.89 | 1.00 | | | | | | | | | | | | |
| (Affect) | -0.82 | 0.87 | 1.00 | | | | | | | | | | | |
| (CogComp) | -0.77 | 0.82 | 0.78 | 1.00 | | | | | | | | | | |
| (Value) | -0.63 | 0.77 | 0.44 | 0.40 | 1.00 | | | | | | | | | |
| (Diff) | -0.68 | 0.81 | 0.63 | 0.56 | 0.52 | 1.00 | | | | | | | | |
| (Study) | -0.09 | 0.16 | 0.22 | 0.29 | -0.02 | 0.04 | 1.00 | | | | | | | |
| (MathPH) | -0.51 | 0.49 | 0.51 | 0.59 | 0.24 | 0.29 | 0.09 | 1.00 | | | | | | |
| (Worth) | 0.90 | -0.87 | -0.72 | -0.67 | -0.77 | -0.63 | -0.09 | -0.40 | 1.00 | | | | | |
| (Interp) | 0.81 | -0.64 | -0.67 | -0.59 | -0.34 | -0.52 | -0.05 | -0.36 | 0.56 | 1.00 | | | | |
| (Tstclss) | 0.85 | -0.75 | -0.76 | -0.62 | -0.46 | -0.64 | 0.06 | -0.42 | 0.66 | 0.73 | 1.00 | | | |
| (Compute) | 0.82 | -0.77 | -0.72 | -0.77 | -0.49 | -0.55 | -0.20 | -0.66 | 0.77 | 0.55 | 0.63 | 1.00 | | |
| (Fearhlp) | 0.61 | -0.38 | -0.36 | -0.42 | -0.17 | -0.34 | -0.05 | -0.34 | 0.36 | 0.60 | 0.52 | 0.40 | 1.00 | |
| (Feartch) | 0.60 | -0.58 | -0.49 | -0.48 | -0.46 | -0.45 | -0.13 | -0.21 | 0.59 | 0.32 | 0.40 | 0.37 | 0.31 | 1.00 |
| Mean | 2.34 | 4.24 | 4.01 | 4.68 | 4.99 | 3.09 | 3.66 | 3.92 | 2.15 | 2.47 | 3.25 | 2.09 | 2.11 | 1.94 |
| S D | 0.70 | 1.01 | 1.57 | 1.25 | 1.20 | 1.04 | 0.74 | 1.07 | 0.88 | 0.77 | 1.03 | 0.99 | 0.96 | 0.69 |

Table 2

Correlations Between Subscales and Demographic Variables.

| | STARS | SATS | Study | MathPH | Expected Grade | Age | Hours | GPA | Years math | College Courses |
|---|---|---|---|---|---|---|---|---|---|---|
| Statistical Anxiety Rating Scale (STARS)* | 1.00 | | | | | | | | | |
| Survey of Attitudes Toward Statistics (SATS)** | -0.89 | 1.00 | | | | | | | | |
| Study Skill (Study)* | -0.09 | 0.13 | 1.00 | | | | | | | |
| Past Math History (MathPH)* | -0.51 | 0.54 | 0.09 | 1.00 | | | | | | |
| Expected Course Grade (Xgrade) | -0.52 | 0.45 | 0.31 | 0.28 | 1.00 | | | | | |
| Age | 0.21 | -0.21 | 0.43 | -0.13 | -0.08 | 1.00 | | | | |
| Earned Credit Hours (Hours) | 0.19 | -0.14 | -0.26 | -0.06 | -0.09 | 0.04 | 1.00 | | | |
| GPA | 0.14 | -0.16 | 0.27 | -0.07 | 0.16 | 0.21 | 0.14 | 1.00 | | |
| Years of High School Mathematics (Yearsmath) | 0.14 | 0.19 | 0.16 | 0.22 | -0.01 | 0.01 | 0.01 | 0.06 | 1.00 | |
| Number of College Math/Stats Courses (CC) | -0.11 | 0.37 | 0.18 | 0.47 | 0.31 | 0.04 | -0.03 | -0.08 | 0.21 | 1.00 |
| Mean | 2.34 | 4.16 | 3.66 | 3.92 | 4.53 | 39.1 | 29.25 | 3.83 | 3.40 | 3.81 |
| SD | 0.70 | 0.94 | 0.74 | 1.07 | 0.60 | 9.21 | 21.70 | 0.23 | 0.93 | 2.64 |

* Scales with a 5 point Likert Scale
** Scales with a 7 point Likert Scale

Table 3

Correlations Between Subscales and Achievement.

| | STARS | SATS | Study | MathPH | Final Grade |
|---|---|---|---|---|---|
| Statistical Anxiety Rating Scale (STARS)* | 1.00 | | | | |
| Survey of Attitudes Toward Statistics (SATS)** | -0.89 | 1.00 | | | |
| Study Skill (Study)* | -0.09 | 0.26 | 1.00 | | |
| Past Math History (MathPH)* | -0.51 | 0.49 | 0.09 | 1.00 | |
| Achievement (Final Grade) | -0.07 | 0.13 | -0.29 | 0.19 | 1.00 |
| Mean | 2.34 | 4.24 | 3.66 | 3.92 | 58.44 |
| SD | 0.70 | 1.01 | 0.74 | 1.07 | 33.38 |

* Scales with a 5 point Likert Scale
** Scales with a 7 point Likert Scale

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