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# The Development and Factor Structure of the Faculty Perceptions of Statistics (FPS) Scale

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**Abstract.** The purpose of this study is to introduce the Faculty Perceptions of Statistics (FPS) scale, report on clusters associated with the inventory, and provide analytical comparisons of sum scores based on demographics. Items on the FPS scale refer to numerous facets of statistics such as the use of statistics in teaching and scholarship. A larger version of the FPS scale was administered online at seven universities and colleges to 747 participants. This research reports on a preliminary validation of the FPS scale to measure attitudes of college faculty towards the statistics discipline based on hierarchical cluster analysis with n=674 participants who completed all items. Seven clusters within the FPS scale were utilized: Comfort, General Teaching, Expectations, Statistical Literacy, Scholarship, Effective Teaching, and Benefits. The Cronbach's alpha values for the individual clusters ranged from 0.58 to 0.92. This article also highlights numerous results of the data collected by cluster based on participant demographics, such as discipline and previous statistical experience.

**Keywords:** attitudes toward statistics; hierarchical cluster analysis; factor structure; scale development.

## 1. Introduction

In light of the widespread teaching and use of statistics, it is important to understand the perceptions towards statistics held by faculty in other disciplines since they serve as role models to their students. Faculty perceptions and use of statistics could have a significant impact on students' perceptions and uses of statistics.

There is a growing collection of research related to students' attitudes and perceptions toward the field of statistics, and several inventories exist to measure these student views. Some prominent inventories include: the Survey of Attitudes Toward Statistics (Roberts & Bilderback, 1980); the Attitudes Toward

Statistics Scale (Wise, 1985); the Statistics Anxiety Rating Scale (Cruise, Cash, & Bolton, 1985); the Survey of Attitudes Towards Statistics (Schau, Stevens, Dauphinee, & Del Vecchio, 1995); and the Mathematics and Statistics Perceptions Scale (Cherney & Cooney, 2005). These instruments focus on understanding how statistics is viewed by students, and often include questions related to whether students believe that statistics is useful in daily life. Previous research has led to many important findings on students' attitudes toward statistics, including an entire special issue of the *Statistics Education Research Journal* devoted to the topic (Schau, Miller, & Petocz, 2012). Findings related to student attitudes indicate a correlation between student's attitudes and academic gain (Emmioğlu & Capa-Aydin, 2012). Additionally, Cherney and Cooney (2005) state that there is a significant, positive correlation between statistics attitudes and students' final grades. These results are important due to the potential for faculty attitudes to impact students' attitudes toward statistics.

Recent research has explored comparative classroom experiments on student attitudes towards statistics. For example, Gundlach et al. (2015) investigated attitudes among students taking a statistical literacy course in traditional, online, and flipped classes. Winquist and Carlson (2014) also looked at the effects of flipped classrooms for introductory statistics, but they considered the impacts a year after instruction and reported significantly higher retention for students in the flipped-classrooms. Ciftci, Karadag, and Akdal (2014) examined the impacts of using computer-based tools in statistics instruction for teacher candidates through a variety of scales to measure student attitudes and anxiety related to statistics. A small research study conducted by Autin, Marchionda, and Bateiha (2014) investigated the effects of a student-centered collaborative-learning class on student attitudes toward statistics and indicated some potential benefits to student-centered collaborative learning.

However, Shaughnessy (2007) states "there has been very little research into […] teachers' beliefs and attitudes toward statistics" (p. 1001) as quoted in Eichler (2010). The only previous research the authors have found on the topic of faculty perceptions toward statistics were the Faculty Attitudes Toward Statistics scale (Hassad & Coxon, 2007) and the Teaching of Introductory Statistics Scale (Hassad, 2011). However, Hassad focused on perceptions of faculty who teach statistics in behavior science programs and/or health programs. Based on the authors' knowledge, there is no survey which considers attitudes of all faculty towards the discipline of statistics, a field utilized by many other disciplines. Additionally, Hassad's Teaching of Introductory Statistics Scale focused on pedagogical aspects of teaching statistics, which are not considered in this research. Hassad (2013) has also developed the Attitude Toward Technology Integrations Scale, which measures attitudes of statistics instructors. In addition, Hassad (2015) has surveyed statistics instructors about the extent to which they teach statistical literacy and highlights discrepancies between what is actually taught and what instructors intend to teach.

It is necessary to further understand statistics perceptions of faculty, especially faculty within client disciplines. These client faculty are interacting with students who exit out of introductory statistics and enter their classes to use statistics. Therefore, a symbiotic relationship exists between statistics departments and client disciplines whereby statistics courses prepare students to be successful in their major area of study. Faculty attitudes and perceptions are an important area of research, particularly outside of mathematics and statistics departments, since statistics is widely taught and utilized by faculty across many client disciplines (Sterling, Rosenbaum, & Weinkam, 1995; Carlson, 2002; Switzer & Horton, 2007; Doehler, Taylor, & Smith, 2013). Indeed, Eichler (2010) states that future research should "investigate the teachers' attitudes towards statistics in more countries involving more representative samples of ordinary teachers" (p. 4). The research presented here considers individuals teaching statistics within many other disciplines. Therefore, it helps to fill a gap in the literature. Since statistics is utilized and taught by faculty in a large number of disciplines, it is imperative to also consider how faculty perceive statistics. If instructors have a poor attitude towards statistics and its usefulness, they could prevent statistics from being a positive experience for their students. Garfield, Hogg, Schau, and Whittinghill (2002) state that "our courses should attempt to build strong positive attitudes towards statistics […] to increase their chances of using statistics after they leave our courses" (p. 3). It seems logical that if this is a goal, then instructors and other individuals who influence students should also have "strong positive attitudes towards statistics." Zieffler et al. (2008) recognize the need for instructors to help students have a positive learning experience when studying statistics. They also state that learning of statistics could increase if students' attitudes toward the discipline improved. Therefore, student learning of statistics may increase when positive attitudes towards the discipline are displayed by faculty. Although this likely applies more so to faculty teaching statistics within any discipline, this may also apply to faculty who do not actually teach statistics. For example, if a student taking an introductory statistics class overhears a professor in another discipline saying that doing statistics is too hard for him/her, this could negatively impact the student's learning.

The study presented in this manuscript is of importance to the educational research community since a large portion of academics teach statistical topics, whether it be within a course in a client discipline or in an actual statistics course. Section 2 discusses features of the survey and results of the hierarchical cluster analysis that was performed. Section 3 presents a summary of sum scores for each demographic characteristic as well as discussion of inference based on the demographic categories. Concluding remarks are provided in Section 4.

## 2. Methodology

The Faculty Perceptions of Statistics (FPS) survey items were developed by the authors to be similar in intent to those in the aforementioned student attitude scales. Modifications and adjustments were made to a few items from student attitude scales so that the instructor was the intended audience. Many items were crafted based on characteristics which the authors believed would impact faculty attitudes. Question items in the FPS were intended to cover aspects of teaching statistics, use of statistics, and statistics in research. A working draft of the initial scale was reviewed by three experts in scale development and two subject matter experts. Additionally, an initial analysis was conducted using the first working draft of the scale. The initial data were analyzed to verify the scale's psychometric characteristics were within industry standards. The final version of the FPS collected information on attitudes and perceptions of faculty towards statistics. This study was conducted under IRB approval. There were 747 participants in the overall study collected from seven colleges and universities in the United States. Responses were collected from four private schools and three public institutions. Of the 747 responses collected, n=674 individuals completed all 33 Likert scale items (see Table 1) used in the hierarchical cluster analysis (HCA) presented in this paper. All Likert items used in the cluster analysis were on a six-point scale from strongly disagree to strongly agree. Demographic information was also collected related to the participants' previous statistical coursework, highest degree attained, years of teaching experience, job position, discipline, sex, school type (private or public), and use of statistics in teaching.

**Table 1: Faculty Perceptions of Statistics Scale with Cluster Identification.**

| Item Label | Survey Item | Cluster |
|---|---|---|
| General_H | I feel comfortable interpreting statistical results. | 1 – Comfort |
| Research_B | I feel comfortable reading scholarly articles that use statistical analyses. | 1 – Comfort |
| Research_D | I feel confident advising students using statistical analyses in their research. | 1 – Comfort |
| Teaching_A | Given the opportunity, I think I would like to teach classes that discuss or use statistics. | 2 – General Teaching |
| Teaching_C | It is likely that I will educate students on statistical analyses (hypothesis tests, confidence intervals, regression, etc.) in my classes. | 2 – General Teaching |
| Teaching_D | It is likely that my students will understand statistical analyses after taking my class. | 2 – General Teaching |
| Teaching_E | I would feel comfortable using basic statistical methods in courses that I teach. | 2 – General Teaching |
| Teaching_F | I would feel comfortable using advanced statistical methods in courses that I teach. | 2 – General Teaching |
| Education_A | I expect my students to do well in an introductory statistics course. | 3 – Expectations |
| Education_B | I expect introductory statistics courses to be relatively easy for my students. | 3 – Expectations |
| Education_C | It is important for my students to understand basic statistics in order to do well in my upper-level undergraduate classes. | 3 – Expectations |

| | | |
|---|---|---|
| General_A | It is useful to be able to understand basic statistics (poll results, averages in newspaper articles, etc). | 4 – Statistical Literacy |
| General_B | I am confident that I understand basic statistics (poll results, averages in newspaper articles, etc). | 4 – Statistical Literacy |
| General_C | I am confident that I can interpret graphs and charts appropriately. | 4 – Statistical Literacy |
| General_F | I think statistical literacy is an important part of being an informed citizen. | 4 – Statistical Literacy |
| General_G | Statistical literacy is important for my field of study. | 4 – Statistical Literacy |
| General_I | It is useful to be able to carry out statistical procedures or methods. | 4 – Statistical Literacy |
| Research_A | It is likely that I will use statistical techniques when conducting research. | 5 – Scholarship |
| Research_C | I find it important to use statistical analyses in my research. | 5 – Scholarship |
| Research_E | I feel that using statistical methods makes research papers stronger. | 5 – Scholarship |
| Research_F | Articles that use statistical methods are more trustworthy. | 5 – Scholarship |
| Research_G | Applying statistical techniques makes my research stronger. | 5 – Scholarship |
| Research_H | It is more likely that I can get a scholarly paper published if it includes statistical analyses. | 5 – Scholarship |
| Research_I | Statistical interpretations written in lay terms have more impact than those technically written. | 5 – Scholarship |
| Teaching_B | It is likely that I will use statistics (poll results, averages, graphs, etc.) in my teaching. | 6 – Effective Teaching |
| Teaching_G | The courses that I teach would be enhanced if I had greater statistical knowledge. | 6 – Effective Teaching |
| Teaching_H | For the classes that I teach, it is more important for students to be able to interpret statistical results than to compute statistics. | 6 – Effective Teaching |
| Education_D | I feel that a student with an understanding of statistics (relative to my field) is more likely to have the independent reasoning/analytical skills needed to succeed in the workplace. | 7 – Benefits |
| Education_E | Students with a better understanding of statistics will have an advantage when applying and interviewing for a job. | 7 – Benefits |
| Education_F | I feel that a student with an understanding of statistics (relative to my field) is more likely to have the independent reasoning/analytical skills needed to succeed in graduate school. | 7 – Benefits |

| | | |
|---|---|---|
| Education_G | Students with a better understanding of statistics will have an advantage when applying to graduate school. | 7 – Benefits |
| Education_H | I feel that having some statistical training is important for today's college graduate. | 7 – Benefits |
| General_D | I like using statistical formulas. | DROPPED |

To examine the underlying relationship between the survey items, HCA with complete linkage was used. Clusters were identified using a dendrogram and descriptive statistics. The best solution presented seven unique clusters of items, each having moderate to high reliability. During the initial analysis, one original survey item (General_D) was dropped from the final solution due to lack of fit. Specifically, the item had very little variability among respondents and did not fit with any of the clusters found in the solution. This brought the final FPS scale to 32 items. The sizes of the clusters ranged from three to seven items. The unique traits that underlie each cluster are as follows: (1) comfort with statistics, (2) general statistics in teaching, (3) student expectations with statistics and success in a statistics course, (4) statistical literacy, (5) use of statistics in own research or scholarship, (6) using statistics as part of an effective teaching practice, and (7) benefits of statistics to a student's training. Note that the cluster information can be found in Table 1 with abbreviated cluster titles. Figure 1 shows the dendrogram for the final solution with the seven clusters or scales. For each of the clusters identified in the analysis, summary statistics are reported in Table 2. There was little variance in the responses on the Comfort, Expectations, and Effective Teaching scales. The highest variances were observed on the General Teaching and Scholarship scales.

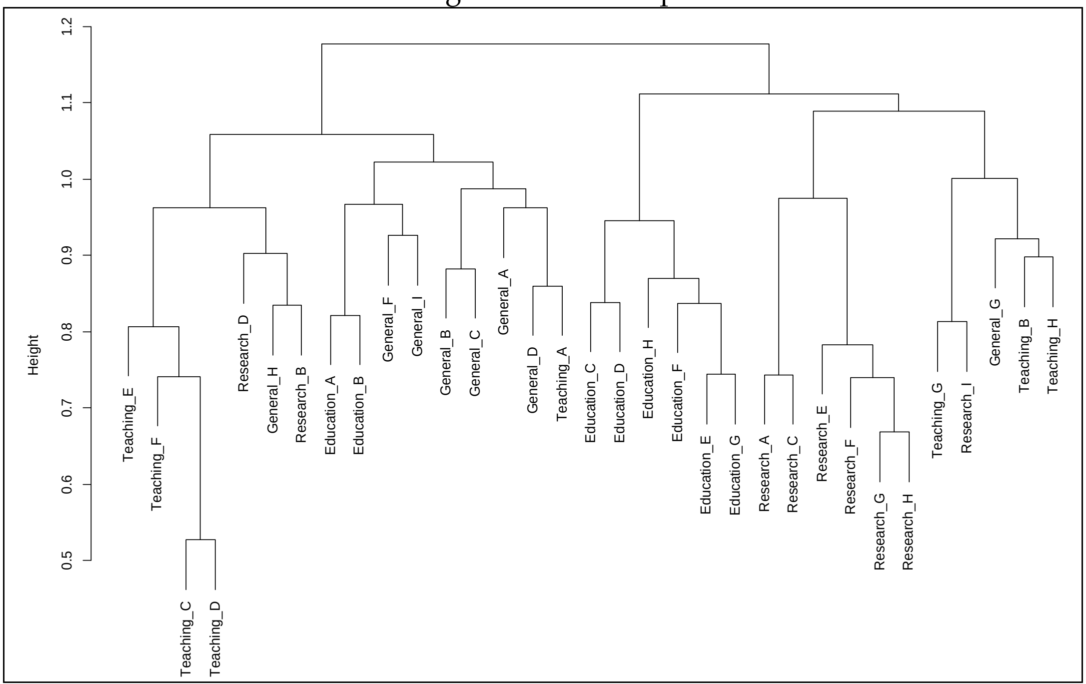



**Figure 1: Final cluster solution based on hierarchical cluster analysis with complete linkage.**

**Table 2: Sum score summary statistics by cluster.**

| Cluster/Scale | N | Min | Q1 | Median | Mean | Q3 | Max | SD |
|---|---|---|---|---|---|---|---|---|
| 1—Comfort | 3 | 3 | 10.0 | 13.0 | 12.0 | 14.0 | 15.0 | 2.8 |
| 2—General Teaching | 5 | 5 | 11.3 | 17.0 | 16.5 | 22.0 | 25.0 | 6.1 |
| 3—Expectations | 3 | 3 | 9.0 | 10.0 | 10.1 | 12.0 | 15.0 | 2.4 |
| 4—Statistical Literacy | 6 | 6 | 26.0 | 28.5 | 27.5 | 30.0 | 30.0 | 3.2 |
| 5—Scholarship | 7 | 7 | 24.0 | 30.0 | 27.7 | 33.0 | 35.0 | 6.2 |
| 6—Effective Teaching | 3 | 3 | 10.0 | 11.0 | 11.0 | 13.0 | 15.0 | 2.6 |
| 7—Benefits | 5 | 5 | 18.0 | 21.0 | 20.3 | 23.0 | 25.0 | 3.8 |

Cronbach's alpha was computed to examine the strength of each cluster. Additionally, to examine the relationship between the clusters, the correlation between each cluster was also calculated. Table 3 shows the reliabilities and correlations between clusters. Note that the reliabilities are in bold along the diagonal. The alpha values indicate that the clusters have moderate to strong reliability, which supports the clusters measuring the same trait. Additionally, the correlations between clusters tend to be in the moderate range which supports the notion that the clusters are measuring unique traits. Note that the most related clusters are Comfort and General Teaching. The most unique pairs of clusters are Comfort and Effective Teaching, Comfort and Expectations, and Expectations and Effective Teaching.

**Table 3: Cronbach's alpha (diagonal) for each cluster and the inter-cluster correlations.**

| Cluster/Scale | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1—Comfort | **0.85** | | | | | | |
| 2—General Teaching | 0.78 | **0.92** | | | | | |
| 3—Expectations | 0.36 | 0.49 | **0.58** | | | | |
| 4—Statistical Literacy | 0.66 | 0.61 | 0.37 | **0.80** | | | |
| 5—Scholarship | 0.56 | 0.54 | 0.41 | 0.53 | **0.88** | | |
| 6—Effective Teaching | 0.36 | 0.54 | 0.36 | 0.48 | 0.45 | **0.60** | |
| 7—Benefits | 0.45 | 0.53 | 0.49 | 0.54 | 0.60 | 0.45 | **0.87** |

## 3. Results

The following section describes the demographics of the sample used in the cluster analysis. Additionally, to gain a better understanding of the differences in perception of statistics among various demographics, the findings from the cluster analysis were used to determine if there were identifiable differences between any demographic subgroups. This was carried out using simultaneous confidence intervals which were generated using Fisher's LSD adjustment to control the family-wise type I error rate at 0.05. The following sections highlight some of the more interesting differences detected, but for brevity, all significant differences are not highlighted.

### 3.1. Demographics

There were 674 respondents from seven universities and colleges in the United States who answered all of the original 33 Likert scale items considered. The participant pool was fairly even between females (51%) and males (49%). Approximately 85% of respondents had taken a statistics class. Of these individuals, about 82% had taken their most recent statistics class at the graduate level. The mean and median of the number of years taught by respondents were 13.3 and 10 years, respectively. The corresponding standard deviation was 10.5 years.

Respondents came from a variety of levels of academic attainment. There were 69% with a Ph.D., 19% with a Masters degree, 4% with a Professional degree, 1% with a Bachelor's degree, and 6% of participants indicated some other degree as their highest level of attainment.

Presented in Table 4 is the distribution of position type within each academic area for the survey respondents. The two disciplines most represented were STEMS (Science, Technology, Engineering, Mathematics, and Statistics) and Social/Behavioral Science with 21% and 20% of responses, respectively. Additionally, most participants had a professorial position (72%) or non-professorial teaching position (21%). Individuals on non-professorial teaching tracks held positions such as lecturer, adjunct, instructor, or similar position. The small number of individuals who selected "Other" as their teaching position tended to identify themselves as professor emeritus, staff, or having multiple positions.

**Table 4: Demographic distribution of faculty position type within academic area.**

| Academic Area | Admin | Assist. Prof. | Assoc. Prof. | Full Prof. | Teach-ing | Other | Total |
|---|---|---|---|---|---|---|---|
| Arts | 0 | 7 | 7 | 3 | 12 | 0 | 29 |
| Business/Mgmt. | 2 | 13 | 16 | 12 | 13 | 3 | 59 |
| Communications | 2 | 8 | 6 | 4 | 8 | 0 | 28 |
| Education | 2 | 21 | 16 | 7 | 16 | 3 | 65 |
| Health/Medicine | 1 | 27 | 32 | 25 | 14 | 11 | 110 |
| Humanities | 0 | 13 | 22 | 14 | 26 | 1 | 76 |
| Professional Fields | 4 | 5 | 4 | 5 | 4 | 4 | 26 |
| STEMS | 2 | 36 | 33 | 38 | 25 | 5 | 139 |
| Social/Behavioral Sciences | 5 | 42 | 35 | 28 | 24 | 4 | 138 |
| Vocational/Technical Fields | 0 | 2 | 1 | 0 | 1 | 0 | 4 |
| Total | 18 | 174 | 172 | 136 | 143 | 31 | 674 |

Almost 31% of respondents indicated that they use statistics or teach statistical methods in their classes "frequently" or "almost all of the time," while 32% stated that they use statistics occasionally in their teaching. The remaining 37% of respondents reported using statistics "rarely" or "never" in their teaching. A vast majority of respondents indicated that they were comfortable teaching statistical procedures in their undergraduate courses, with only 12.5% indicating that they were "neutral" or "not comfortable" teaching statistics.

Sum scores were calculated for each scale to measure statistics attitudes and were combined to calculate an overall sum score. Table 5 contains summary statistics for average overall sum scores and averages for each of the seven scale sum scores for each demographic category.

**Table 5: Summary statistics of sum scores for major demographics reported as mean (standard deviation).**

| | Overall | 1 – Comfort | 2 – General Teaching | 3 – Expectations | 4 – Statistical Literacy | 5 – Scholarship | 6 – Effective Teaching | 7 – Benefits |
|---|---|---|---|---|---|---|---|---|
| Previous statistics coursework | | | | | | | | |
| No (n=101) | 104.4 (21.1) | 9.5 (2.9) | 11.4 (5.4) | 9.0 (2.4) | 25.3 (3.4) | 21.5 (7.2) | 9.8 (2.9) | 17.9 (4.3) |
| Yes (n=573) | 128.7 (18.8) | 12.4 (2.6) | 17.4 (5.7) | 10.3 (2.3) | 27.9 (3.0) | 28.8 (5.3) | 11.2 (2.5) | 20.8 (3.5) |
| Most recent statistics coursework | | | | | | | | |
| Graduate (n=471) | 132.4 (15.6) | 12.8 (2.3) | 18.3 (5.3) | 10.5 (2.2) | 28.3 (2.6) | 29.8 (4.4) | 11.6 (2.1) | 21.2 (3.2) |
| Undergraduate/HS (n=101) | 111.4 (22.3) | 10.3 (3.0) | 13.4 (6.0) | 9.5 (2.5) | 25.9 (3.7) | 24.1 (6.6) | 9.3 (3.2) | 18.9 (4.0) |
| Highest Degree | | | | | | | | |
| Bachelor's (n=9) | 122.6 (16.6) | 11.3 (2.2) | 15.4 (5.7) | 9.9 (2.3) | 27.1 (2.8) | 28.4 (2.7) | 9.8 (3.8) | 20.6 (3.2) |
| Masters (n=132) | 116.1 (21.2) | 10.5 (2.9) | 13.5 (6.0) | 9.5 (2.2) | 26.1 (3.9) | 26.5 (5.5) | 10.2 (3.2) | 19.7 (3.7) |
| Ph.D. (486) | 128.2 (20.6) | 12.5 (2.6) | 17.7 (5.7) | 10.3 (2.3) | 28.0 (2.9) | 27.9 (6.5) | 11.3 (2.4) | 20.6 (3.9) |
| Professional (n=38) | 118.7 (16.0) | 10.2 (2.6) | 12.8 (4.9) | 9.9 (2.5) | 26.3 (3.1) | 28.7 (5.2) | 10.9 (2.4) | 19.9 (2.8) |
| Other (n=9) | 117.9 (17.4) | 11.4 (2.2) | 13.6 (5.7) | 10.0 (2.8) | 25.9 (2.8) | 28.2 (5.7) | 8.8 (3.8) | 20.0 (3.5) |
| Teaching Experience | | | | | | | | |
| 0-5 (n=199) | 123.8 (20.7) | 11.6 (2.8) | 15.8 (6.0) | 9.8 (2.3) | 27.3 (3.3) | 28.4 (5.7) | 10.8 (2.8) | 20.1 (3.8) |
| 6-10 (n=137) | 124.9 (21.9) | 11.7 (3.0) | 16.4 (6.3) | 10.0 (2.2) | 27.6 (3.0) | 27.6 (6.6) | 11.4 (2.5) | 20.2 (4.2) |
| 11-19 (n=149) | 126.0 (21.8) | 12.5 (2.5) | 17.0 (6.0) | 10.1 (2.6) | 27.7 (3.1) | 27.4 (6.5) | 10.9 (2.9) | 20.3 (4.1) |
| 20-29 (n=107) | 124.7 (20.1) | 11.9 (2.8) | 16.7 (5.8) | 10.4 (2.2) | 27.2 (3.5) | 27.0 (6.3) | 11.0 (2.4) | 20.4 (3.3) |
| 30+ (n=72) | 129.5 (19.2) | 12.5 (2.9) | 18.0 (5.9) | 10.6 (2.3) | 28.1 (2.6) | 27.8 (5.9) | 11.2 (2.2) | 21.4 (2.7) |
| Position | | | | | | | | |
| Administrator (n=18) | 126.4 (17.4) | 12.2 (2.3) | 16.6 (5.7) | 10.6 (2.4) | 27.0 (3.8) | 27.7 (5.9) | 11.2 (2.3) | 21.3 (2.8) |
| Assistant Professor (n=174) | 127.3 (19.6) | 12.1 (2.7) | 16.9 (5.8) | 10.0 (2.4) | 27.9 (2.8) | 28.7 (6.2) | 11.2 (2.3) | 20.4 (3.9) |
| Associate Professor (n=172) | 126.9 (21.0) | 12.3 (2.6) | 16.8 (6.0) | 10.2 (2.3) | 27.8 (3.4) | 27.9 (6.2) | 11.2 (2.5) | 20.6 (3.7) |
| Professor (n=136) | 128.0 (20.9) | 12.3 (2.9) | 17.8 (5.9) | 10.6 (2.3) | 28.0 (2.2) | 27.5 (6.6) | 11.1 (2.3) | 20.7 (3.6) |
| Teaching (n=143) | 117.3 (22.8) | 10.9 (3.0) | 14.4 (6.3) | 9.7 (2.3) | 26.2 (3.9) | 26.4 (5.9) | 10.3 (3.1) | 19.6 (4.1) |
| Other (n=31) | 124.9 (15.0) | 12.0 (2.6) | 16.9 (5.6) | 9.5 (2.4) | 27.7 (2.3) | 28.1 (4.8) | 10.6 (3.1) | 20.2 (2.6) |
| Discipline | | | | | | | | |
| Arts (n=29) | 98.6 (18.2) | 9.5 (2.7) | 10.3 (4.7) | 8.2 (2.1) | 24.2 (3.7) | 21.8 (5.6) | 8.0 (2.6) | 16.5 (4.3) |
| Business/Manage. (n=59) | 130.8 (15.7) | 12.6 (2.2) | 18.3 (5.5) | 10.1 (2.1) | 28.3 (3.7) | 29.2 (4.2) | 10.9 (2.3) | 21.4 (3.2) |
| Communications (n=28) | 119.9 (18.0) | 11.9 (2.5) | 14.8 (5.5) | 8.8 (1.9) | 27.4 (2.5) | 26.0 (5.6) | 11.4 (2.1) | 19.7 (3.5) |
| Education (n=65) | 123.6 (17.4) | 11.7 (2.6) | 15.5 (5.5) | 9.8 (2.2) | 27.4 (3.4) | 27.9 (5.6) | 11.4 (2.3) | 20.0 (3.0) |
| Health/Medicine (n=110) | 128.8 (14.3) | 11.7 (2.6) | 16.3 (5.3) | 10.9 (2.0) | 27.5 (2.4) | 30.3 (3.4) | 11.6 (2.4) | 20.6 (2.9) |
| Humanities (n=76) | 98.9 (22.1) | 9.2 (3.2) | 10.0 (5.0) | 8.1 (2.2) | 24.6 (3.6) | 20.7 (7.2) | 9.0 (3.4) | 17.2 (4.5) |
| Professional Fields (n=26) | 124.3 (19.2) | 11.4 (2.6) | 15.4 (5.6) | 10.3 (2.7) | 26.7 (3.6) | 28.5 (5.5) | 11.1 (2.9) | 20.9 (2.7) |
| STEMS (n=139) | 131.5 (17.8) | 12.8 (2.3) | 19.4 (4.9) | 11.0 (2.0) | 28.4 (2.7) | 27.9 (6.1) | 11.1 (2.4) | 20.9 (3.7) |
| Social/Behav. Sci. (n=138) | 134.9 (16.5) | 13.2 (2.3) | 18.9 (5.3) | 10.5 (2.3) | 28.7 (2.1) | 30.0 (5.0) | 11.8 (1.9) | 21.8 (3.2) |
| Vocational/Technical (n=4) | 131.3 (7.6) | 12.5 (0.6) | 17.5 (3.9) | 10.0 (1.6) | 28.3 (0.5) | 29.5 (3.3) | 12.3 (1.5) | 21.3 (1.5) |
| Sex | | | | | | | | |
| Female (n=337) | 123.0 (21.6) | 11.5 (2.9) | 15.4 (6.1) | 10.0 (2.5) | 27.1 (3.4) | 27.9 (6.0) | 11.0 (2.7) | 20.1 (3.8) |
| Male (n=326) | 127.3 (20.2) | 12.4 (2.7) | 17.6 (5.8) | 10.2 (2.2) | 28.0 (2.6) | 27.5 (6.4) | 11.0 (2.5) | 20.6 (3.7) |
| School type | | | | | | | | |
| Private (n=250) | 122.6 (24.3) | 11.6 (3.1) | 16.4 (6.6) | 10.2 (2.4) | 27.3 (3.4) | 26.0 (7.0) | 11.0 (2.6) | 20.2 (4.0) |
| Public (n=424) | 126.6 (18.7) | 12.2 (2.6) | 16.6 (5.7) | 10.1 (2.3) | 27.6 (3.1) | 28.7 (5.4) | 11.0 (2.7) | 20.4 (3.6) |
| Use of Statistics | | | | | | | | |
| Almost all of the time (n=55) | 145.2 (7.0) | 14.3 (1.3) | 23.7 (1.8) | 11.3 (1.9) | 29.6 (0.7) | 30.8 (3.5) | 12.4 (1.9) | 23.1 (2.4) |
| Frequently (n=152) | 139.8 (13.8) | 13.5 (1.9) | 21.3 (3.8) | 11.2 (2.1) | 28.8 (3.1) | 30.4 (4.7) | 12.3 (2.0) | 22.3 (3.3) |
| Occasionally (n=218) | 127.7 (14.8) | 12.4 (2.1) | 17.0 (4.6) | 10.2 (2.0) | 28.0 (2.2) | 28.5 (5.0) | 11.4 (2.1) | 20.2 (3.3) |
| Rarely (n=168) | 114.9 (18.3) | 10.6 (2.9) | 12.8 (4.5) | 9.4 (2.5) | 26.5 (3.2) | 25.9 (6.3) | 10.3 (2.4) | 19.3 (3.6) |
| Never (n=81) | 98.0 (18.9) | 8.9 (2.7) | 9.1 (4.1) | 8.3 (2.2) | 24.4 (3.7) | 22.1 (7.4) | 7.8 (2.9) | 17.5 (4.1) |

### 3.2. Previous Statistics Coursework

Boxplots of sum scores for respondents based on the indicator variable of previous statistics coursework is shown in Figures 2 and 3. Overall there was a significant difference between responses of individuals who have taken a statistics class and those who have not ($F_{1,672}$ = 138.8, p < 0.0001). In particular, respondents who had taken a statistics class scored significantly higher overall and on all scales (higher on average by 24.3, 2.9, 6.0, 1.3, 2.6, 7.3, 1.4, and 2.9, respectively for overall and scales 1–7) based on Fisher's LSD adjusted simultaneous pairwise confidence intervals. There was a significant difference between those that had taken their most recent statistics course at the graduate level and those who had taken their most recent statistics course at the undergraduate or high school level ($F_{1,570}$ = 127.2, p < 0.0001). In particular, respondents who had taken their most recent class at the graduate level scored significantly higher overall and on all scales than individuals who took their most recent statistics class as an undergraduate or high school student (higher on average by 21.0, 2.5, 4.8, 0.9, 2.4, 5.7, 2.3, and 2.3, respectively for overall and scales 1–7).

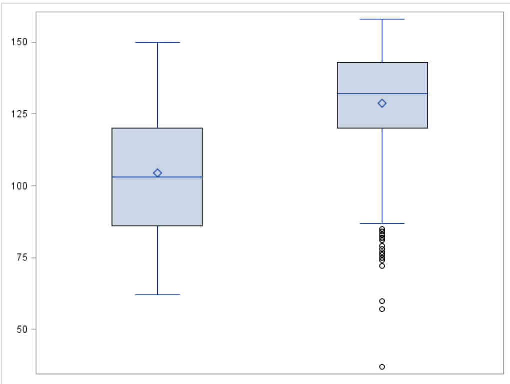



**Figure 2: Sum scores based on previous statistics course (No, Yes).**

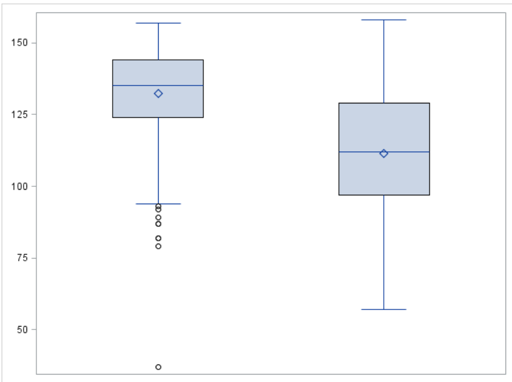



**Figure 3: Sum scores based on most recent statistics coursework (Graduate, Undergraduate/HS).**

### 3.3. Highest Degree

Boxplots of sum scores for respondents based on highest degree are shown in Figure 4. Differences in overall average scores based on highest degree were detected ($F_{4,669}$ = 12.4, p < 0.0001) with a Ph.D. yielding a significantly higher overall average score than those with a Professional degree, Masters degree, or

"Other" degree (higher on average by 8.7, 12.6, and 12.2, respectively). While there was no significant difference detected between overall scores for those with a Ph.D. compared to a Bachelor's degree, it is worthwhile to note that the sample size for Bachelor's degree was nine. It is also of interest to note that there are no significant differences detected between Bachelor's degrees and any other degree overall or on any scale. Individuals with a Ph.D. degree scored significantly higher than individuals with a Masters degree across all scales (higher on average by 2.1, 4.4, 0.7, 1.9, 1.4, 1.2, and 1.0, respectively for scales 1–7). Additionally, in all scales except Expectations and Scholarship, respondents with a Ph.D. scored significantly higher than individuals who selected "Other" for their highest degree (higher on average by 2.1, 4.7, 1.8, 1.3, and 1.3, respectively for scales 1–2, 4, and 6–7).

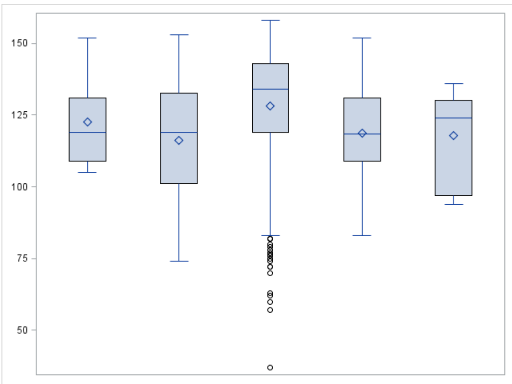



**Figure 4: Sum scores based on highest degree (Bachelor's, Masters, Ph.D., Professional Degree, Other).**

## 3.4. Teaching Experience

Years of teaching experience were categorized into the following categories: 0-5, 6-10, 11-19, 20-29, and 30 or more years. Figure 5 shows boxplots of sum scores for respondents based on the years of teaching category. No significant differences in overall scores based on teaching experience were detected ($F_{4,659}$ = 1.0, p =0.3821). The Comfort scale was the only scale with significant differences detected based on teaching experience ($F_{4,659}$ = 2.8, p = 0.0251). However, there were no meaningful patterns in the pairwise differences of average sum scores on the Comfort scale.

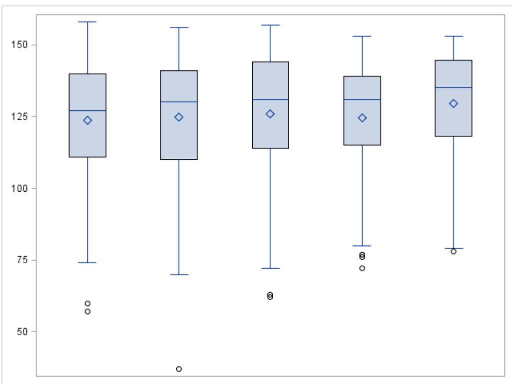



**Figure 5: Sum scores based on teaching experience (0-5, 6-10, 11-19, 20-29, 30+ years).**

## 3.5. Position

Figure 6 provides boxplots of sum scores for position type. There was a difference detected in the overall average score based on position type ($F_{5,668}$ = 5.3, p < 0.0001). Full professors, associate professors, and assistant professors scored higher overall than individuals on non-professorial teaching tracks by 10.7, 9.6, and 10.0 points, respectively, on average. Similarly, full professors, associate professors, and assistant professors scored significantly higher than individuals in non-professorial teaching positions for the Comfort, General Teaching, Statistical Literacy, and Effective Teaching scales. On the Expectations scale, full professors scored significantly higher on average than assistant professors, individuals in non-professorial teaching positions, and individuals in the "Other" category by 0.5, 0.9, and 1.1 points, respectively. On the Expectations, Scholarship, and Benefits scales, associate professors scored significantly higher on average than individuals in non-professorial teaching positions, by 0.5, 1.5, and 1.0 points, respectively. Note that among the assistant, associate, and full professors, the only significant difference detected was a higher score on the Expectations scale for full professors compared to assistant professors, with an average difference of 0.5 points.

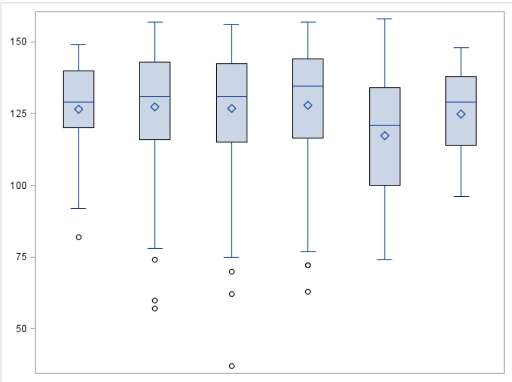



**Figure 6: Sum scores based on position (Administrator, Assistant Professor, Associate Professor, Professor, Teaching, Other).**

## 3.6. Discipline

Participants were asked to identify their discipline from one of the following fields: Arts, Business/Management, Communications, Education, Health/Medicine, Humanities, Professional Fields, STEMS, Social/Behavioral Sciences, and Vocational/Technical Fields. Boxplots of overall sum scores by discipline are given in Figure 7 and for each scale in Figure 8. All comparisons were made for the overall sum scores and the seven scale sum scores among all disciplines with the exception of Vocational/Technical Fields which had only four respondents. There was a difference in overall scores detected based on discipline ($F_{8,661}$ = 39.5, p < 0.0001).

As seen in Table 5, the lowest average sum score overall and for each of the clusters was associated with either the Arts or Humanities. The highest overall sum score was attributed to the Social/Behavioral Sciences, which also yielded the highest average sum score in four of the scales: Comfort, Statistical Literacy, Effective Teaching, and Benefits scales. The highest average sum score for the

General Teaching and Expectations scales were associated with STEMS disciplines. Health/Medicine had the highest average sum score on the Scholarship scale.

In general, fewer differences were detected on the Effective Teaching scale, and the most differences were detected on the General Teaching scale. Each discipline was compared with the remaining eight disciplines across the seven scales and across overall sum scores for a total of 64 pairwise comparisons. Professional Fields had the least number of significant pairwise differences detected among these comparisons with a total of 22 significant differences detected. Both Arts and Humanities had the most significant pairwise differences when compared to other disciplines with a total number of 52 significant pairwise differences detected. There were six or seven significant differences detected on each scale and in the overall sum scores for both Arts and Humanities. The only pairs of disciplines that were not significantly different from each other overall or across any scales were (1) Arts and Humanities and (2) Health/Medicine and Professional Fields. The following pairs of disciplines were significantly different from each other in overall sum scores and on every scale were Arts with (1) Business/Management, (2) Education, (3) Health/Medicine, (4) STEMS, and (5) Social/Behavioral Science and Humanities with the same disciplines as Arts.

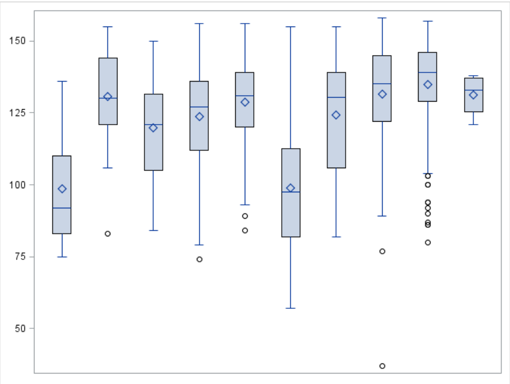
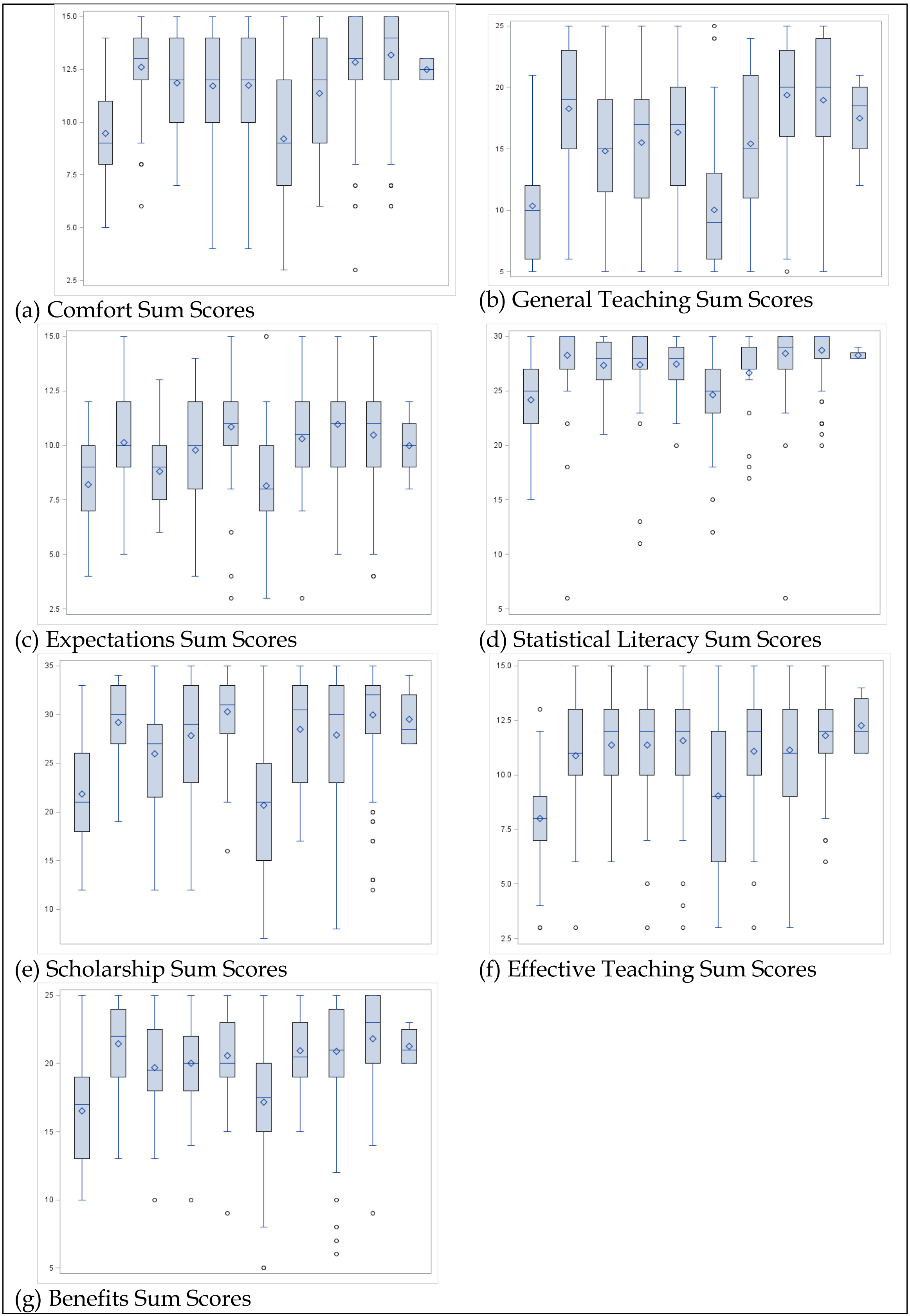



**Figure 7: Overall sum scores based on discipline (Arts, Business/Management, Communications, Education, Health/Medicine, Humanities, Professional fields, STEMS, Social/Behavioral Sciences, Vocational/Technical fields).**



(a) Comfort Sum Scores

(b) General Teaching Sum Scores

(c) Expectations Sum Scores

(d) Statistical Literacy Sum Scores

(e) Scholarship Sum Scores

(f) Effective Teaching Sum Scores

(g) Benefits Sum Scores

**Figure 8: Boxplots of sum scores for scale by discipline ((Arts, Business/Management, Communications, Education, Health/Medicine, Humanities, Professional fields, STEMS, Social/Behavioral Sciences, Vocational/Technical fields).**

### 3.7. Sex

Boxplots of sum scores by sex are given in Figure 9. There was a difference in average sum scores between males and females ($F_{1,661} = 7.1$, $p = 0.0080$) with male respondents scoring significantly higher overall than female respondents by between 1.1 and 7.5 points. In addition, scores on the Comfort, General Teaching, and Statistical Literacy scales were also significantly higher for males (higher on average by 0.9, 2.2, and 0.9, respectively for scales 1–2 and 4). The Expectations, Scholarship, Effective Teaching, and Benefits scales showed no significant differences between females and males.

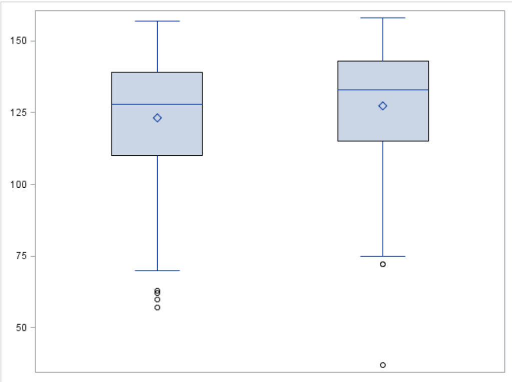



**Figure 9: Sum scores based on sex (Female, Male).**

### 3.8. School Type

Figure 10 shows overall sum scores based on school type. Average overall score was significantly different ($F_{1,672} = 5.7$, $p = 0.0168$) with individuals from public institutions scoring significantly higher than those at private institutions by between 0.7 and 7.3 points. Similarly, scores on the Comfort and Scholarship scales were also significantly higher at public institutions (higher on average by 0.6 and 2.7, respectively). No other significant differences were detected between scale scores based on school type.

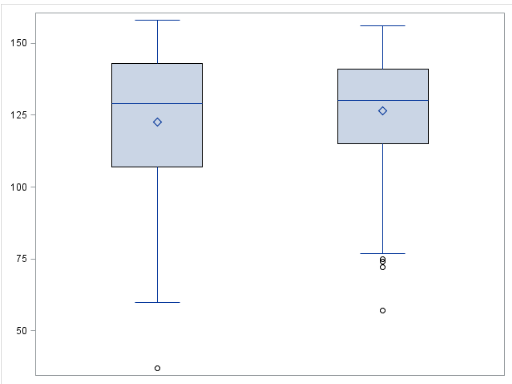



**Figure 10: Sum scores based on school type (Private, Public).**

### 3.9. Use of Statistics

Each respondent was asked to identify how often they use statistics or teach statistical methods in their classes. Associated boxplots of sum scores are located in Figure 11. There was a significant difference in the average overall sum scores based on use of statistics ($F_{4,669} = 136.8$, $p < 0.0001$). Specifically, average sum scores increased as the frequency of statistics usage increased from "Never," "Rarely," "Occasionally," "Frequently," and "Almost all of the time." The average overall sum scores were 98.0, 114.9, 127.7, 139.8, and 145.2, respectively. Significant pairwise differences were detected between all use of statistics response categories in overall sum scores and in the sum scores for the Comfort and General Teaching scales. For the remaining scales, all pairwise differences of sum scores were significantly different with the exception of the "Almost all of the time" and "Frequently" response categories, for which no significant differences were detected.

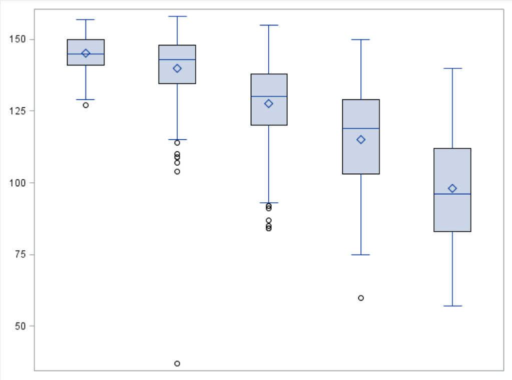



**Figure 11: Sum scores based on the use of statistics (Almost all of the time, Frequently, Occasionally, Rarely, Never).**

## 4. Discussion

Not surprisingly, a comparison of sum scores based on demographics indicated that the presence of previous statistics coursework is an indicator of the importance for which faculty have towards the discipline of statistics. This appeared higher with graduate level statistical coursework compared to lower levels of coursework in statistics. In addition, the level of academic achievement held some importance on the sum scores overall and across scales with Ph.D. respondents scoring consistently and significantly higher than individuals with a Masters degree. The type of position provided some indication on sum scores. In particular, individuals on the professorial track tended to have higher scores. Scores varied greatly across disciplines with Humanities and Arts having scores significantly lower than other fields. Male respondents had significantly higher scores on some but not all scales. Based on the results, private colleges and universities have a significantly higher overall sum score. However, these results may be associated with whether an institution is considered to be a Research I, liberal arts, or other type of school. As expected, a higher frequency of teaching statistics is associated with a significantly higher average statistics attitude scores. Based on the results, there was not a relationship detected between overall sum scores and years of teaching experience. Initially this was somewhat surprising, since it is likely that more experience teaching is positively correlated with more exposure to statistics. However, with statistics being a relatively new and rapidly growing discipline, it is possible that younger faculty and instructors utilize statistics more and therefore also have positive attitudes towards the discipline and its usefulness.

While the current study includes responses from seven colleges and universities, the responses were collected through online surveys for convenience. As is the norm, participation was voluntarily. Although this type of sampling method is common in many studies, it is possible that respondents were more likely to be interested in statistics, resulting in more positive attitudes. In an effort to reduce possible biases and encourage more individuals to respond, participants at six of the seven schools were eligible to enter a drawing to win one of multiple $20 gift cards that were available. The number of responses obtained also appeared to be related to how the email with the survey link was distributed. For example, at some schools the survey was sent by a contact individual, while at other schools the survey link was sent out via a forwarded email. In general larger schools tended to yield more responses. Varying response rates among institutions could have impacted the demographic characteristics of our sample.

## 5. Conclusion

Little to no research exists measuring the attitudes of faculty across all disciplines towards statistics. The Faculty Perceptions of Statistics (FPS) scale introduces a survey of 32 Likert scale items to measure these attitudes. Based on the results of the hierarchical cluster analysis, it is clear that there are some underlying constructs related to the views that faculty or academic department members have towards the use and importance of statistics. The analysis indicates seven scales: Comfort, General Teaching, Expectations, Statistical Literacy, Scholarship, Effective Teaching, and Benefits. This study is an initial exploration into the area of faculty attitudes and shows promise with Cronbach's alpha values ranging from 0.58 to 0.92 for the different clusters identified. Based on these results, differences in cluster sum scores were detected among demographic groups. Many of the differences were not surprising. For example, having statistical experience tended to lead to increases in sum scores. There was a lot of variability in sum scores among the disciplines, with Arts and Humanities having the lowest sum scores both overall and for all clusters. Somewhat surprisingly, there did not appear to be a relationship between years taught and attitudes towards statistics based on sum scores.

The FPS instrument would benefit from further refinement, and additionally, a cross-validation study and invariance testing should be conducted in order to see if the clusters found are generalizable. It would also be beneficial to administer the FPS scale survey across a wider variety of institutions such as community colleges.

The FPS scale and the findings presented in this paper are an initial step into examining the interwoven attitudes of faculty and students. Previous literature indicates a strong relationship between students' attitudes and academic success in statistics courses (Emmioğlu & Capa-Aydin, 2012; Cherney & Cooney, 2005).

Based on this, more research should be conducted to explore the relationship between faculty attitudes towards statistics and students' attitudes.

## References


Autin, M. Marchionda, H. & Bateiha, S. (2014). Attitude Adjustment in Introductory Statistics. In *proceedings of the 41th Annual Meeting of the Research Council on Mathematics Learning*, San Antonio, Texas, 80-88.

Carlson, B. (2002). Preparing Workers for the 21st Century: The Importance of Statistical Competencies. In *proceedings of the International Conference on Teaching Statistics (ICOTS-6)*, Cape Town, South Africa, 1-6.

Ciftci, S. K., Karadag, E., & Akdal, P. (2014). Instruction of Statistics via Computer-Based Tools: Effects on Statistics' Anxiety, Attitude, and Achievement. *Journal of Educational Computing Research, 50(1)*, 119-133.

Cruise, J. R., Cash, R. W., & Bolton, L. D. (1985). Development and validation of an instrument to measure statistical anxiety. In *proceedings of the American Statistical Association, Section on Statistical Education*, Las Vegas, 92-97.

Cherney, I. D. & Cooney, R. R. (2005). Predicting student performance in a statistics course using the Mathematics and Statistics Perception Scale (MPSP). *Transactions of the Nebraska Academy of Sciences, 30,* 1-8.

Doehler, K., Taylor, L., & Smith, J. (2013). A Study of Faculty Views of Statistics and Student Preparation Beyond an Introductory Class. Journal of Statistics Education, *21*(1). Retrieved from http://www.amstat.org/publications/jse/v21n1/doehler.pdf

Eichler, A. (2010). The Transformation Process from Written Curricula to Students' Learning. In *proceedings of the International Conference on Teaching Statistics 8* (ICOTS8), Ljubljana, Slovenia. Voorburg, The Netherlands. Retrieved from http://icots.info/8/cd/pdfs/invited/ICOTS8_8E3_EICHLER.pdf

Emmioğlu, E. & Capa-Aydin, Y. (2012). Attitudes and achievement in statistics: A meta-analysis study. *Statistics Education Research Journal*, *11*(2), 95-102. Retrieved from http://iase-web.org/documents/SERJ/SERJ11(2)_Emmioglu.pdf

Garfield, J., Hogg, B., Schau, C., & Whittinghill, D. (2002). First Courses in Statistical Science: The Status of Educational Reform Efforts. *Journal of Statistics Education*, *10*(2). Retrieved from http://ww.amstat.org/publications/jse/v10n2/garfield.html

Gundlach, E., Richards, K. A., Nelson, D. & Levesque-Bristol, C. (2015). A Comparison of Student Attitudes, Statistical Reasoning, Performance, and Perceptions for Web-augmented Traditional, Fully Online, and Flipped Sections of a Statistical Literacy Class. *Journal of Statistics Education, 23(1)*. Retrieved from http://www.amstat.org/publications/jse/v23n1/gundlach.pdf

Hassad, R. A. & Coxon, A. P. M. (2007). Development and Initial Validation of a Scale to Measure Instructors' Attitudes toward Concept-Based Teaching of Introductory Statistics in the Health and Behavioral Sciences. In *proceedings of the International Statistical Institute, 56th Session*, Lisbn, Portugal. Retrieved from http://files.eric.ed.gov/fulltext/ED506520.pdf

Hassad, R. A. (2011). Constructivist and Behaviorist Approaches: Development and Initial Evaluation of a Teaching Practice Scale for Introductory Statistics at the College Level, Numeracy, *4*(2). Retrieved from http://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=1057&context=numeracy

Hassad, R. A. (2013). Faculty Attitude towards Technology-Assisted Instruction for

Introductory Statistics in the Context of Education Reform. *Technology Innovations in Statistics Education, 7(2)*.
Hassad, R. A. (2015). Variability in the Teaching of Statistical Literacy: A Case of Pedagogical Dissonance. In *proceedings of the Satellite Conference of the International Association for Statistical Education (IASE)*, Rio de Janeiro.
Roberts, D. M. & Bilderback, E. W. (1980). Reliability and Validity of Statistics Attitude Survey. *Educational and Psychological Measurement, 40*(1), 235-238.
Schau, C., Miller, M., & Petocz, P. (Eds.). (2012). Research on Attitudes Towards Statistics [Special Issue]. *Statistics Education Research Journal*, *11*(2).
Schau, C., Stevens, J., Dauphinee, T. L, & Del Vecchio, A. (1995). The development and validation of the Survey of Attitudes Toward Statistics. *Educational and Psychological Measurement, 55*(5). 868-875.
Shaughnessy, J. M. (2007). Research on statistics learning and reasoning. In F. K. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 957-1010). Charlotte, NC: Information Age Publishing.
Sterling, T. D., Rosenbaum, W. L., & Weinkam, J. J. (1995). Publication Decisions Revisited: The Effect of the Outcome of Statistical Tests on the Decision to Publish and Vice Versa. *The American Statistician, 49*(1), 108-112.
Switzer, S. S. & Horton, N. J. (2007). What Your Doctor Should Know about Statistics (but Perhaps Doesn't…). *CHANCE, 20*(1), 17-21.
Winquist, J. R. & Carlson, K. A. (2014) Flipped Statistics Class Results: Better Performance Than Lecture Over One Year Later. *Journal of Statistics Education, 22(3).* Retrieved from http://www.amstat.org/publications/jse/v22n3/watkins.pdf
Wise, S. L. (1985). The development and validation of a scale measuring attitudes toward statistics. *Educational and Psychological Measureme*nt, *45*(2), 401 – 405.
Zieffler, A., Garfield, J., Alt, S., Dupuis, D., Holleque, K., & Chang, B. (2008). What Does Research Suggest About the Teaching and Learning of Introductory Statistics at the College Level? A Review of the Literature. *Journal of Statistics Education*, *16*(2). Retrieved from www.amstat.org/publications/jse/v16n2/zieffler.html