Understanding The Negative Graduate Student Perceptions Of Required Statistics And Research Methods Courses: Implications For Programs And Faculty

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ABSTRACT

The authors of this study endeavor to explore the negative opinions and perceptions of graduate students in business and social science programs, regarding their required statistics and research methods courses. The general sense of instructors of such courses is that students dread and resent having to take courses dealing with statistics and social research because they are both intellectually demanding and require students to call on mathematics skills. Students also seem to put a low value on such courses in terms of application to their own careers.
Clearly, the above-mentioned perceptions derive from intuitive knowledge and anecdotal statements by students. The authors of this study devised a research design to test the validity of the perceptions of negative attitudes among students in their graduate programs and to gain some understanding of the basis of the negativity.

INTRODUCTION

Instructors of statistics and research methods courses, in graduate business or social science programs speak of the dread and negative anticipation students bring to their classes. "While many teachers of statistics are likely to focus on transmitting knowledge, many students are likely to have trouble with statistics due to non-cognitive factors, such as negative attitudes or beliefs towards statistics." [1] Many graduate business and social science programs require students to study empirical, quantitative research techniques as a component of their curriculum. Many students enter the courses worried they will not perform well and resenting the fact that they must take the courses. Instructors must overcome the implications of such an emotional attitude toward their classes and may not always be successful. "The existence of these strongly-held ideas may explain, in part, why learning probability and statistics is especially problematic."[2]

One important consequence of the unenthusiastic attitudes of students may be derogatory course evaluations of statistics and research methods courses. The instructor must bear the professional implications of biased, unenthusiastic course evaluations, perhaps regardless of the quality of their teaching or course content. For the instructor, that may mean less than stellar annual evaluations, lower merit raises, and may even affect tenure decisions. For business and social science graduate programs, it may mean fewer and fewer faculty is willing to teach the required courses.

[1]Gal, Iddo and Ginsburg, Lynda. The Role of Beliefs and Attitudes in Learning Statistics: Towards an Assessment Framework, *Journal of Statistics Education* v.2, n.2 (1994)
[2]Konold, Clifford. Issues in Assessing Conceptual Understanding in Probability and Statistics, *Journal of Statistics Education* v.3, n.1 (1995)

Literature and empirical studies regarding this subject are sparse and dated. "Although many articles in the education literature recommend how to teach statistics better, there is little published on how students actually learn statistics concepts."[3] This paper endeavors to test the notion of disproportionate dislike of statistics and research methods courses when compared to other, less technical courses. The authors use student course evaluations to compare and statistically test the significance of the difference between a two-course sequence of statistics and research methods and a course in administrative behavior over a multi-year period. The findings of the study hold implications for understanding the disparity in student perceptions between the two types of courses as well as for the use of student evaluations for accessing instructor performance in statistics and research methods courses.

METHODOLOGY

Because course evaluations are so key to the understanding and effects of negative student attitudes toward statistics and research courses, the authors chose to use them as the empirical basis of this study. The research design takes the responses of students to nine questions on the course evaluations, given to all students in all classes of the School of Business of the University of New Haven. To provide a valid, contrasted design, the authors chose two statistics or research courses (Research Strategies and Research Seminar) and compared them to two non-statistics based courses (Administrative Behavior and Introduction to Microeconomics and Macroeconomics.) To control for differences created by instructor or teaching variation, the authors used the same two instructors' evaluations; both instructors teach one of the statistics based courses and one of the non-statistics based courses. The evaluations derive from a four-year period from 2002 to 2006.

The questions in the evaluations require answers on an ordinal scale, with five levels. Because of the level of measurement of the responses, the authors were limited in their analytical techniques, focusing on chi square analysis and Gamma analysis of correlation. In the examination of the data, both the individual classes and a recoded scheme putting the courses into the category of either statistics based or non-statistics based, became the basis of comparison. The total number of cases was 430.

ANALYSIS

Initial analysis found that of the 430 cases, 180 were in the non-statistical courses and 250 were in the statistical courses. The course specific breakdown of responses appears below in Table 1.

Table 1

Course	Students	Percent of Total
Administrative Behavior (non-stat)	127	29.5
Macro and Microeconomics (non-stat)	53	12.3
Research Strategies (stat)	123	28.6
Research Seminar (stat)	127	29.5
Total	430	100

The School of Business of the University of New Haven uses a standardized evaluation form that asks students to choose from an array of scaled responses to answer course related questions. The actual questions asked on the evaluation instrument, that the authors chose to use in this study, are as follow:

[3] Garfield, Joan and Ahlgren, Andrew. "Difficulties in Learning Basic Concepts in Probability and Statistics: Implications for Research, ***Journal for Research In Mathematics Education****, vol. 19, no. 1, January 1988*

Table 2

1.	How much class time the student missed.
2.	If they completed all readings and assignments.
3.	The student's QPR
4.	The student's expected grade for the class
5.	Whether they believed the course was helpful to their career
6.	How much they felt they learned compared to other courses
7.	The student's perceptions of the overall effectiveness of the instructor
8.	The student's overall rating of the course

The authors chose to approach the analysis by looking at the differences among the various classes in the study as well as the differences between the reclassified "stat" and "non-stat" courses. To analyze the differences, the authors used chi square analysis and related statistics as well as Spearman's rho and Gamma analyses analysis of correlation among the variables, using question 8 in the above table as a dependent variable. In this way, the hypothesis that there exists a pervasive negative attitude among students toward their statistics based classes compared to others.

FINDINGS

Chi square analysis comparing the individual courses found confirmation of the strong differences among the courses. Analysis revealed statistically significant associations between the courses and the questions in the analysis of all the questions. The individual course findings appear in Table 3, below.

Table 3
Course by Evaluation Question

	Question	Chi^2 Sig.	Cramer's V
1.	How much class time the student missed.	.000[4]	.195
2.	If they completed all readings and assignments.	.016	.149
3.	The student's QPR	.000	.209
4.	The student's expected grade for the class	.000	.229
5.	Whether they believed the course was helpful to their career	.000	.252
6.	How much they felt they learned compared to other courses	.000	.320
7.	The student's perceptions of the overall effectiveness of the instructor	.000	.351
8.	The student's overall rating of the course	.000	.378

Interpretation of these findings reveals that there are substantial differences among the classes. Based on the Cramer's V findings of effect size, the smallest difference from class to class was in completion of all readings and assignments. The largest or strongest difference among the classes emerged in the overall rating of the course with a moderate finding of .378. This finding shows the general difference in attitudes found among these classes. The other strong findings are in the questions of whether they believed the course was helpful to their career (.352); the student's perceptions of the overall effectiveness of the instructor (.351); and how much they felt they learned compared to other courses (.320). Due to the nominal nature of the courses data and the ordinal nature of all the question data, no directional measures were possible in the analysis of these variables.

The fact that the same instructors taught both statistics based and non-statistics based courses in the study, shows how the nature of course colors the perception of the professor. As stated in the introduction, this finding has serious negative implications for professors who choose to teach statistics based courses.

[4] The authors used SPSS v. 13 for analysis of this data. In SPSS any finding of significance that is less than .050 is considered significant at the .95 level. A finding of .000 is a significant finding.

Armed with the knowledge that salient differences exist among the classes, and in order to control for substantive differences among the classes, the authors chose to explore the distinguishing features in the perceptions of students when comparing statistics based classes and non-statistics based classes. For this analysis, they classified the Administrative Behavior and Introduction to Microeconomics and Macroeconomics courses as non-statistics based courses while reclassifying Research Strategies and Research Seminar as statistics based courses. Once completed, the authors applied the same chi square analysis as in the above course specific analysis. The findings appear in Table 4.

Table 4
Statistics or Non-Statistics by Evaluation Question

	Question	Chi^2 Sig.	Cramer's V
1.	How much class time the student missed.	.000[5]	.281
2.	If they completed all readings and assignments.	not significant	
3.	The student's QPR	not significant	
4.	The student's expected grade for the class	not significant	
5.	Whether they believed the course was helpful to their career	.000	.383
6.	How much they felt they learned compared to other courses	.000	.300
7.	The student's perceptions of the overall effectiveness of the instructor	.000	.364
8.	The student's overall rating of the course	.000	.444

In every association showing a significant finding, the Cramer's V measure of effect size is larger. The interpretation of that finding is that when the basis of comparison is only the use of statistics in the class, the difference between statistics based and non-statistics based classes becomes larger. The large Cramer's V findings for the questions regarding whether they believed the course was helpful to their career (.383), how much they felt they learned compared to other courses (300), and their overall rating of the course (.444) could be interpreted to show the reality of different opinions of the courses based entirely on their content. The finding of the student's perceptions of the overall effectiveness of the instructor (.364) again shows a serious disparity in how the students perceived their professors and that the nature of the course colored the perception of the professor more so than the competence or style of the teaching . The authors are able to draw such a conclusion because of the control measure of having both professors teach in both areas. The important implications of this perceptual disparity is obvious and reinforces the common notion that professors of statistics based classes tolerate an automatic negative bias in their evaluations regardless of the quality of their teaching.

Again, because of the nominal and ordinal nature of the data in the above analysis, no directional measures could result. The findings to this point only show that differences exist and the size of those differences. In order to discern whether the differences reflect positive or negative relationships, the authors chose to pursue a Spearman's rho and Gamma analyses of the ordinal correlation between the statistics or non-statistics classification and the evaluation questions. The authors chose to classify the dichotomy using 1 to indicated statistics courses and 0 to indicate non-statistics courses. This coding scheme is important in understanding the direction and meaning of the resulting correlations.

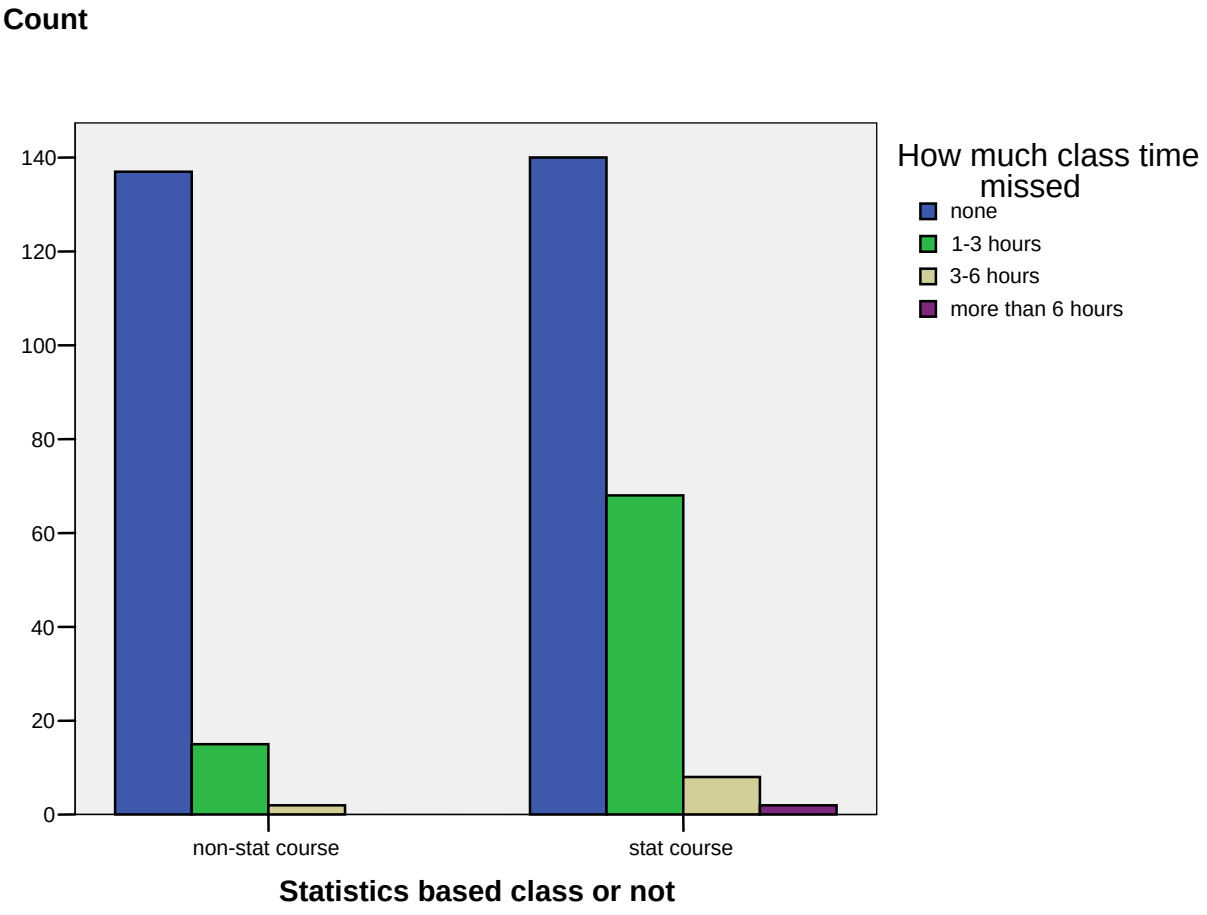
SPEARMAN'S RHO AND GAMMA ANALYSIS

Significant Spearman's rho findings resulted for correlations of "stat class" with the variables "how much class time missed", "course helpful to career", "how much learned in course," "overall instructor effectiveness", and "overall rating of course." Gamma statistics were also part of the analysis, shedding more light on the strength of the correlations. The following graphs help to illustrate the significant correlations.

[5] The authors used SPSS v. 13 for analysis of this data. In SPSS any finding of significance that is less than .050 is considered significant at the .95 level. A finding of .000 is a significant finding.

Question: How Much Class Time Missed?

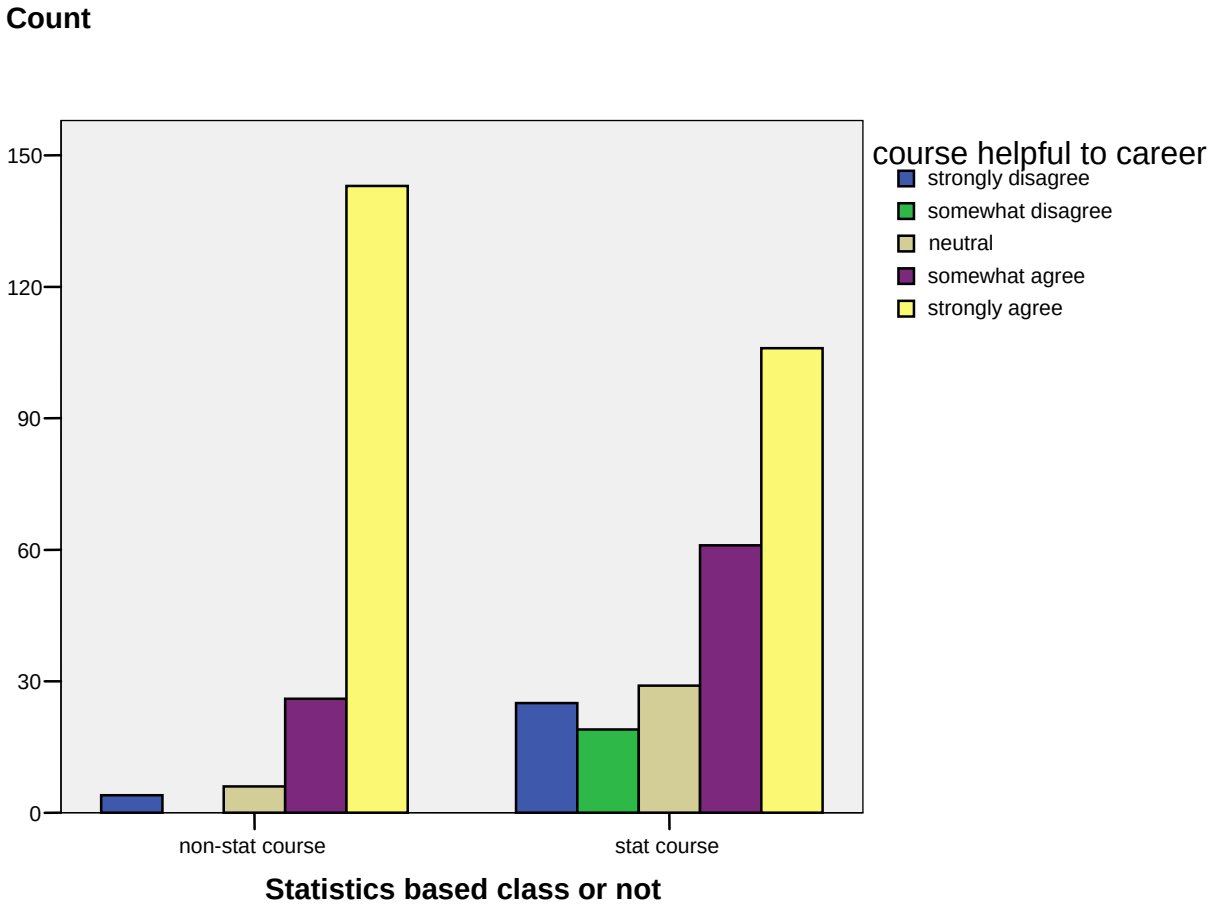
For "how much class time missed" the two-tailed significance was .000 and the rho was .279. The Gamma statistic for this correlation is .623, showing a strong relationship. The direction is positive meaning the students were more likely to miss class in the statistics based classes. The graph below shows the character of the findings.



From this graph, we may see that more students missed more class time in the statistics based courses. Such absences might reflect the disdain and dread students hold for those courses, however further research would have to test that hypothesis.

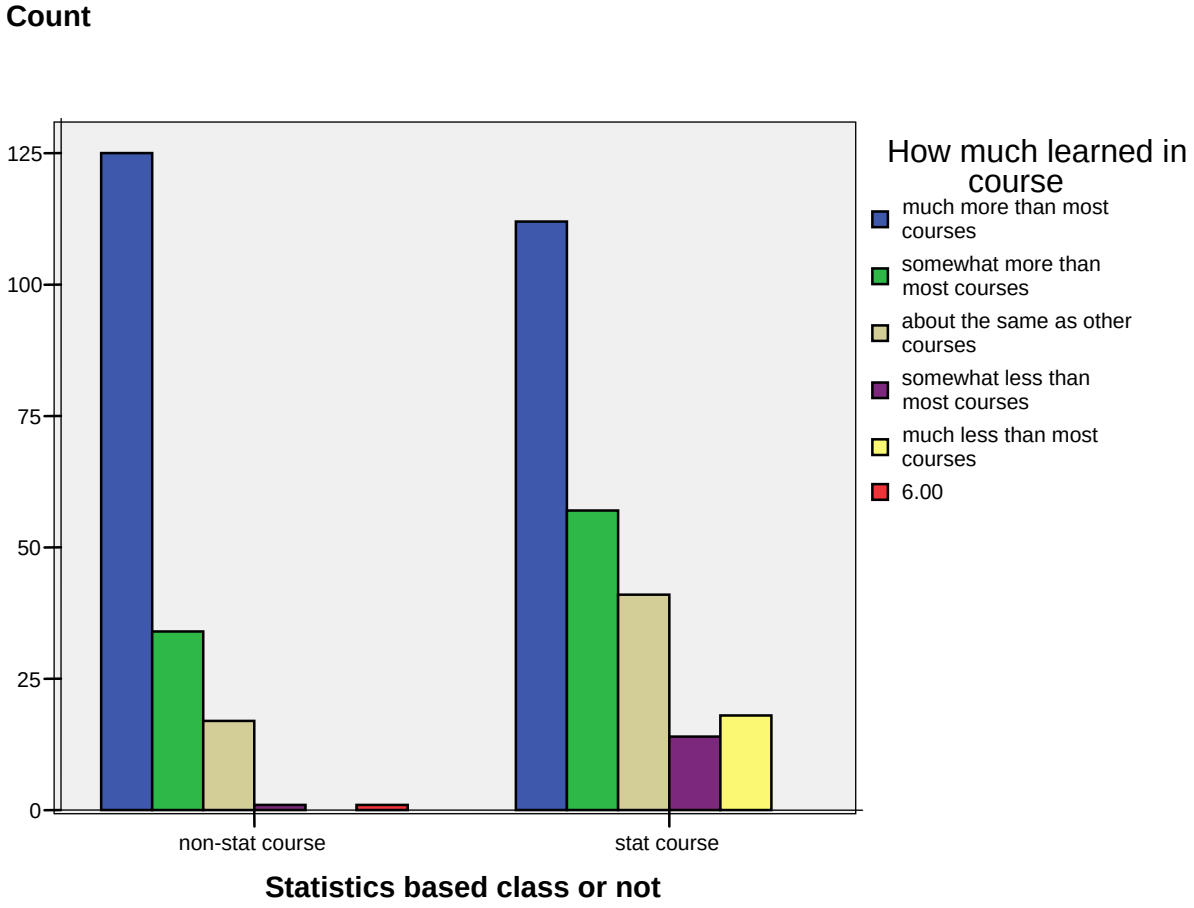
Question: Course Helpful To Career?

For the question which asked how helpful they perceived the course to be for their career, the Spearman's rho was significant at .000 with a rho measure of -.377, indicating a moderately strong inverse relationship between the type of course and the responses to the question. Interpretation of that finding is that students were moderately more likely to see the non-statistics based course as more helpful to their careers. The Gamma statistic for this correlation was -.644, indicating a strong, negative correlation which we may interpret as a strong indication that the students did not view the statistics based courses as useful to their careers.



Question: How Much Learned In Course?

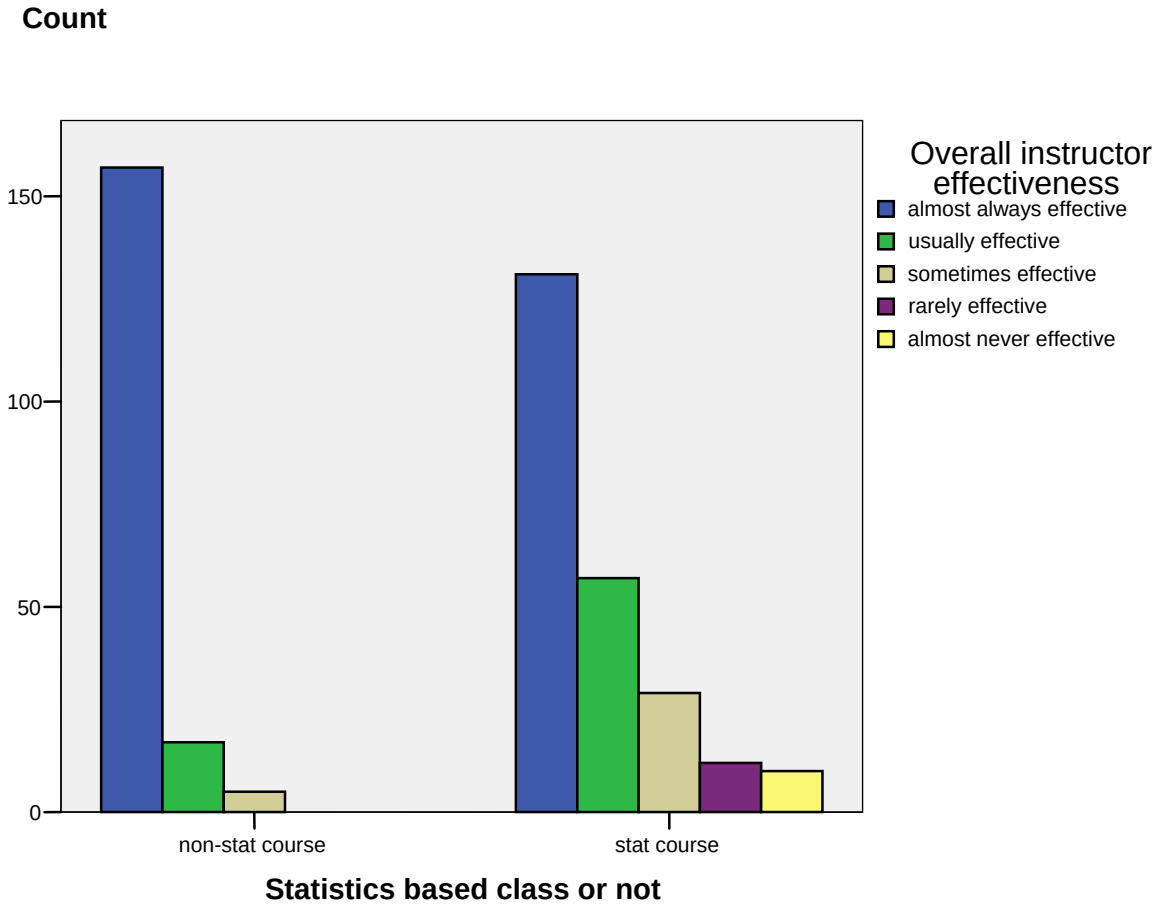
This question addresses the amount of knowledge a student feels they gain from a course. In this case, there was a statistically significant correlation; however, its positive direction indicates a wider dispersion of responses in which students felt they learned slightly more in the statistics based courses. Confirming this idea is the significant Spearman's rho statistic of .269. Both show a weak, but significant correlation.



Question: Overall Instructor Effectiveness?

This question asks the students to rate the overall teaching effectiveness of the course instructor. The authors' research design included one statistics based course and one non-statistics based course from each of two instructors. In this way, the authors achieved control of the variance explained by personal teaching differences. The findings of this analysis are statistically significant for both the Spearman's rho and Gamma calculations. The Spearman's rho statistic for this correlation was .362 and the Gamma was .700. Because of the coding scheme of this question, a positive finding means that the more pejorative rankings of effectiveness were more likely to occur in the reviews of the statistics based classes.[6] While the Gamma statistic shows a much stronger relationship that the rho, the indications are that there is a significant difference in the perceptions of teaching effectiveness between the two types of classes with a trend of greater perceived effectiveness by the two instructors in the non-statistics based classes. The bar chart below shows there seemed to be greater polarization in terms of students of opinions among the statistics based courses indicated by the responses that the instructor was almost never effective where no such responses occurred in the non-statistics based courses. Given the fact that the same two instructors taught in the both areas, meaning the students were assessing the same instructors in statistics based courses as well as non-statistics based, the polarization may be attributable to the prevailing opinions about the nature of the statistics based classes. This finding again raises the question of the impact on professorial professional development by the seemingly automatic lower rankings of any professor who teaches a statistics based course in an MBA, MPA, or related program.

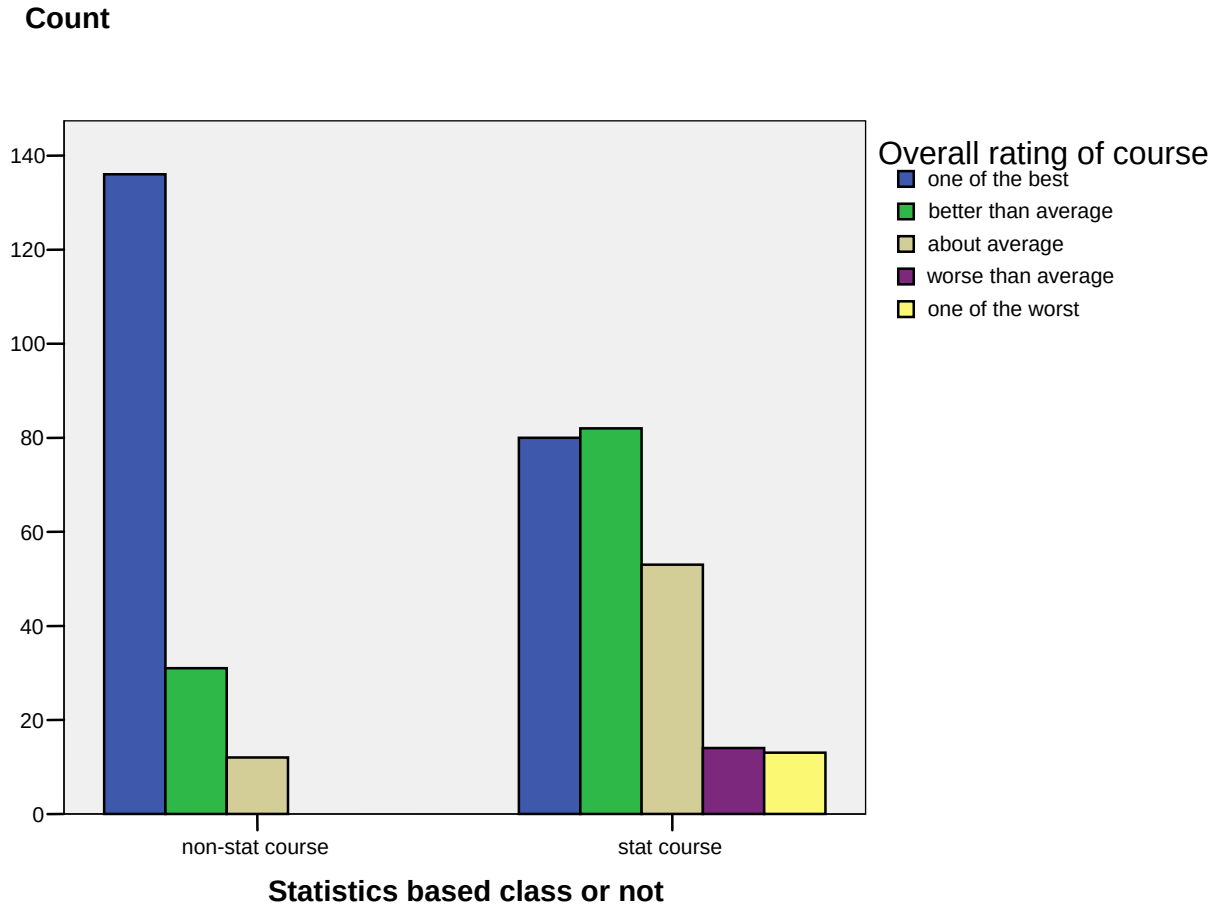
[6] The instrument asked students to choose from (1) almost always effective, (2) usually effective, (3) sometimes effective, (4) rarely effective, or (5) almost never effective, creating a inverse scale from previous questions.



Question: Overall Rating Of Course?

The standardized evaluation of the University of New Haven asks students to review the course in comparison with other courses they have taken at the university. In this analysis, there were significant Spearman's rho and Gamma findings, with a .440 and .698 respectively. These statistics are positive but still hold unenthusiastic implications for the statistics based courses. As in the above case, the response scale of this question was inverse, in which a high number reflected a negative review.[7] The interpretation of this finding is that the students had moderate to strong opinions that the statistics based courses were not among the best they had taken at the university.

[7] The ranking scheme of this question was: (1) one of the best, (2) better than average, (3) about average, (4) worse than average, or (5) one of the worst.



CONCLUSIONS

The original question posed by the authors as to the reality of the negative bias against statistics based courses in graduate business and public administration programs seems to have resulted in confirmation. At least in this case study, there is a pervasive dislike of statistics based classes when compared with non-statistics based classes. The research design, which controlled for differences in teachers, removes that variable from possible explanation, leaving on the nature of the courses.

One possible explanation for the pejorative attitudes toward statistics based courses is that students find them extremely difficult because they have never acquired the math and cognitive skills necessary to adequately grasp and use statistics concepts. "The experience of psychologists, educators, and statisticians alike is that a large portion of students, even in college, do not understand many of the basic statistical concepts they have studied."[8] The failure may lie in undergraduate or even high school preparation for graduate school. In recent years, statistics educators have focused attention on rethinking the process of statistics education at both the college and pre-college levels, with calls for reform of college level statistics education urging faculty to update their materials and methods and to involve

[8]Garfield, Joan and Ahlgren, Andrew. "Difficulties in Learning Basic Concepts in Probability and Statistics: Implications for Research," *Journal for Research In Mathematics Education, vol. 19, no. 1, January 1988.*

students more in hand-on activities.[9] Such measures might help improve the graduate education experience of students as regards their statistics classes; however, the attitudinal obstacles will remain. "While statistics educators have focused on improving the cognitive side of instruction, i.e., the skills and knowledge that students are expected to develop, little regard have been given to non-cognitive issues such as students' feelings, attitudes, beliefs, interests, expectations and motivations."[10] Overcoming these motional factors and changing the way students feel about statistics classes, appears to be an insurmountable problem. Gal, Ginsburg, and Shau report the following comments from high school and university students who had never taken a statistics class before: "I was terrified when I learned that I would have to take statistics because I have always had a mental block dealing with mathematical formulas"; "My teacher said statistics can be misleading and in any case do not relate to people as individuals"; "Although I have never taken a statistics course, I hear they are very difficult and abstract."[11] The feelings expressed in these comments give way to an anxiety about being compelled to take a statistics course as part of a required curriculum. Onwuegbuzie, Slate, et al. stated that in their studies,75% to 80% of graduate students in social science programs appeared to experience uncomfortable levels of statistics anxiety which negatively affected learning.[12] Clearly, educators in graduate business and social science programs have their work cut out for them.

There are two basic consequences of the antipathy students hold for statistics based courses: impacts on the ability of students to complete programs and impacts on the teaching reputations of faculty who teach such courses. As regards the first consequence, Onwuegbuzie posits the following:

Statistics anxiety is not only due some lack of training or insufficient skills, but is also due to misperception about statistics and negative experiences in previous statistics classes. For instance, students often then they do not have enough mathematics training to do well in statistics classes. The fear of failing the course causes a delay in enrolling in statistics classes for as long as possible, and the delay often leads to failure to complete degree programs.[13]

Compounding this problem for students is the added phenomenon that the lack of confidence and high anxiety in statistics keep many students away from engaging in research work or furthering an academic career.[14]

For professors who must show quality teaching as assessed in part by student evaluation, the consequences of student antagonism to statistics based courses clearly means lower evaluations. As a result, the tenure, promotion, or changes in compensation for such faculty may lag behind those instructors teaching the more popular (and less statistical) courses in the same graduate programs. Automatically a disincentive to teach statistical courses emerges making it increasingly difficult for departments to find instructors or for new Ph.D.'s in the business and social science areas to choose research methods as a career, teaching path.

The substantive are of statistical analysis is critical to most graduate business and social science curricula reflecting its importance in the future of the fields. However, until academia can better understand and address the problems created by student enmity for such studies, problems in both teaching such courses as well as attending and completing them will continue.

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[9] Gal, Iddo and Ginsburg, Lynda. "The Role of Beliefs and Attitudes in Learning Statistics: Towards an Assessment Framework," *Journal of Statistics Education, v.2, n.2, 1994.*

[10] Ibid.

[11] Gal, Iddo, Ginsburg, Lynda, and Schau, Candace. "Monitoring Attitudes and Beliefs in Statistics Education," from *The assessment, Challenge in Statistics Education,* International Statistical Institute, 1994.

[12] Onwuegbuzie, A. and Slate, J.R. "Factors Associated with Achievement in Educational Research Courses," *Research in the Schools, 7, 53-65, 2000.*

[13] Onwuegbuzie, A. "Writing a research proposal: The role of Library Anxiety, Statistics Anxiety, and Composition Anxiety," *Library and Information Science, 19, 5-33, 1997.*

[14] Blalock, Hubert. "Some General Goals in Teaching Statistics," *Teaching Sociology, 15, 164-172, 1987.*