STUDENTS' PERCEPTIONS AND ATTITUDES TOWARDS STATISTICS IN SOUTH AFRICAN UNIVERSITY: AN EXPLORATORY FACTOR ANALYSIS APPROACH

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Abstract

The major part of students at institutions of higher learning has shown an aversion for statistics. These attitudes impede on students' performance. Among factors affecting students' achievement in the subject is self-efficacy, self-concept, anxiety and low self-perception. In the main, this study sought to explore students' perceptions and attitudes towards statistics. Data used was collected through SATS-36 and MPSP questionnaires from students who availed themselves for lectures of first year statistics and statistics related courses at a university in South Africa. The findings proved that students' perceived academic and professional relevance of statistics relates to their statistics proficiency. Students with low statistics self-perception are bound to develop negative attitudes towards the subject. Interest, mathematics and statistics self-efficacy, enjoyment, worth, relevance and effort were identified as precursors of statistics course achievement.

Keywords: Attitudes, Perceptions, Self-efficacy, Self-concept, Achievement, Anxiety, Exploratory Factor Analysis

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1 Introduction

Most students at undergraduate university level do at some stage in their studies take an introductory statistics course to fulfil requirements for their degree programs. This is confirmed by Sachau et al. (1995) who highlighted that most graduate programs require students to take statistics as a prerequisite. The majority of students at institutions of higher learning around the globe have shown an aversion for statistics. At the university in South Africa, students who experience this aversion for statistics in most cases those registered in Social Sciences and Behavioural Sciences degrees. Most students go to university with different experiences and background in statistics as this subject is not fully taught in surrounding and feeder high schools. Rather, mathematical literacy at school level is taught as a replacement of pure mathematics to some learners especially those who have less passion for mathematics. This may be one of the reasons leading to different attitudes towards statistics or any related courses.

A number of the faculties in the university, especially those that offer technical programs admit students who have a minimum of four as an Admission Point Score (APS) in mathematics. A minimum of APS score twenty six is required from learners to be admitted into foundation programs which usually take a minimum of four years to complete. A very limited number of learners have a required score in pure mathematics as a requirement and lots of them are placed into foundation phase which is used in the form of preparatory for the first degree. Despite this process, the throughput rates in statistics course do not improve and leave a number of students having to repeat statistics at their first year levels before they can be allowed to proceed with their studies. This has been found to be one of the threats to students' completion of their degrees on record time, as also reported by Onwuegbuzie, et al. (1997). A poor performance in statistics is often preceded by its negative perception as highlighted by Galli et al. (2008).

This study explores the factors associated with perceptions and attitudes of statistics registered students at the university in South Africa. Statistics modules are offered by a faculty which attracts students with varying statistical and mathematical background and competence. Despite the fact that some of these students excelled in high school or their studies prior to the university, it is worrying to note their dismal performance in statistics or statistics related courses at university level. Students' poor performance in first-year undergraduate statistics

courses, their absence of long-term retention of statistical concepts and academic procrastination prompted this investigation. Exploratory factor analysis framework is used to achieve this objective. The findings of this study may help the faculty to come up with better strategies which will benefit both the university and the community. The strategies may also help towards obtaining better throughput rates in the course and stimulate interest to students who see statistics as wider bridge to cross.

The remainder of this study is arranged as follows; Section 2 reviews literature and Section 3 gives a description of the data used. Methods and the findings are discussed in Section 4 and Section 5 provides conclusions and recommendations for policy and further studies.

2 Literature review

This section reviews literature about the perceptions and attitudes towards statistics.

2.1 Attitudes

Hopkins, Hopkins, and Glass (1996) suggest that prevailing attitudes toward statistics among students included feelings of anxiety, cynicism, contempt and fear. Negative attitude and anxiety are said to be linked to students' course achievement (Benson, 1989). This is area of study that has received much attention over the decades (e.g. Schau *et al*., 1995; Roberts and Bilderback, 1980; Cashin and Elmore, 1997; Wise, 1985; McCall, Belli and Madjidi, 1980; Auzmendi, 1991). Contrary to expectation, Slootmaeckers' (2012) study of 630 Social Sciences and other programs' students in first year, 39 in second year, 41 in third year and 116 in masters programs, using Schau's (2003a) SATS-36, found that first year students with regards to interest in learning statistics achieved lower grades. The study further found that mathematical self-concept was related positively to number of mathematics classes taken in high school, and found students' attitudes toward difficulty of statistics were related to better long-term retention of statistical skills. This may be due to the fact that attitudes develop and change through one's academic life.

However in another study, (Coetzee and van der Merwe, 2010) using cross-sectional survey design, administered the SATS-36, to a convenient sample of 235 Industrial and Organisational Psychology students at a large tertiary institution in South Africa. Confirmatory factor analysis was employed to test the validity of the survey instrument for the sample. The findings revealed that although students perceived statistics to be complicated, difficult and technical, they are interested in learning the subject as they also believe it to be a valuable instrument in their careers of choice as a professional tool. Students who had high mathematics self-efficacy also had high statistical self-efficacy. The study suggested that students' mathematics self-perception could be managed in preparing students for statistics. The study reported no significant correlation between students' attitudes toward statistics and the number of years they had studied mathematics at high school, or the number of mathematics courses they had previously taken at the university. The study further revealed a significant correlation between students' perception of their statistics and mathematics competence. No significant differences between postgraduate and undergraduate students' attitudes towards statistics from the results were gathered. The study widely suggested that students who exhibit negative attitudes and aversion after taking a statistics course will most probably never use it again. Schau and Emmioglu (2012) recommend that instructors should attempt to sway students' attitudes for the better. Extrinsic factors affecting students' attitudes towards statistics should be studied (Coetzee and van der Merwe, 2010). This may range from students' past mathematics education and performance, study behavior, class size and the instructor himself.

Shultz and Koshino (1998), in their study which comprised of a sample of 36 undergraduate statistics students taking an introductory course and 38 masters students taking a graduate level psychological statistics course, using the SATS measurement scale found that postgraduate students had more positive attitudes towards statistics than their undergraduate counterparts, as both specific and field course. Both groups had more positive attitudes toward statistics in relation to their field of study. Shultz and Koshino (*ibid*.) made recommendations that researchers investigate the influence of teaching methods on students' attitudes towards statistics at the beginning to the end of the academic year, and possible inclusion of computer technology in statistics education.

2.2 Perceptions

Perception is defined by Bond *et al*. (2012) as an interaction between cognitive and non-cognitive factors. Gregory (1970) defines this concept as a constructive process that relies on prior knowledge and past experience, also responsible for ordering, interpreting, searching for meaning or making sense out of a situation. Students enter introductory classes with different levels of competence, especially mathematical competence (Chiesi and Primi, 2010). Their verbal statistical reasoning and numeracy skills are constantly tested and challenged in any statistics class. Zeidner's (1991) study looked at statistics and mathematics anxiety in Social Science students. The findings showed that students' mathematics self-perception and their final grade 12 mathematics grades were negatively correlated with students' statistics anxiety, and consequently their performance.

Cognitive ability is said to be a strong predictor of academic performance (Neisser *et al.*, 1996),

although cognitive ability cannot account for all of the variation in academic performance, suggests (Kaplan and Saccuzzo, 2009; Rohde and Thompson, 2007). Also, measures of cognitive ability cannot indicate whether students possess study behaviour mastery or aptitude requisite to process, integrate, and recall the material (Crede and Kuncel, 2008). There is a vast body of research that seek to look beyond 'intellectual predictors' (e.g. Grigorenko and Sternberg, 2001; Mattern and Shaw, 2010; Sanford, 2009) and the effect of these factors on academic performance (Crede and Kuncel, 2008; Young, 2005). An understanding of the level of interplay between cognitive skills, non-cognitive skills and academic behaviours (Farrington *et al*., 2012) is of keen interest.

Non-cognitive factors such as motivation, perseverance and self-control, are students attitudinal attributes, study behaviour, and strategies for coping with course anxiety and course load or tests. Contrasted with cognitive factors, non-cognitive factors include literacy and numeracy and are quantified by academic tests. One's perception of their capability, their expectations of success in a course, their valuing of an activity may impact on their persistence and motivation (Gutman and Schoon, 2013). Further improvement on these attributes may have positive academic outcomes.

Negative mindsets stifle perseverance, and undermine academic behaviors (these include attending classes regularly, being ready to work with all study material at hand, attentiveness during lessons, actively participating in all class activities, and completion of tasks) which results in poor academic performance. Poor performance in turn reinforces negative mindsets, perpetuating a self-defeating cycle. Thus, for a student to attain higher grades for their statistics course, the vast spectrum of intrinsic and extrinsic factors must be explored, well developed and retained for improved academic performance.

3 Data collection

Respondents of this study are students taking first year statistics and statistics related courses at one university in South Africa. Permission was sought from Schau (2003) and Scale (Cherney and Cooney, 2005) to modify SATS-36 and MPSP questionnaires. The questionnaires is divided into three sections and combined according to: (1) students' perception, (2) students' attitude, and (3) student's demographics and background in statistics and mathematics. A questionnaire on attitudes consists of six subscales such as: (a) affect (six items): feelings concerning statistics, (b) cognitive competence (six items): attitudes about intellectual knowledge and mathematical or statistical ability, (c) difficulty (seven items): attitudes about difficulty of statistics, (d) value (nine items): attitudes about relevance an worth of statistics in professional and personal life, (e) interest (four items): level of interest in statistics, (f) effort (four items): amount of time put in learning statistics, and a section on respondents academic background and demographics. The MPSP is a 22-item questionnaire with statement on statistics and mathematics perceptions. The responses of the questionnaires are in a form of a likert-scale ranging from strongly disagree (1) to strongly agree (7).

The questionnaire was administered to a total of 500 students who availed themselves for lectures in statistics and statistics related course on a particular day. Sampling was done using the stratified sampling technique to a total of 918 students registered for statistics course at first year level. A return rate of about 50% was achieved and this sample is adequate according to Krejcie and Morgan (1970). SPSS version 22 was used to obtain results for the data. The results are presented in tables and on figures. The sample distribution is shown in Table 1.

Table 1. Sample distribution

Stratum h	***Population***	f_h	n_h	% $of\ N_h$
Module 1	578	0.40	231	53.1
Module 2	141	0.50	71	16.3
Module 3	103	0.60	62	14.3
Module 4	91	0.78	71	16.3
Total	913		N=435	100%

4 Methods and results

This section discusses the methods used in the study and the results obtained.

4.1 Sample adequacy and reliability

The initial analysis of data focuses on the suitability of data for factor analysis. The study uses the Kaiser-Meyer-Olkin (KMO) and Cronbach's alpha to address issues of sampling adequacy and reliability of constructs. Cronbach's alpha is a commonly used measure of internal consistency and reliability of the data and the constructs from the variables. It measures how well a set of items measure a single unidimensional latent construct. Owing to the multiplicity of the variables measuring the factors, Cronbach's alpha is often considered most suitable since it has the most utility of multi-item scales at the interval level of measurement (Cooper and Emory, 1995). Cronbach's alpha coefficient ranges from 0 to 1 with values closer to 0 implying that the items do not measure the same construct and values closer to 1 measuring the same construct. Kaiser (1974) and Cronbach and Shavelson (2004) recommend minimum of 0.6 and 0.7 for KMO and alpha respectively. A value less than these two imply that the sample is not adequate and that the issue of reliability is violated. The results of these measures are presented in Table 2.

Table 2. KMO and Cronbach's alpha

Construct	*KMO*	*Cronbach's alpha*	*Items*	*Decision*
Attitudes	0.874	0.880	41	Significant
Perceptions	0.873	0.798	16	significant

The results for KMO and alpha coefficients confirm that the sample used for this study excellent and is in accordance with Kaiser (1974) and Cronbach and Shavelson (2004). These findings encourage the application of factor analysis to the data. Presented next are the strategies used in this study to retain number of factors and the related results.

4.2 Number of factors retained

The study used minimum eigenvalue criterion to decide on the appropriate number of factors to retain. The number of factors to be extracted is equal to the number of eigenvalues equal to or in excess of one. Due to the complexity of the variables used, some of the tables are big and could not be shown. However, by observation, the results showed that eight factors will be retained from the 41 statements on attitudes and four from the 16 statements on perceptions. These factors will account for about 52.79% and 61.84% of variation for attitudes and perceptions respectively with the first factor in each accounting for more variation. This information is used to construct matrix of factor pattern for these constructs and the results are discussed below.

4.3 Factor extraction

Some studies consider factor loadings of $\geq |0.3|$ as being more important and significant. Tabachnick and Fidell (2007) recommend a loading of 0.45 and a minimum factor loading of 0.32. In contrast, Comrey and Lee (1992) made the following recommendations; loadings in excess of 0.71 (50% overlapping variance) are excellent, 0.63 (40% overlapping variance) are very good, 0.55 (30% overlapping variance) are good, 0.45 (20% overlapping variance) are fair, and 0.32 (10% overlapping variance) are poor. These guidelines are referred to when making the decision about factor loadings.

For the purpose of this study, values less than 0.4 in the pattern matrix will not be considered. This logic is based on Stevens' (2002) suggestion also adopted by Montshiwa and Moroke (2014). The visual inspection of the original matrix shows that the results that are not easy to interpret due to intercorrelatedness between the statements. This was anticipated due to the nature of the data. To simplify the structure of the matrix, direct oblimin rotation was used to rotate the original factors. Table 3 and 4 give summaries of the factor loadings pertaining to perceptions and attitudes respectively.

It is evident from Table 3 and 4 that more statements loaded more on Factor 1 confirming the importance of this factor in the analysis. The structure of this matrix looks good and provides a basis for allocating reasonable names to the factors associated with students' attitudes towards statistics. Five variables have inadvertently been regarded as redundant and were eliminated as members of the attitudes construct. These include, (1) 'I have trouble understanding statistics because of how I think', (2) 'Statistical skills will make me more employable', (3) 'I use statistics in my everyday life', (4) 'I am under stress during statistics class' and (5) 'I find it difficult to understand statistical concepts'.

The next step would be to check the items for any similarities, i.e. whether they are addressing attitudes or not. Statements such as, 'Statistical skills will make me more employable', 'I use statistics in my everyday life'; and 'I am motivated to learn statistics', seemed confusing to students. Seemingly, these statements were addressing the worth and relevance of statistics to the respondents. The last two statements, 'I do not want to learn statistics' and 'I do not want anything that has got to do with statistics' seemed to be focused on respondents' feelings towards and difficulty of statistics. The following are suggested names for the factors displayed in Table 3.

Factor 1 = *Worth* (worth of statistics in one's academic and professional life), Factor 2 = *Difficulty* (the degree of difficulty of statistics), Factor 3 = *Enjoyment* (feelings of gratification and worth of statistics when doing statistics tasks), Factor 4 = *Effort* (amount of time put in studying statistics), Factor 5 = *Interest* (willingness learning statistics), Factor 6 = *Anxiety* (anxiety due to statistics), Factor 7 = *Relevance* (ability to solve mathematically) and Factor 8 = *Difficulty and Worth* (inherent qualities and abilities to learn statistics).

The suggested names of factors related to perception are: Factor 1 = *Statistics proficiency*, Factor 2 = *Statistics anxiety* (anxiety due to statistics), Factor 3 = *Relevance and Self-perception* (relevance of Statistics in one's life, academic and professional and perceived ability in the course) and Factor 4 = *Mathematics proficiency* (Statistics self-perception).

4.4 Validity of factor analyses results

This section determines if the factors are reliable or not. Interpretation of the alpha coefficient is made following the guidelines by Kline (1999) and Cronbach and Shavelson (2004) as follows: $\alpha \geq 0.9$ is excellent, $0.8 \leq \alpha < 0.9$ is good, $0.7 \leq \alpha < 0.8$ is acceptable, $0.6 \leq \alpha < 0.7$ is questionable, $0.5 \leq \alpha < 0.6$ is poor and $\alpha < 0.5$ is unacceptable.

Table 3. Attitudes rotated pattern matrix

	Factor							
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Statistics is not useful to the profession of my choice	.791							
Statistical thinking is not applicable in my life, outside my job	.714							
I get frustrated going over Statistics test in class	.702							
I have no idea of what is going on in this Statistics course	.579							
I am under stress during Statistics class	.566							
Statistics is worthless	.549							
I have trouble understanding Statistics because of how I think	.533							
I feel insecure when I have to do Statistics problems	.427							
Statistics is a complicated module	.417							
Statistics is highly technical		.679						
Most people have to learn a new way of thinking to do Statistics		.648						
Learning Statistics requires a great deal of discipline		.494						
Statistics is a subject quickly learned by most people			-.611					
Statistics formulas are easy to understand			-.565					
I enjoy taking Statistics modules			-.539					
I like Statistics			-.462					
I understand Statistics equations			-.460					
Statistics conclusions are rarely presented in everyday life			.401					
I try to study hard for every Statistics test				.883				
I work hard in my Statistics module				.862				
I try to attend every Statistics class session				.711				
I try to complete all my Statistics assignments				.627				
I am interested in understanding statistical concepts					.965			
I am interest in being able to communicate statistical information to others					.963			
I am interested in using Statistics					.938			
I am interested in learning Statistics					.819			
Statistics test or examination make me anxious						-.807		
Statistical results interpretation make me nervous						-.806		
I make a lot mathematical errors in Statistics						-.536		
Statistics involves massive computations							-.634	
Statistics should be a required part of my professional training							.441	
I would deregister Statistics anytime							-.418	
I am scared by Statistics							-.410	
Statistics is irrelevant in my life								.770
I find it difficult to understand statistical concepts								.617
I will have no application for Statistics in my profession								.575

Table 4. Perception rotated pattern matrix

Statements	*Component*			
	1	*2*	*3*	*4*
Can identify if a distribution is skewed	.935			
Can identify the scale of measurement for a variable	.898			
Can select the correct statistical procedure to be used to answer a question	.827			
Can communicate statistical results without a problem	.768			
Can read a value from any statistical table	.762			
Statistics is very different from Mathematics		.831		
A thought of Statistics makes me nervous		.648		
I do not enjoy Statistics, since I have never enjoyed Mathematics		.641		
As you complete the remainder of your degree program, how much will you use Statistics?			-.997	
In the field in which you hope to be employed when you finish school, how much will you use Statistics?			-.896	
I am doing well in my Statistics module			-.622	
How confident are you that you have mastered introductory statistics material up to this point in the present academic year?			-.581	
Statistics is relatively easy			-.513	
I believe Statistics is not really bad. It is just too mathematical.				-.708
I need strong Mathematics background to do well in Statistics				-.705
How good are you at mathematics?				-.417

Table 5. Construct Validity

Construct	*Factor*	*Cronbach's Alpha*	*Guideline*	*Conclusion*
Attitudes	Worth	0.801	Good	Valid
	Difficulty	0.445	Unacceptable	Not valid
	Enjoyment	0.605	Questionable	Not valid
	Effort	0.774	Acceptable	Valid
	Interest	0.874	Good	Valid
	Anxiety	0.736	Acceptable	Valid
	Relevance	0.457	Unacceptable	Not valid
	Difficulty and Worth	0.633	Questionable	Not valid
Perceptions	Statistics Proficiency	0.867	Good	Valid
	Statistics anxiety	0.551	Poor	Not valid
	Relevance and Self-perception	0.848	Good	Valid
	Mathematics Proficiency	0.321	Unacceptable	Not valid

Not all individual factor alpha coefficients exceed 0.7. The internal consistencies for the eight factors are: *worth* (0.801) is good, *difficulty* (0.445) is unacceptable, *enjoyment* (0.605) is poor, *effort* (0.774) is acceptable, *interest* (0.874) is good, *anxiety* (0.736) is acceptable, *relevance* (0.457) is unacceptable and *difficulty and worth* (0.633) is poor using based on Cronbach and Shavelson (2004) guiding principle. Only four factors and two factors are reliable in attitudes and perceptions constructs respectively.

5 Discussion and key findings

Students' self-perceptions about statistics are important factor problem and this can affect the in statistics performance either positively or negatively. This goes along with interest to learn statistics, motivation to attend statistics classes or do and complete statistics tasks. The perceived worth or relevance of statistics in one's academic and professional life, effort put in (attending classes, consultation, or study for every test or examination) and innate ability to learn statistics are also measures of self-perception. Students' perceptions to use statistics in future may be measured by their ability to solve statistical problems with ease. This is in line with Ben-Zvi and Garfield (2004b). Future use and achievement could be the result of their perception of the relevance of statistics in their academic and professional lives. Negative or positive experiences about statistics may pose a threat or motivation, respectively, to take up statistics module in future (Onwuegbuzie, 1997a).

However, if left unattended or unchanged; the negative self-perception, statistics perception and statistics worth and relevance, develop into negative attitudes towards Statistics. On one hand mathematics and statistics proficiency (Cherney and Cooney, 2005) and relevance (or worth of statistics) in agreement with (e.g. Cruise *et al.* 1985, Coetzee and van der Merwe, 2010), contribute to statistics course achievement (see Onwuegbuzie *et al.*, 2000 and Fitzgerald *et al.,* 1996). On the other hand, statistics anxiety hinders statistics learning and understanding, thus proficiency as hinted by Cruise *et al*. (1985).

The correlations among perceptions and attitudes in this study reveal that students who have generally bad attitudes towards statistics have low statistics self-perception and the results are in agreement with those reported by Cherney and Cooney (2005) and Onwuegbuzie *et al*. (2000). This results in students not doing well in the course. On the contrary, students who have positive attitudes towards statistics perform well in the course (Slootmaeckers, 2012). Another way to look at this scenario is that those who do not do well in a subject generally develop negative attitudes. Conversely, those who do well do not have any negative attitudes towards that subject. However, the question is: Can these negative attributes be monitored and mitigated for consequent improved achievements in statistics?

Based on the findings of this study, the following recommendations are formulated:

5.1 Further studies

Interest, effort, and relevance could be emphasized to curb the degenerating appreciation of statistics among students. Anxiety could be alleviated through continuous engagement with statistics course material, which will have a positive effect on the students' mathematics and statistics self-concept. Three of the five items are hindering statistics learning and two promote the process. The coefficient if item deleted has revealed discernible construct inconsistencies and unreliability. The following items of the SATS-36 final scoring for negative item statements need to be revised as these produce a negative or non-significant Cronbach's alpha.

In the attitude scale: Item 4 = 'I feel insecure when I have to do statistics problems', item 24 = 'Learning statistics requires a great deal of discipline', item 16 = 'I will have no application for statistics in my profession', item 33 = 'Statistics is irrelevant in my life', and item 34 = 'Statistics is highly technical'. In the perception scale items: item 9 = 'I believe statistics is not really bad. It is just too mathematical.' and item 10 = 'I need strong mathematics background to do well in statistics' should not be reversed, the better option would be to revise them.

Revision of statements that solicit the same response from the respondent is highly recommended. Adding more statements could prove to be essential. After reliability and validity checks of the new (or altered) statements the resulting model would then be used for further analysis. Due to the correlations of perceptions and attitudes and since the factors exhibiting intercorrelatedness, an exploratory structural equation modelling could be investigated with expectation to uncover the underlying causal nature of items and constructs. Other multivariate methods such as discriminant analyses, regression analyses, MANOVA, etc. may be used as follow-up techniques and in assessing the reliability of the factors obtained. It is important to review the questionnaire to ensure that the statements are true measures of perception about and attitude towards statistics. This may improve the reliability of the factors from these constructs which were found to be less than 0.7.

5.2 Policy

Integration of computers and use of statistical software, using practical examples and using real-life data could be instrumental in sparking interest in students as they discover the relevance of statistics in their lives. This could be achieved by introducing group tasks and assignments in undergraduate first year statistics classes. Identification of students with low affinity to numbers can help mollify the consequences of low self-perceptions, low-self-efficacy, mathematics and statistics anxiety, and negative attitudes towards statistics. Students with low mathematical self-efficacy and self-concept could be registered for basic to intermediate mathematics course to sharpen their mathematical abilities. Students provided some of recommendations as a way to help them develop interest and increase performance rate in statistics. They thought the following could be done differently to help them understand the course;

- More exercises after each chapter
- Groups assignment and presentations could help
- Presentations on how statistics can be integrated or applied in a job setting might help
- Use of statistical software to solve practical questions
- Quizzes could help a great deal
- I just need to put more effort into my statistics course
- We need extra resources; questions in the prescribed book

The university could introduce a two year basic statistics course in undergraduate level. Instead of two semester courses, each module could be spread out into semesters. Calculus should be made compulsory as its application is unavoidable; more specifically for economics majors. Computer aided learning through students' interaction with statistical software should be made compulsory.

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Appendix A. Survey of Attitude toward Statistics

The statements are designed to identify your attitudes and perception about statistics. Each item has 7 possible responses. The responses range from 1 (strongly disagree) through 4 (neither disagree nor agree) to 7 (strongly agree). Please read each statement. Mark the one response. Record your answer and move quickly to the next item. Please respond to all of the statements. Circle your selection.

Table A.1. Attitudes about statistics

I like statistics.	1	2	3	4	5	6	7
I feel insecure when I have to do statistics problems.	1	2	3	4	5	6	7
I have trouble understanding statistics because of how I think.	1	2	3	4	5	6	7
Statistics formulas are easy to understand.	1	2	3	4	5	6	7
Statistics is worthless.	1	2	3	4	5	6	7
Statistics is a complicated module.	1	2	3	4	5	6	7
Statistics should be a required part of my professional training.	1	2	3	4	5	6	7
Statistical skills will make me more employable.	1	2	3	4	5	6	7
I have no idea of what's going on in this statistics course.	1	2	3	4	5	6	7
Statistics is not useful to the profession of my choice.	1	2	3	4	5	6	7
I get frustrated going over statistics tests in class.	1	2	3	4	5	6	7
Statistical thinking is not applicable in my life, outside my job.	1	2	3	4	5	6	7
I use statistics in my everyday life	1	2	3	4	5	6	7
I am under stress during statistics class.	1	2	3	4	5	6	7
I enjoy taking statistics modules.	1	2	3	4	5	6	7
Statistics conclusions are rarely presented in everyday life.	1	2	3	4	5	6	7
Statistics is a subject quickly learned by most people.	1	2	3	4	5	6	7
Learning statistics requires a great deal of discipline.	1	2	3	4	5	6	7
I will have no application for statistics in my profession.	1	2	3	4	5	6	7
I make a lot of mathematical errors in statistics.	1	2	3	4	5	6	7
I am scared by statistics.	1	2	3	4	5	6	7
Statistics involves massive computations.	1	2	3	4	5	6	7
I am motivated to learn statistics.	1	2	3	4	5	6	7
I understand statistics equations.	1	2	3	4	5	6	7
Statistics is irrelevant in my life.	1	2	3	4	5	6	7
Statistics is highly technical.	1	2	3	4	5	6	7
I find it difficult to understand statistical concepts.	1	2	3	4	5	6	7
Most people have to learn a new way of thinking to do statistics.	1	2	3	4	5	6	7
I would deregister statistics anytime.	1	2	3	4	5	6	7
I try to complete all of my statistics assignments.	1	2	3	4	5	6	7
I work hard in my statistics module.	1	2	3	4	5	6	7
I try to study hard for every statistics test.	1	2	3	4	5	6	7
I try to attend every statistics class session.	1	2	3	4	5	6	7
I am interested in being able to communicate statistical information to others.	1	2	3	4	5	6	7
I am interested in using statistics.	1	2	3	4	5	6	7
I am interested in understanding statistical concepts.	1	2	3	4	5	6	7
I am interested in learning statistics.	1	2	3	4	5	6	7
I do not want to learn to like statistics and anything that has got to do with it.	1	2	3	4	5	6	7
If you could, how likely is it that you would choose to take another module in statistics?	1	2	3	4	5	6	7
I feel anxious when taking a statistics test or examination.	1	2	3	4	5	6	7
I feel anxious when interpreting statistical results to a friend or the lecturer.	1	2	3	4	5	6	7

Note: 1 – strongly disagree, 7 – strongly agree

Table A.2. Perceptions about statistics

How good at mathematics are you?	1	2	3	4	5	6	7
In the field in which you hope to be employed when you finish school, how much will you use statistics?	1	2	3	4	5	6	7
How confident are you that you have mastered introductory statistics material up to this point in the present academic year?	1	2	3	4	5	6	7
As you complete the remainder of your degree program, how much will you use statistics?	1	2	3	4	5	6	7
I am doing well in my statistics module.	1	2	3	4	5	6	7
Statistics is relatively easy.	1	2	3	4	5	6	7
A thought of statistics makes me very nervous.	1	2	3	4	5	6	7
I do not enjoy statistics, since I have never enjoyed mathematics.	1	2	3	4	5	6	7
I believe statistics is not really bad. It is just too mathematical.	1	2	3	4	5	6	7
I need strong mathematics background to do well in statistic	1	2	3	4	5	6	7
Statistics is very different from mathematics	1	2	3	4	5	6	7
Can identify the scale of measurement for a variable.	1	2	3	4	5	6	7
Can identify if a distribution is skewed.	1	2	3	4	5	6	7
Can select the correct statistical procedure to be used to answer a question.	1	2	3	4	5	6	7
Can communicate statistical results without any problem	1	2	3	4	5	6	7
Can read a value from any statistical table.	1	2	3	4	5	6	7

Note: the labels for the scale on each of the following items differ from those used above