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Examining Postgraduate Students' Perceived Competency In Statistical Data Analysis And Their Attitudes Toward Statistics

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***Abstract*—**This paper examined postgraduate students' competency in statistical data analysis and their attitudes toward statistics. Students' attitudes toward statistics (ATS) were measured across 28-Likert scale items across four dimensions, namely Affect, Cognitive Competence, Value and Difficulty and their competency in data analysis were assessed using *DaComp* instrument. The findings revealed two facets of students' attitudes toward statistics, i.e., positive or negative. Students' attitudes toward statistics varied between the four ATS dimensions with Difficulty items been highly mentioned as the factors that influence their attitudes toward statistics. In examining students' perceived competency in statistical data analysis, it was found that those with little background in statistics had difficulty in identifying the relevant and approroaite statistical tools for their study. The significant results of the study were used to benchmark the quality of research output of postgraduate students. This includes, among others, students' ability to match analytical tools with research objectives which will later be matched with core knowledge objectives required for data analysis.

***Keywords*—**Data analysis competency, attitudes toward statistics, ATS dimensions, statistical tools

I. Introduction

In its quest to be a world renown research university, Universiti Teknologi MARA (UiTM) strives for excellence in all its activities, one of which is the quality of research conducted by its postgraduate students. The reputation and quality of the university's postgraduate programmes are measured in part by the quality of the research activities and theses produced by the students. Since research reports, particularly theses or dissertations, are open to scrutiny, students must strive to develop competencies in research-related activities such as competency in statistical data analysis and research methodology. The increase in the number of postgraduate research students in UiTM and the concern for quality in postgraduate research is a motivation for this study.

Research competency is evidenced by the ability to demonstrate knowledge in identifying researchable problems, developing research questions and/or research hypotheses, reviewing relevant literature, matching purpose, design and methods, applying appropriate statistical techniques, interpreting results and finally, effectively communicating the research findings.

Weinert [6] noted that specific competencies refer to clusters of cognitive prerequisites that an individual requires in order to be able to perform adequately in a given substantive area. Specific competencies usually rely on a system of specialized skills and routines stored in memory. These include: (i) extensive mental networks of specialized knowledge, and (ii) automatic action routines that must be controlled at a high awareness level and which are acquired through long term learning, experience and deep understanding of the topic. General competencies on the other hand, include concepts such as intelligence, information-processing models, meta-competencies and key-competencies. Allen *et. al.* [1] reported that key competencies allow one to perform tasks in a broad scale of contexts. They include basic competencies such as planning for problem solving, competent use of media and computer skills, communicative competencies such as command of foreign languages, rhetoric skills and verbal and written presentation skills, and reasoning competencies such as critical thinking and multidimensional evaluation of one's own action as well as the actions of others.

Studies in research competencies are wide range in nature [3], [4]. This study will however only focus on data analysis competencies in postgraduate research. The benchmark for the measurement will be the researchers' ability to match research objectives with the chosen analysis as reported in their dissertations. This will later be matched with the core knowledge objectives required for data analysis which include the ability to: (i) determine the most appropriate method of statistical analysis; (ii) demonstrate the correct use of each set

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of the basic set of statistical procedures; (iii) critically review and summarize statistical analyses presented in the scientific literature; and (iv) to interpret the analysis in accordance to the research questions and objectives. Additionally, it is expected that students will understand the strengths and limitations of various data collection methodologies and be able to choose among them and/or develop a multi-method approach appropriate to the research task.

II. Study Objectives And Scope

The main objective of the study is to investigate the attitudes of postgraduate research students' toward statistics. In the process, students' perspective on the tools, techniques and concepts which are important in data analysis, and students' perceived importance and competency in statistical data analysis are identified. To accomplish this, an instrument to measure data analysis competency in postgraduate research is developed.

The study was conducted on UiTM first year postgraduate research degree students who have completed 33 hours of a "Thesis Writing" module. When the questionnaires were administered, they had completed 9 hours of a "Data Analysis" module. The students had also gone through 40 hours of lessons in Research Methodology and Presentation Skills in the first semester. About 90% of the students were based in the UiTM Shah Alam campus while 10% were from state campuses.

III. Study Design

The study began with an exploratory search of related literature specifically on other studies related to the survey of attitudes toward statistics and competencies in data analysis. Several informal interviews were conducted among the PhD and Master students to gain insights into their attitudes toward statistics and the need for statistical consultancy in academic research. Interviews and observations were conducted over several weeks during the research methodology and data analysis course. Several interviews also took place between the researchers and lecturers who were assigned to conduct the courses.

The first part of the study utilized a descriptive method to investigate the students' attitudes toward statistics, to identify the importance of statistical analysis in postgraduate research and to determine the students' perceived competency in statistical data analysis. It focused on several major aspects: (1) attitudes toward statistics; (2) importance and perceived competencies in statistical analysis; and (3) respondents' profile and characteristics. In the second part of the study an instrument to gauge the students' competency in data measurement and analysis was developed.

This research used a probability sampling, namely, simple random sampling to select sample elements from the list of all second semester postgraduate research students. Those chosen from the list attended the Data Analysis in Research course (PPS902) conducted by The Institute of Graduate Studies, UiTM. From the list of 98 students, 42 were chosen for the study. Students who enrolled in various postgraduate research degree programs from Science and Technology, Management Science and Humanities attended the PPS902 course.

The process of data collection involved the distribution of questionnaires for the purpose of investigating students' attitudes toward statistics, to what extent they perceived the statistical analysis to be important and the extent of their knowledge competencies in data analysis. The questionnaires were distributed to two groups of 42 students from various programs of study, i.e. Group 1 - Science Social, Humanities and Management Science and Group 2 - Science and Technology. The course was conducted over five weekends and the questionnaires were only administered at the end of week five.

Two main instruments were used in the study. The first instrument (questionnaire) consists of three sections, namely, Section A: Profile of Respondents, Section B: Students' Attitudes Toward Statistics (SATS), and Section C: Importance and Perceived Competencies in Statistical Data Analysis (IPCS). The Survey of Attitudes Toward Statistics Scale – SATS was adapted from Schau *et al.* [5]. The SATS constructs were used to gather information on students' attitudes toward statistics. The SATS is a 28-item instrument with a 7-point, Likert-type response format, with higher ratings indicating more positive attitudes after recoding the 19 negatively keyed items. The instrument incorporates four subscales, including the 6-item Affect subscale, the 6-item Cognitive Competence subscale, the 9-item Value subscale, and the 7-item Difficulty subscale. Sample items/constructs on the Affect subscale are "I like statistics" and "I feel insecure when I have to do statistics problems"; on the Cognitive Competence subscale – "I make a lot of math errors in statistics" and "I can learn statistics"; on the Value subscale – "Statistics is worthless" and "I use statistics in my everyday life"; and on the Difficulty subscale – "Statistics is a complicated subject" and "Learning statistics requires a great deal of discipline".

The IPCS items consist of 14 topics with several sub-topics or concepts embeded in each topic. This was used by students to gauge the importance and perceived competencies of each itemised statistical tool. The statistical tools, techniques and concepts displayed are deemed to be necessary and important for inclusion in most research analysis.

The second instrument was developed based on the researchers' experience in the instruction of research methodology and analysis and the evaluation of students' theses on the methodological aspects of research and data analysis.

IV. Data Analysis And Results

The completed questionnaires were edited and the data were duly coded for analysis using the SPSS software. The following statistical analyses were performed:

(i) One-way frequency (counts) and percentage tables on variables of interest.
(ii) Multiple response tables showing the joint frequencies (counts) and percentages of two independent categorical variables.

(iii) Graphical representations
(iv) Internal consistency reliability estimates
(v) Normality test
(vi) Comparison of mean/median scores on the attitude, importance and perception response scales.
(vii) Gap analysis

V. Composition and Respondents

Results of the analyses of the data gathered from 43 postgraduate research students showed that the highest representation came from students in the age group of 23 to 31 years old. This is followed by 30.2% and 25.6% in the age group of 32 to 41 years old and 42 to 50 years old, respectively. There was a higher participation of male students in the PhD program as compared to the Master's program. On the other hand, there were more female students in the Master's program who participated in the study. There was also a slightly higher representation of full-time students (57.5%) than that of part-time students (42.5%).

VI. Reliability and Normality Assumption of ATS Scales

The Cronbach's α internal consistency reliability estimates for female respondents were consistently high across all four ATS subscale ranging from 0.75 to 0.80. The Cronbach's α for male respondents were also consistently high for Affect, Cognitive Competence and Value subscale ranging from 0.74 to 0.81 but recorded a low consistency estimates in Difficulty subscale scores of 0.56. These results are in consistence with Hilton *et. al.* [4]. which indicated a low reliability estimates in Difficulty subscale for both male and female respondents. However, based on the combined ATS components, Cronbach's α shows extremely high internal consistency in reliability estimates of 0.92 (see Table 1).

Table 1 Cronbach's α Internal Consistency Reliability Estimates for ATS scales

ATS COMPONENTS	Cronbach's α Internal Consistency Reliability Estimates		
	Male	Female	Overall
Affect	0.741	0.793	0.785
Cognitive Competence	0.823	0.761	0.805
Value	0.807	0.767	0.800
Difficulty	0.555	0.749	0.697
ATS Components Combined	0.912	0.918	0.920

The distribution of ATS mean scores was also checked against the normality assumption and from the Shapiro-Wilk test (since $n < 50$), $p = 0.200 > 0.05$, the overall mean score distribution was found to be approximately normally distributed. All subscale scores, with the exception of the Difficulty subscale, were found to be normally distributed.

VII. Perceived Usefulness And Importance of the Research Methodology Course

Over 70% of the students who attended the Research Methodology Course on Data Analysis module (PPS902) found the course to be useful and informative, while around 66% found that they could follow the course and that it could be easily understood. However, slightly less than 50% agreed that the course was sufficient to enable them to get started on their research work. Sixty-nine percent of the students (69%) rated the course as very important.

A majority of the respondents indicated a strong agreement in terms of usefulness of the course. They also felt that the course was informative and easy to understand. However a slightly lower mean score was noted in their agreement towards the sufficiency of the course content to enable them get started on their research work. A majority of the students also perceived the course as being important for them to get started on their research work. It was also discovered that more male students perceived the course as more important compared to the female students. A few students in both groups perceived the course as somewhat not important. The perception of importance is higher among full-time students compared to part-time students. A small number of students in both groups perceived the course as somewhat not important.

VIII. Attitudes Toward Statistics

Scores from the ATS assessed four components of Attitudes Toward Statistics. These components include the following:
(i) Affect (six items): Students' positive and negative feelings about statistics.
(ii) Cognitive Competence (six items): Attitudes about the students' intellectual knowledge and skills when applied to statistics.
(iii) Value (nine items): Attitudes about the usefulness, relevance, and worth of statistics in personal and professional life.
(iv) Difficulty (seven items): Attitudes about the difficulty of statistics as a domain.

Results of the assessment of students' positive and negative feelings about statistics show that 78% of the respondents enjoyed taking statistics and 71% were not under stress during statistics class On average, 60% had a positive attitude toward statistics in the Affect component. (see Table 2).

Table 2 Attitudes Toward Statistics Based On Affect Items

No.	Attitudes Towards Statistics (AFFECT items)	Agree (%)	Neutral (%)	Disagree (%)
1	I like statistics	60.5	27.9	11.6
2	**I feel secure when I have to do statistics problems**	32.6	18.6	48.8
11	**I do not get frustrated going over statistics problem exercises in class**	64.3	23.8	11.9
14	**I am not under stress during statistics class**	71.4	19.1	9.5
15	I enjoy taking statistics course	78.0	14.0	7.3
21	**I am not scared by statistics**	54.8	19.0	26.2
	Mean/Median (%) Affect	60.3		11.8

In the assessment of attitudes about the students' intellectual knowledge and skills when applied to statistics - Cognitive Competence, a majority said that they could learn statistics. Slightly over 70% said that they had some idea of what was going on in statistics and that they could understand statistics equation. On average, 66% had a positive attitude towards statistics in the Cognitive Competence component (see Table 3).

Table 3 Attitudes toward statistics based on *Cognitive Competence* items

No.	Attitude Towards Statistics (COGNITIVE COMPETENCE items)	Agree (%)	Neutral (%)	Disagree (%)
3	**I do not have trouble understanding statistics because of how I think**	48.8	23.3	27.9
9	**I have some idea of what's going on in statistics**	73.8	11.9	14.3
20	**I do not make a lot of math errors in statistics**	45.2	35.7	19.1
23	I can learn statistics	92.9	7.1	-
24	I understand statistics equations	78.6	11.9	9.5
27	**I find it easy to understand statistics concepts**	54.8	14.3	31.0
	Mean/Median (%) Cognitive Competence	65.7		16.9

In the assessment of attitudes about the usefulness, relevance, and worth of statistics in personal and professional life, results show that a majority felt that statistics should be a required part of their professional training and that it was useful and applicable outside their jobs. On average, 72% had a positive attitude towards statistics in the Value component. (see Table 4).

Table 4 Attitudes toward statistics based on *Value* items

No.	Attitude Towards Statistics (VALUE items)	Agree (%)	Neutral (%)	Disagree (%)
5	**Statistics is useful**	76.2	11.9	11.9
7	Statistics should be a required part of my professional training	88.4	9.3	2.3
8	Statistical skills will make me more employable	79.1	16.3	4.7
10	**Statistics is useful to the typical professional**	78.6	7.1	14.3
12	**Statistical thinking is applicable in my life outside my job**	81.0	4.8	14.2
13	I use statistics in my everyday life	45.2	21.5	33.3
16	**Statistics conclusion are often presented in everyday life**	50.0	2.4	47.6
19	**I will have some application for statistics in my profession**	82.9	9.8	7.3
25	**Statistics is relevant in my life**	69.0	23.8	7.1
	Mean/Median (%) Value	72.3	11.9	15.9

With respect to attitudes about the difficulty of statistics as a domain, a majority felt that learning statistics required a great deal of discipline. On average, 50% of the respondents perceived some difficulties in learning statistics (see Table 5).

Table 5 Attitudes toward statistics based on *Difficulty* items

No.	Attitudes Towards Statistics (DIFFICULTY items)	Agree (%)	Neutral (%)	Disagree (%)
4	Statistics formulas are easy to understand	42.9	19.0	38.1
6	**Statistics is not a complicated subject**	39.5	18.6	41.9
17	Statistics is a subject quickly learned by most people	23.8	26.2	50.0
18	**Learning statistics do not require a great deal discipline**	4.8	11.9	83.3
22	**Statistics do not involve massive computations**	28.6	19.0	52.4
26	**Statistics is not highly technical**	23.8	26.2	50.0
28	**Most people do not have to learn a new way of thinking to do statistics**	11.9	33.3	54.8
	Mean/Median (%) Difficulty	25.0		50.0

Among the ATS components, the median percentage attitude about the students' intellectual knowledge and skills when applied to statistics was highest. On the other hand, the lowest median percentage attitude was found with those who agreed less on the usefulness, relevance, and worth of statistics in personal and professional life. The median percentage attitude about the difficulty of statistics as a domain was found to be the highest (see Fig. 1). This indicates that the majority of respondents disagreed that statistics was an easy subject to handle.

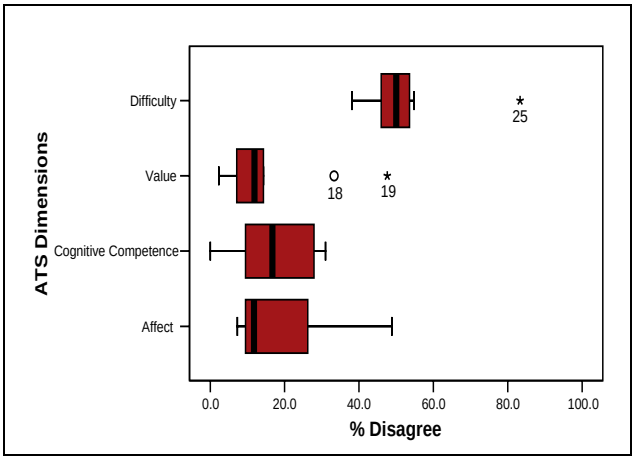


Fig.1 Distribution of responses across ATS dimensions

The average mean scores of female respondents across all ATS components is higher than the male respondents. The female group indicates a strong agreement towards all items in three components (Affect, Cognitive Competence and Value) with the exception of Difficulty component which indicates a moderate to low agreement towards its items (see Table 6, Fig. 2 - Fig. 5). The average mean score of items across all ATS components is comparable among each other. There was no significant difference in the average mean score items across all ATS components.

Table 6 Comparison of ATS scores between gender group

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Mean score Affect	Male	18	4.4907	1.01214	.23856
	Female	25	5.0280	.99404	.19881
Mean score Cognitive Competence	Male	18	4.6574	1.17639	.27728
	Female	25	5.1200	.87734	.17547
Mean score Value	Male	18	4.8210	.96725	.22798
	Female	25	5.4678	.84503	.16901
Mean score Difficulty	Male	18	3.2698	.77922	.18366
	Female	25	3.6457	.96196	.19239

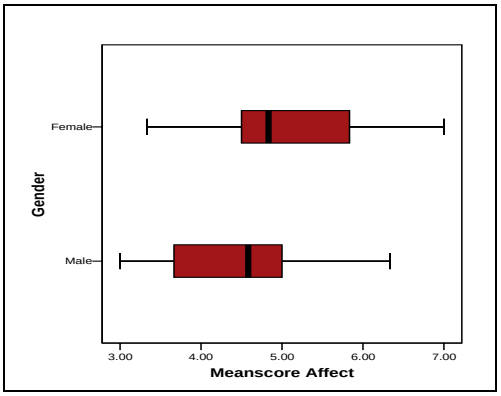


Fig.2 Attitude toward statistics between gender (*Affect*)

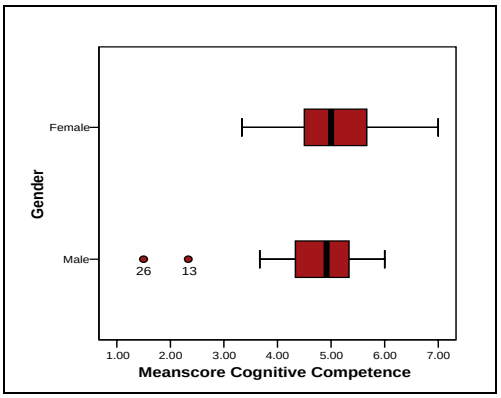


Fig.3 Attitude toward statistics between gender (*Cognitive Competence*)

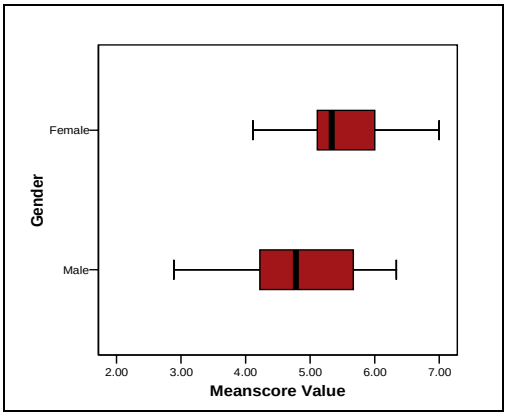


Fig. 4 Attitude toward statistics between gender (*Value*)

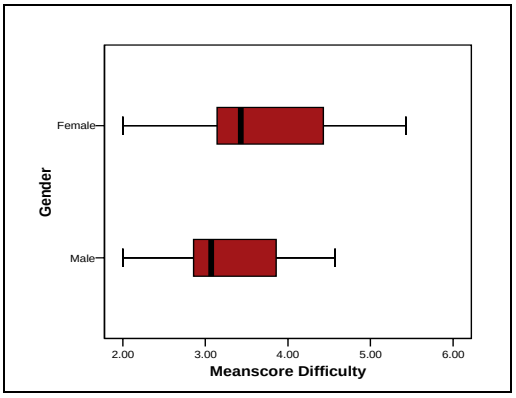


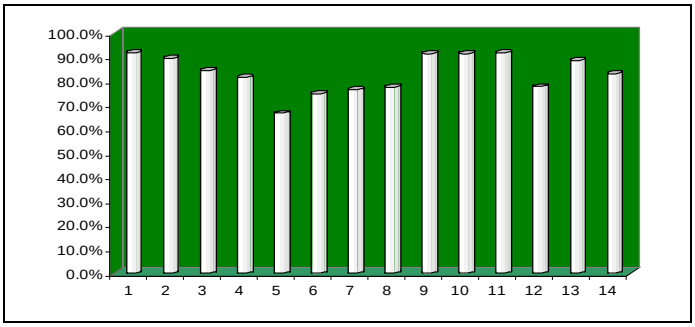
Fig. 5 Attitude toward statistics between gender *(Diffculty)*

IX. Correlation and Groups Differences

There was no significant correlation between the respondents' profile and the majority of the mean score subscales. A significant positive correlation was only found between the mean score value and gender at r = 0.327. The overall mean score ATS did not show any significant correlations with gender, age and mode of study.

The overall mean ATS scores and mean for each component of ATS sub-scores were assessed for differences between the

Fig.5 Percentage of respondents who acknowledged that



Statistical Tools/Techniques/Concepts

1	Measures of Central Tendency	8	Knowledge of a Statistical Software
2	Measures of Dispersion	9	Knowledge of Measurement Scales
3	Graphical Presentation	10	Knowledge of Types of Variables
4	Tabulation	11	Knowledge of Types of Data
5	Test of Normality	12	Sampling Technique
6	Testing Hypothesis	13	Exploratory Analysis
7	Testing Hypothesis	14	Correlation Analysis

statistical tools, techniques and concepts are important in research work

attributes of several categorical variables which include gender, age and mode of study. Levene's test for equality of variance shows no significant difference in the variance between the groups. With an equal variance assumed, a t-test was conducted to determine the significant differences of mean ATS scores between gender. The results show that there was a significant difference in mean ATS scores between male and female respondents. Female respondents were found to have a more positive attitude towards statistics than male respondents as indicated by the higher average mean score for female.

Levene's test for equality of variance shows no significant difference in the variance between the groups. With an equal variance assumed, a t-test was conducted to determine the significant differences of mean ATS scores between gender. The results show that there was no significant difference in mean ATS scores between the mode of study. The mean ATS scores were comparable between the group.

X. Importance and Perceived Competency

(i) Importance of Statistical Tools, Techniques and Concepts as Acknowledged by the Respondents

The percentage of respondent agreement on the importance of each of the 14 groups of tools, techniques and concepts in statistical analysis ranged from 66.7% for Tests of Normality (Kolmogorov-Smirnov, Shapiro Wilks, Q-Q plot, degree of skewness) to 92.1% for Measures of Central Tendency (Mean, Median). The remaining 12 groups exhibited high percentage of agreement. The overall percentage for the 14 categories is a high value of 83.9%. This shows that a big majority of the respondents believed that statistical tools, techniques and concepts were important in research works (see Fig.5).

The scarcity of the percentage of respondents who feel that Statistical Tools/Techniques/Concepts are not important to research works is evident from the large incidence of zero frequencies in the "not at all important" and "not so important" scores. The overall mean percentage for the two scores are, respectively, 0.0% and 1.2%, with the highest percentage of the "not so important" score recorded at 13.9% for the Test of Normality category.

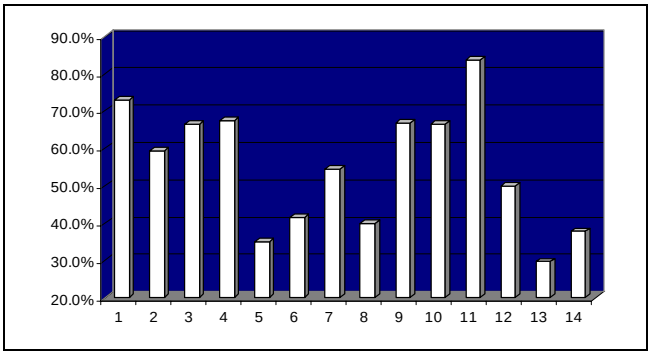
(ii) Understanding of Statistical Tools, Techniques and Concepts as Perceived by the Respondent

The percentages of the level of understanding of each of the 14 groups of tools, techniques and concepts in statistical analysis as perceived by respondents ranged from a low 29.7% for Exploratory Analysis to 83.8% for Knowledge of Types of Data. The remaining 12 groups exhibited low percentage of level of understanding which ranged from 35.1% to 73.0%. The overall percentage for the 14 categories is a fairly low value of 55.2%. This shows that quite a high percentage of the respondents perceived that they had little or no knowledge of the tools, techniques or concepts which were important in research works (see Fig. 6).

(iii) Comparison between Understanding of Statistical Tools, Techniques and Concepts as Perceived by the Respondents and their Acknowledged Importance

A comparison of the percentage of importance and the perceived level of understanding of each of the 14 groups of tools, techniques and concepts in statistical analysis shows a marked difference between the two sets of percentages. In all cases (groups), the percentages for the perceived level of understanding is lower than those of the level of importance. Thus qualitatively (visually), it is observed that large gaps between pairs of percentage of importance and percentage of the perceived level of understanding are evident. It can be tentatively said that the respondents' level of understanding of the tools, techniques and concepts of statistics do not "match" their importance (see Fig. 7).

A quantitative comparison of the importance and the perceived level of understanding of each of the 14 groups of tools, techniques and concepts in statistical analysis was done through the paired-sample t-tests of the differences in the mean score between importance and perceived level of understanding. In the analysis of the overall sample, out of the 14 groups of Tools, Techniques and Concepts, a total of 13 groups recorded a significant gap between importance and perceived understanding at a 5% significance level. The only group which recorded an insignificant gap is "Knowledge of a Statistical Software". These results strengthened the earlier qualitative findings.



Statistical Tools/Techniques/Concepts

1	Measures of Central Tendency	8	Knowledge of a Statistical Software
2	Measures of Dispersion	9	Knowledge of Measurement Scales
3	Graphical Presentation	10	Knowledge of Types of Variables
4	Tabulation	11	Knowledge of Types of Data
5	Test of Normality	12	Sampling Technique
6	Testing Hypothesis	13	Exploratory Analysis
7	Testing Hypothesis	14	Correlation Analysis

Fig..6 Percentage of perception of level of understanding of tools/techniques/concepts

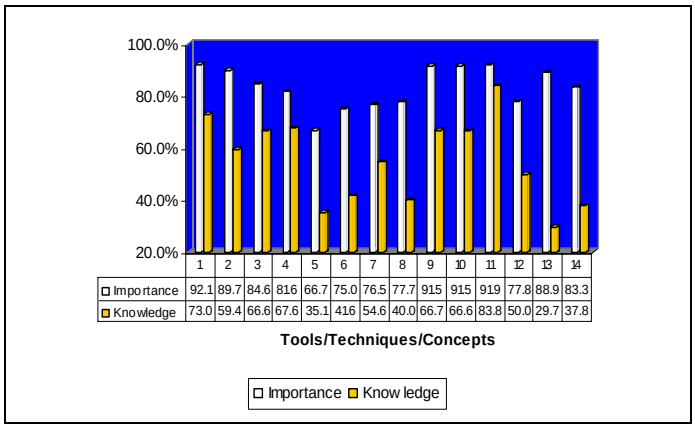


Fig.7 Percentage of importance vs level of understanding of tools, techniques and concepts of statistics

The results of the analysis of the group which comprised PhD students shows that out of the 14 groups of Tools, Techniques and Concepts, a total of 13 groups recorded a significant gap between importance and perceived understanding at a 5% significance level. Overall, the only group which recorded an insignificant gap is "Knowledge of a Statistical Software". The analysis of the group which comprised Master's students only shows that a total of 13 groups recorded a significant gap between importance and a perceived understanding at a 5% significance level. Overall, the only group which recorded an insignificant gap is "Knowledge of a Statistical Software" (see Table 7).

Table 7 Analysis of gap between importance and perceived competency in tools, techniques, concept used in statistical analyses

Tool/Techniques /Concepts	IMPORTANCE		COMPETENCY		GAP BETWEEN IMPT AND COMP			
	mean	s.d	mean	s.d.	mean	s. e	t-stat	p-value
Measures of Central Tendency	4.514	0.651	3.757	0.895	0.757	0.183	4.126	0.000
Measures of Dispersion	4.405	0.686	3.459	1.043	0.946	0.190	4.989	0.000
Graphical Presentation	4.250	0.649	3.583	0.874	0.667	0.169	3.944	0.000
Tabulation	4.378	0.861	3.622	0.893	0.757	0.175	4.323	0.000
Test of Normality	3.829	0.954	2.914	1.095	0.914	0.226	4.047	0.000
Testing Hypothesis (Parametric Analysis)	4.143	0.772	3.171	1.014	0.971	0.199	4.890	0.000
Testing Hypothesis (Non Parametric Analysis)	4.000	0.718	3.250	1.078	0.750	0.201	3.735	0.001
Knowledge of a Statistical Software	4.000	0.816	3.571	0.976	0.429	0.481	0.891	0.407
Knowledge of Measurement Scales	4.278	0.815	3.667	0.894	0.611	0.140	4.378	0.000
Knowledge of Types of Variables	4.412	0.657	3.647	0.849	0.765	0.153	5.012	0.000
Knowledge of Types of Data	4.500	0.655	3.917	0.770	0.583	0.166	3.513	0.001
Sampling Technique	4.086	0.742	3.371	0.942	0.714	0.162	4.415	0.000
Exploratory Analysis	4.229	0.646	3.086	0.981	1.143	0.184	6.211	0.000
Correlation Analysis	4.171	0.707	3.143	0.944	1.029	0.176	5.835	0.000

XI. Conclusion And Recommendations

The results of the study show that a majority of the respondents indicated a moderately high positive attitude toward statistics. However, several negative attitudes towards statistics were also detected. These include considering statistics as complicated, that it is a subject not easily learned by most people, that it requires a great deal of discipline, that it involves massive computations and is highly technical.

Further analysis involving the comparisons between understanding of statistical tools, techniques and concepts as perceived by the respondents and their acknowledged importance shows marked differences between the two sets of percentages. In all cases (groups), the percentages for the perceived level of understanding were lower than those for the level of importance. Hence large gaps were found in the percentages between these two dimensions/constructs which further indicate that the respondents' level of understanding of the tools, techniques and concepts of statistics did not "match" their importance. These are signs or indications that this group of postgraduate students requires substantial help and guidance in doing data analysis.

The students who were exposed to the 9 hours of PPS902 course on Data Analysis Module also found that the course was useful, informative, and important and that they benefited as a result of attending the course even though it was conducted within a short period of time. However, the majority agreed that the course was barely sufficient in helping them get started on their analysis.

Based on these important and significant results, it is recommended that postgraduate students be given more exposure to the learning and understanding of statistical tools, techniques and concepts. Group discussion with networked cooperative learning is also encouraged as this could get students to interact with others on their statistical learning skills [7]. These type of courses may be conducted at the

university. It is also recommended that a "Statistical Consulting Service Unit" in which services are provided by statistics experts with a wide range of experience in all forms of statistical analysis and statistical software be created. The Statistical Consulting Service unit should be able to provide consulting services in topics which include, *inter alia*, Research and Sample Design, Qualitative Research Methods, Survey Sampling, Questionnaire Design, Data Screening, Statistical Graphics, Regression, ANOVA and other General Linear Models (MANOVA), Multivariate Analysis (Factor analysis, PCA, Cluster analysis, Discriminant Analysis), Categorical Data Analysis, Longitudinal and Multi-Level Data, Structural Equation Modeling, and Statistical Computing using SAS, SPSS, and Splus/R.

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