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Incoming engineering students' self-assessment of their mathematical background

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The aim of this study was to develop a tool to measure levels of mathematical knowledge gained in high school, as perceived by incoming engineering students. The study included 657 engineering students in the 2011–2012 academic year. Factor analysis was used to obtain a scale consisting of 47 items (Cronbach Alpha coefficient, 0.975). The mathematical knowledge scale consisted of five sub-dimensions (Integration, Differentiation, General subjects, Graphing and Limit) related to subjects in the high school mathematics curriculum. Engineering students were asked to evaluate their own levels of knowledge. There was a significant difference between average scale scores of students successfully completing the calculus I course during the first semester of university and those failing this course. This difference was in favour of the students completing the lesson successfully.

Key words: Mathematical knowledge, engineering students, success in mathematics, mathematical knowledge scale.

INTRODUCTION

Mathematics is defined as the language of engineering, and so its role and importance in engineering education cannot be underestimated. It is seen that engineering students with poor mathematics skills are more likely to experience some difficulties during their university educations. A study conducted in the United States of America reported that half of students who started engineering courses either dropped out of university within the first two years or transferred to a different department (Crawford and Schmidt, 2004). It was also reported that most students who failed university engineering courses had also failed the prerequisite mathematics courses (Cuthbert and MacGrillivray, 2007). Previous studies showed a gradual decline in the level of mathematical background among students applying to study engineering at university in Europe, America and Australia (Adamczyk et al., 2002; Broadbridge and Henderson, 2008; Crowther et al., 1997; Kent and Noss, 2003; Lawson, 2003; Shaw and Shaw, 1999). Due to the establishment of many new universities and increases in the capacity of engineering departments, there are also questions about the decline in mathematics readiness among university-level engineering students in Turkey. National student placement exam results indicate a general decline in mathematics background among students enrolled in school of engineering at many universities (URL 1).

The importance of mathematical knowledge for engineering education is recognized by many organizations (Broadbridge and Henderson, 2008; Cox, 2001; Engineering Council, 2000; London Mathematics Society, 1995; Mustoe and Lawson, 2002). Some universities hold

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an initial mathematics examination to determine students' mathematical knowledge; the exam results, and discussion with their academic advisors, determine the mathematics classes that the students will attend. While these exams can be applied as a classical exam or test in the university, it can also be made as an online exam which students take at home (Britton et al., 2007). Certain universities prefer using another method, where students determine their mathematical knowledge themselves rather than taking an exam. Students complete a self-assessment form and an appropriate decision is taken about the mathematical courses they should attend (LeBold et al., 1998).

Previous studies have examined the relationships between high school academic performance of engineering students, their university entrance exam scores, parents' education levels, socio-economic background and university academic averages (Barry and Chapman, 2007) or their success on university mathematics courses (Pugh and Lowter, 2004). Universities that anticipate the success of engineering students in the first year mathematics courses, and provide academic and personal support, reported that their assistance programs generally increased academic performance (Lawson, 2012).

Academic assistance programs, peer tutoring (Evans et al., 2001; Fayowski and MacMillani 2008) and mathematics help-centre applications (Fuller, 2002; Lawson, 2012) are implemented differently when providing students with additional education on the subjects they need, either before the start of the university year (Reisel et al., 2012) or during the semester (Bamforth et al., 2005).

It was also found that students starting their university education following high school have difficulties in adapting to crowded classrooms and long course hours (Mulryan-Kyne, 2010). Another factor in poor performance is that students find it easy to be absent from courses delivered by instructors who do not know them personally (Arulampalam, 2008; Jungic et al., 2006; Massingham and Herrington, 2006; Toth and Montagna, 2002).

Previous works have reported that motivation of student (Anthony, 2000), regular follow-up during courses (Arulampalam, 2008) and the university environments (LeBold et al., 1998) affect the academic success of students starting to study engineering at university. However, studies of the factors affecting mathematics performance among university students indicate that the mathematics courses students received at high school and their performance in these courses play the biggest role (Fayowski et al., 2009; Ferrini-Mundy and Gaudard, 1992; Pugh and Lowther, 2004; Rylands and Coady, 2009; Varsavsky, 2010; Wilhite et al., 1998; Wilson and MacGrillivary, 2007).

Studies in some countries also attempted to anticipate students' performance in relevant courses or semester by evaluating their knowledge in specific subjects (Baird, 1976; LeBold et al., 1998). However, a review of the relevant literature showed that no previous study employed a tool measuring the mathematical knowledge of university students studying engineering. The present study partially addresses this gap in the literature by developing a self-assessment tool to determine mathematical knowledge among freshman engineering students. In addition, the study examined the relationship between self-assessment scores on the mathematical knowledge scale and students' performance in calculus I course.

Previous studies that attempted to predict which students are at risk of failing a mathematics course or in general academic life mostly considered the academic histories of newly enrolled university students and the results of university entrance exams (Lee et al., 2008). Certain universities require freshmen to take a placement test in mathematics (Robinson and Croft, 2003), where text scores determine which mathematics class they will attend. However, as the measurement of mathematical knowledge via a multiple choice test was similar to the scores obtained in university entrance exams, it is thought that placement tests may not be sufficiently decisive in identifying those students at risk in mathematics (Medhanie et al., 2012). A great majority of students who prepare for university entrance exams attend private training centres and take many pilot tests, thereby identifying their academic strengths and weaknesses. Some studies reported that self-assessment was a better predictor of actual competence level (Baird, 1976; LeBold et al., 1998).

In the scale developed in this study, students were asked about their perceived knowledge of specific mathematics subjects. It was thought that the risk of academic failure would be better predicted by combining scores obtained from the self-assessment scale, academic history, performance in university exams and demographic information.

METHOD

Developing the draft scale

The items of the self-assessment mathematical knowledge scale were determined in three stages. First, the mathematics subjects of the 9^{th} to 12^{th} grades of high school were identified via the website of the Ministry of National Education (URL 2). Then, the contents of university freshman calculus courses were investigated via the websites of some Turkish universities to identify the mathematics subjects taught during the first semester.

In addition, the study reviewed documents on the mathematical background that engineering students should have at the beginning of university education, obtained from international institutions such as the London Mathematics Society, European Society for Engineering Education, Australian Mathematical Sciences Institute and Engineering Council (Broadbridge and Henderson, 2008; Engineering Council, 2000; London Mathematics Society, 1995;

Table 1. Results of KMO and Bartlett sphericity tests.

KMO		**0,965**
Bartlett Sphericity	χ^2	4057.137
	Sd	2080
	P	.000

Mustoe and Lawson, 2002). Items used in previous studies that asked students to evaluate their own mathematical knowledge were also reviewed (Baird, 1976; LeBold et al., 1998). Lastly, by reviewing the work which reported the opinions of 24 world-renowned mathematicians on the content of first-year university mathematics courses, a list of 94 high school mathematics subjects was developed (Sofronas et al., 2011).

Receiving expert opinion

The scale consisting of 94 items was presented to five instructors from the department of mathematics who had at least ten years of experience in lecturing to engineering students, and to four instructors from the faculty of engineering. Instructors were asked to determine which of the 94 mathematics subjects would affect the calculus I performance of first-year engineering students. Items considered insignificant by at least six instructors were excluded from the scale; 29 items were excluded and the revised draft scale included 65 items in total (Appendix 1). As the scale was one dimensional, it was prepared as a Likert-type scale to obtain more sensitive results (Tavşancıl, 2005).

Pilot study

A pilot study was conducted by applying the draft scale to 215 students studying at the Foreign Language Preparatory School and Departments of Physics and Mathematics at the Faculty of Science and Letters of Pamukkale University. Students participating in the pilot study were asked to indicate any expressions that were unclear in the pilot scale. At the end of the pilot study, items 37, 55, 56, 61, 62, 63 and 64 were also excluded. These items were related to Taylor’s formula, iteration method in integration, Riemann sum, finding volumes by slicing, finding volumes by washer cross sections, finding volumes by cylindrical shells, lengths of plane curves, respectively.

Preparation of the scale

Following the pilot study, a 58-item scale of mathematical knowledge was obtained. Forms used in the research consisted of three parts. In the first part, the objective of the planned research and the content of the questionnaire were explained. The second part comprised demographic questions. In this part, students were asked about their gender, the type of high school they attended, and whether they attended preparatory school before starting their engineering education. The third part of the survey comprised the 58 items of the mathematical knowledge scale. In this part, students were asked to determine their knowledge of each subject according to the five-point Likert scale, rated as: (1) No knowledge, (2) Slight knowledge, (3) Moderate knowledge, (4) Good knowledge (5) Very good knowledge.

At the end of the third part, it was reported that students’ calculus I grades would be used to investigate the relationship between the self-assessment scores and actual performance levels in the calculus I course. Students who gave permission for the researchers to receive their calculus I grades from the registrar’s office were asked to write their student numbers on the questionnaire form, and it was emphasized once more that these data would only be used for this academic study.

Implementation of the scale

The 58-item scale was applied to students from the departments of computer engineering, environmental engineering, electrical and electronics engineering, industrial engineering, food engineering, civil engineering, geological engineering, mechanical engineering and textile engineering at the School of Engineering, Pamukkale University at the beginning of the fall semester of the 2011–2012 academic year. Permission for the study was obtained from the Dean’s office of the School of Engineering, and scales were applied at the “Introduction to Engineering” seminar course of each department. The objective of the study was explained to the students by the researcher, and participation was voluntary. The research form and a reminder from the researcher informed participants that data would only be used for an academic study and would not be disclosed to third parties or shared with other organisations or institutions under any circumstances. Students who agreed to participate in the research completed the forms in approximately 35 min and submitted them to the researcher.

Data analysis

A total of 716 forms collected from students studying at nine different engineering departments were reviewed individually by the researcher and 17 forms which were left completely or mostly empty were excluded. A further 42 forms were excluded because either the same choice was selected for all questions or the answers formed an observable pattern. In total, 657 questionnaires were analysed (209 female students, 448 male). Forms were numbered from 1 to 657 and data were recorded as computer file and statistically analysed using SPSS 16.

FINDINGS

Validity and reliability analysis

Factor analysis was performed to examine the structural validity of the mathematical knowledge scale. In addition, Kaiser–Meyer–Olkin (KMO) and Bartlett sphericity tests were used to check whether the results of the factor analysis were useful and usable, and whether data were appropriate for factor analysis (Table 1).

The KMO value of 0.965 and the Chi Square obtained from the Bartlett sphericity test indicate that the factor analysis can be conducted (Kalaycı, 2008). The factor load of each item was calculated by using Viramax factor analysis rotation. Items 24, 33, 34 and 45 were excluded from the scale because their factor loads were less than 0.450. Furthermore, it was observed that items 10, 17, 18, 19, 20, 35 and 65 had highly similar factor loads

Table 2. Factor loads of items.

Factor 1 Integration		Factor 2 differentiation		Factor 3 general subjects		Factor 4 graphing		Factor 5 limit	
50	.800	26	.820	5	.717	41	.769	14	.823
53	.773	25	.813	6	.716	40	.763	13	.801
54	.772	29	.765	3	.713	39	.753	15	.767
49	.769	27	.764	2	.676	42	.730	16	.693
52	.765	28	.712	7	.629	43	.676	12	.670
58	.760	22	.699	4	.620	38	.647	11	.667
48	.747	21	.697	8	.589	44	.637		
59	.714	23	.672	9	.574				
47	.711	31	.617	1	.551				
51	.674	30	.614						
60	.665	32	.613						
46	.649	36	.579						
57	.628								
E.	22.288	E.	3.274	E.	2.383	E.	2.069	E.	1.816
F.V.	47.421	F.V.	6.965	F.V.	5.070	F.V.	4.401	F.V.	3.863
T.V.	47.421	T.V.	54.386	T.V.	59.455	T.V.	63.857	T.V.	67.720

E.= Eigenvalue; F.V.= Variance explained by the factor; T.V.= Total variance.

Table 3. Pearson correlation coefficients between factors.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 1	1	.685(**)	.627(**)	.655(**)	.689(**)
Factor 2		1	.691(**)	.711(**)	.698(**)
Factor 3			1	.594(**)	.613(**)
Factor 4				1	.662(**)
Factor 5					1

** p< .01.

(difference < 0.100) in two or more factors were excluded from the scale (Cohen et al., 2008; Kalaycı, 2008).

The eigenvalues of the remaining 47 items were calculated; the first eigenvalue of 22.288 was more than six times that of the second eigenvalue, 3.274. This finding indicates that all of the items were one dimensional (Cohen et al., 2008; Kalaycı, 2008).

Subsequent principal components analysis based on Viramax rotation showed that items were grouped into five factors: (1) Integrations, (2) Differentiation, (3) General subjects, (4) Graphing and (5) Limit. The factor loads of items in these factors are given in Table 2.

Table 2 shows that the factor loads of each of the items constituting factors exceed 0.550, and total variance of the factors constituting the scale is 67.720.

Later t and p values were calculated to find the items discriminability property of the 47 items constituting the scale, by examining whether there was a difference between the averages of lower 27% and upper 27% groups for each item (Results are given in Appendix 2). It was seen that each item had discriminability property (p<.001) (Tavşancıl, 2005). In addition, revised total correlation coefficients calculated for 47 items varied between 0.551 and 0.823 (Item total correlation results for each item are given in Appendix 2). The results indicate that each item is consistent with the whole scale.

In addition, Pearson correlation coefficients were calculated between the factors in order to determine the relationship between five factors constituting the scale (Table 3). A highly significant relationship was found between the differentiation and graphing factors (r=0.771 p=0.01), and significant relationships were found between the other factors (Kalaycı, 2008).

Cronbach alpha coefficients of the scale and its five sub-dimensions were calculated (Table 4).

High Cronbach Alpha coefficients were found for the measurement tool and its factors, indicating that the measurement tool is highly sensitive to the characteristic

Table 4. Factors' items and Cronbach Alpha scale.

Factors	Number of items	Cronbach Alpha
Integration	13	.957
Differentiation	12	.958
General subjects	9	.889
Graphing	7	.938
Limit	6	.933
Total	47	.975

Table 5. Arithmetic averages and perceived knowledge levels of students in the scale and its factors.

Factors	Mean	Level of knowledge
Integration	3.117	Moderate
Differentiation	3.841	Good
General subjects	3.675	Good
Graphing	3.377	Moderate
Limit	3.517	Good
Total	3.498	Good

it intends to measure (Cohen et al., 2008).

As the scale contains 47 items and participant responses are coded as integers between 1 and 5, the highest possible score was 235 and the lowest, 47. Based on the assumption that five-point evaluation intervals are equal in the scale, score interval is 0.80 for averages. Therefore, evaluation intervals of item averages to be calculated are: 1.00–1.80 "No knowledge"; 1.81–2.60 "Slight knowledge"; "2.61–3.40 "Moderate knowledge"; 3.41–4.20 "Good knowledge" and 4.21–5.00 "Very good knowledge" (Sümbüloğlu and Sümbüloğlu, 1993; Tavşancıl, 2005).

Mathematical knowledge of incoming engineering students

The averages of the mathematical knowledge scale and of each factor were calculated (Table 4). The results show that students perceive the highest level of knowledge on the subject of differentiation, whereas integration is the least-known of the five subjects. It is clear that students do not think that they know any one of the subjects slightly or very well. In general, it can be implied that students evaluate their levels of mathematical knowledge to be good (Table 5).

A total of 537 participants permitted access to their grades for the calculus I course at the end of the semester. The average scale score of the 222 students successfully completing the calculus I course was 171.41, which differed significantly from the average scale score of 159.93 among the 315 students who failed the course (t=3.701; p= .000).

DISCUSSION

The study developed a 47-item self-assessment scale to measure perceived levels of mathematical knowledge among incoming engineering students Table 5. The tool used a Likert-type scale, and each of the subjects is evaluated via the following options: (1) No knowledge, (2) Slight knowledge, (3) Moderate knowledge, (4) Good know-ledge and (5) Very good knowledge. The minimum score is 47, and the maximum 235.

Factor analysis showed that the scale consists of five factors, and that these factors are closely related to the mathematics curriculum for engineering students during the first semester of the first year of university. The scale factors are named: (1) Integrations, (2) Differentiations, (3) General subjects, (4) Graphing and (5) Limit.

The significance of the difference between the lower 27% and upper 27% of the scale indicated that the items had the discriminability property. Total Cronbach Alpha coefficient of the scale was 0.975, which indicates high internal consistency. Furthermore, the Cronbach Alpha coefficients of each of the five factors exceeded 0.880, indicating that the reliability coefficients of the sub-dimensions of the scale were also high.

The finding of a positive relationship between self-perceived mathematical knowledge and performance in calculus I course suggests that the scale reliably evaluated the level of mathematical knowledge among students. It is concluded that the scale developed in this study provides a valid and reliable means of measuring levels of mathematical knowledge among university students starting engineering education.

The result of present study shows that incoming engineering students measure their mathematics background for general subjects, differentiation and limit as good. But, for integration and graphing they grade their knowledge level as moderate. These results contradict with some previous research results, which found students mathematics background less than satisfactory (Cox, 2001; LeBold et al., 1998; Mustoe, 2002). We believe further and widespread research is needed to understand incoming engineering students' mathematics background in Turkish universities.

CONCLUSION AND RECOMMENDATIONS

Successfully completing the first semester mathematics course increases the probability of freshman engineering students completing their engineering education in a timely manner (DeBerard et al., 2004). Thus, it is helpful to establish the level of mathematical knowledge among engineering students at the beginning of their university education. Identifying those students with poor mathematical skills at the beginning of the semester, and arranging specialized programmes to provide the necessary academic support can increase the achievement levels of students at risk of failing mathematics courses.

Machine learning is another method used at the beginning of the semester to evaluate students at risk of failing the calculus I course. Models obtained via the machine learning method incorporate information such as high school grades, university entrance exam performance, parents' educational and socio-economic level and students' study habits, and can be up to 80% accurate in identifying students at risk of failing academic courses (Choudhury, 2002; Güner and Çomak, 2011; Kovacic, 2010; Vandamme et al., 2007). New—and potentially more accurate—models can be developed to identify at risk students by using the mathematical knowledge level scale in combination with the other information provided above. Thus, the achievement levels among freshman students can be increased through extracurricular academic support provided to those students identified as being at risk of failing the mathematics course.

To be able to increase freshman engineering students' achievement in calculus courses some extra measures may be taken by Turkish universities. For example, universities may establish mathematics learning centres and employ some last year mathematics students for peer teaching. Many universities use mathematics learning centres and supplementary instructions to increase their students' achievement in first and second year mathematics courses. Like many US and UK universities, they may use supplementary instructions to increase their students' achievement level in first and second year mathematics courses.

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Appendix 1.

Draft scale:

1. Modular algebra
2. Absolute value function
3. Polynomials and their properties
4. Chinese Remainder Theorem
5. Second degree equations and their solutions
6. Operations with powers and roots
7. Trigonometric functions
8. Law of sines and cosines
9. Complex numbers
10. Logarithmic functions
11. Definition of limit
12. Right-hand and left-hand limits
13. Product rule for limit
14. Quotient rule for limit
15. Limits of indeterminate forms
16. Limits of a function at infinity
17. Definition of continuity
18. Properties of continuous functions
19. Limits of continuous functions
20. Definition of derivative
21. Derivatives of polynomial functions
22. Derivatives of trigonometric functions
23. Derivatives of logarithmic and exponential functions
24. Derivatives of elementary functions
25. Product rule for derivative
26. Quotient rule for derivative
27. The chain rule in derivative
28. Derivatives of inverses of differentiable functions
29. Second derivatives
30. Higher order derivatives
31. Derivatives of parametric functions
32. Implicit differentiation
33. Geometric meaning of derivative
34. Physical meaning of derivative
35. Mean Value Theorem
36. L'Hopital's rule
37. Taylor's formula
38. Critical points of a function
39. Increasing – decreasing function
40. Concavity of functions
41. Finding extreme values of functions
42. Finding an inflection point(s) of functions
43. Finding asymptotes of function
44. Graphing a function
45. Integration of elementary functions
46. Relation between derivative and integral
47. Integration of polynomials
48. Integration of trigonometric functions
49. Integration of logarithmic functions
50. Integration of exponential functions
51. Method of simplification of integration
52. Integration by substitution

53. Integration by parts
54. Integration by partial fractions
55. Iteration method in integration
56. Riemann sums
57. Fundamental theorem of calculus
58. Improper integrals
59. Area between curves
60. Volume calculation by integration
61. Finding volumes by slicing
62. Finding volumes by washer cross sections
63. Finding volumes by cylindrical shells
64. Lengths of plane curves
65. Surface area of rotated curves

Appendix 2.

Table 1. The results of t test related to items discriminability of the scale.

Item no	Lower-Upper (27%)	Mean	Sd.	t	Item total correlation
1	Lower 27%	1.8371	.66501	41.926	.465
	Upper 27%	4.4494	.49884		
2	Lower 27%	2.4888	.63101	35.632	.531
	Upper 27%	4.6180	.48725		
3	Lower 27%	2.5000	.62210	43.330	.577
	Upper 27%	4.8427	.36511		
4	Lower 27%	1.9270	.79565	39.920	.560
	Upper 27%	4.6854	.46567		
5	Lower 27%	2.9831	.68457	39.306	.552
	Upper 27%	5.0000	.00000		
6	Lower 27%	3.0843	.73545	34.753	.482
	Upper 27%	5.0000	.00000		
7	Lower 27%	2.5112	.66586	32.204	.622
	Upper 27%	4.5225	.50090		
8	Lower 27%	2.4382	.70439	33.837	.619
	Upper 27%	4.6124	.48859		
9	Lower 27%	2.3764	.72790	33.694	.530
	Upper 27%	4.5955	.49218		
11	Lower 27%	2.3764	.69616	31.936	.695
	Upper 27%	4.4213	.49517		
12	Lower 27%	2.4607	.67324	33.812	.649
	Upper 27%	4.5787	.49517		
13	Lower 27%	2.3652	.71015	35.387	.632
	Upper 27%	4.6404	.48122		
14	Lower 27%	2.3371	.75080	34.947	.629
	Upper 27%	4.6629	.47405		
15	Lower 27%	2.2753	.67861	33.887	.640
	Upper 27%	4.4045	.49218		
16	Lower 27%	2.1011	.68963	36.333	.627
	Upper 27%	4.4101	.49324		

Table 1. Contd.

21	Lower 27%	2.5618	.74341	43.757	.705
	Upper 27%	5.0000	.00000		
22	Lower 27%	2.4382	.70439	48.523	.764
	Upper 27%	5.0000	.00000		
23	Lower 27%	2.4326	.69579	49.229	.752
	Upper 27%	5.0000	.00000		
25	Lower 27%	2.8258	.68227	33.640	.723
	Upper 27%	5.0000	.00000		
26	Lower 27%	2.8483	.84004	33.949	.721
	Upper 27%	4.9944	.07495		
27	Lower 27%	2.5281	.68214	48.347	.738
	Upper 27%	5.0000	.00000		
28	Lower 27%	2.3483	.73801	43.166	.729
	Upper 27%	4.9101	.28683		
29	Lower 27%	2.7584	.80469	37.165	.707
	Upper 27%	5.0000	.00000		
30	Lower 27%	2.2416	.76878	37.234	.695
	Upper 27%	4.7247	.44792		
31	Lower 27%	1.9438	.72657	40.428	.722
	Upper 27%	4.6011	.49105		
32	Lower 27%	2.1404	.76465	39.514	.704
	Upper 27%	4.7472	.43585		
36	Lower 27%	2.6348	.82771	38.123	.675
	Upper 27%	5.0000	.00000		
38	Lower 27%	2.2247	.68483	39.949	.676
	Upper 27%	4.6966	.46101		
39	Lower 27%	2.1742	.71149	38.569	.711
	Upper 27%	4.6517	.47778		
40	Lower 27%	1.6854	.52282	52.395	.645
	Upper 27%	4.5281	.50062		
41	Lower 27%	2.2247	.73266	36.659	.713
	Upper 27%	4.6067	.48985		
42	Lower 27%	2.0787	.72447	38.568	.742
	Upper 27%	4.6067	.48985		
43	Lower 27%	1.9213	.70068	40.783	.671
	Upper 27%	4.5506	.49884		
44	Lower 27%	1.6236	.48585	53.349	.601
	Upper 27%	4.3146	.46567		
46	Lower 27%	1.7247	.59902	47.399	.719
	Upper 27%	4.5000	.50141		
47	Lower 27%	1.6966	.57055	57.762	.754
	Upper 27%	4.7697	.42224		
48	Lower 27%	1.5899	.49324	55.310	.771
	Upper 27%	4.5056	.50138		
49	Lower 27%	1.4831	.50113	55.643	.752
	Upper 27%	4.4213	.49517		
50	Lower 27%	1.6067	.48985	54.861	.741
	Upper 27%	4.4888	.50128		

Table 1. Contd.

51	Lower 27%	1.9326	.70186	47.453	.659
	Upper 27%	4.8034	.39857		
52	Lower 27%	1.7584	.69140	44.975	.712
	Upper 27%	4.6124	.48859		
53	Lower 27%	1.5449	.49938	54.220	.709
	Upper 27%	4.3764	.48585		
54	Lower 27%	1.4831	.50113	55.829	.711
	Upper 27%	4.4382	.49757		
57	Lower 27%	1.0000	.00000	61.850	.472
	Upper 27%	4.0337	.65440		
58	Lower 27%	1.4270	.49603	56.630	.694
	Upper 27%	4.3652	.48284		
59	Lower 27%	1.5225	.50090	55.032	.694
	Upper 27%	4.4326	.49683		
60	Lower 27%	1.4607	.49986	56.635	.629
	Upper 27%	4.4101	.49324		
Total	Lower 27%	119.70	21.976	43.760	
	Upper 27%	203,00	12,511		