Title: An Experimental Comparison of Pairwise Comparison Method And Point Allocation Method

Course:
Year: 1991
Author(s): W. Liu

Report No: P91010

ETM OFFICE USE ONLY
Report No.: See Above
Type: Student Project
Note: This project is in the filing cabinet in the ETM department office.

Abstract: Most managerial decisions in project selections involve tradeoffs among a number of criteria. Pairwise comparison is one of the most powerful methods for determining the relative weights (or relative importance) among a number of project evaluation criteria. The objectives of this experimental study is to examine the performance of pairwise comparison method when the number of criteria increases, with comparison to the straight forward point allocation method. An experiment was designed and conducted using 24 graduate students. The experimental results show that with the increase in number of criteria the accuracy of the pairwise comparison method increases. The comparison between the pairwise comparison method and the point allocation method remains to be studied in the future.

AN EXPERIMENTAL COMPARISON OF PAIRWISE COMPARISON METHOD AND POINT ALLOCATION METHOD

Win Liu

EMP-P9110

AN EXPERIMENTAL COMPARISON OF PAIRWISE COMPARISON METHOD AND POINT ALLOCATION METHOD

To: Dr. Dundar F. Kocaoglu

For EMGT 510F

Team #3

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To: Dr. Dundar F. Kocaoglu
For: EMGT 510P
From: Team #2, Win G. Liu

Executive Summary

An Experimental Comparison of Pairwise Comparison Method and Point Allocation Method

Most managerial decisions in project selections involve tradeoffs among a number of criteria. The pairwise comparison is one of the most powerful methods for determining the relative weights (or relative importance) among a number of project evaluation criteria. The objectives of this experimental study is to examine the performance of pairwise comparison method when the number of criteria increases, with comparison with the straight forward point allocation method. An experiment is designed and conducted among 24 graduate students. The experimental results show that with the increase in the number of criteria the accuracy of the pairwise comparison method increases. Because of the noise in the experimental data of pairwise comparison methods and the relatively small size of the sample, the comparison between the pairwise comparison method and the point allocation method remains to be studied in the future.

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Abstract

Most managerial decisions in project selections involve tradeoffs among a number of criteria. The pairwise comparison is one of the most powerful methods for determining the relative weights (or relative importance) among a number of project evaluation criteria. The objectives of this experimental study is to examine the performance of pairwise comparison method when the number of criteria increases, with comparison with the straight forward point allocation method. An experiment is designed and conducted among 24 graduate students. The experimental results show that with the increase in the number of criteria the accuracy of the pairwise comparison method increases. Because of the noise in the experimental data of pairwise comparison methods and the relatively small size of the sample, the comparison between the pairwise comparison method and the point allocation method remains to be studied in the future.

Introduction

Pairwise comparison method is one of the most popular and efficient approaches to quantifying subjective judgements in people's minds when objective values are not available. A lot of research effort, both experimental and theoretical, has been done [1,2,3,4,5]. The purpose of this method is to find out the relative weights among different elements as closed to the subjective judgements in a person's mind as possible. So, the effectiveness of the method will depend on how accurate the result reflects the judgements in the person's mind. The pairwise comparison method is based on the assumption that people can give more accurate weights by comparing a pair of elements than by comparing more than two elements. It is obvious that it is easier to tell the relationship or ratio between two elements than among three elements. The final purpose is to find out the weights for each element other than the relationships between each pair of elements. For a problem with more than ten elements, it is hard for a person to directly give a set of weights among the elements. If he is asked to give the weights in such a way, it will probably lead a significant deviation from what is really in his mind. In this situation the pairwise comparison approach will efficiently help him to find out what he really has in his mind. But for a problem with only three or four elements to be assigned a weight, such an assumption that people can not give the weights among three elements more accurate than through pairwise comparison approach may or may not correct. In other words, for a problem with three or four elements, giving the weights directly may produce comparable or better accuracy than through the

may produce comparable or better accuracy than through the pairwise comparison method. If it is true, we don need to use the pairwise comparison method to obtain the weights among three or four elements, which will make the survey process much simpler.

The problem is how many elements a normal person can handle, or can give relatively accurate weights. If we could identify in what range people can give fairly accurate weights, and in what range people can not, it will help the implementation of the pairwise comparison method. In order to do this, we designed a set of experiments, in which a group of people are given a set of alternatives from three to six, and asked to give the weights among elements and or do the pairwise comparisons between each pair of elements. Then we can compare the results by these two methods in different number of elements to see how many elements an ordinary people can handle, giving comparable weights among elements. We begin with a discussion on the experimental design for this study. The data analysis method is then given. Finally, the experimental result is discussed along with the discussion about the noise in the data.

The Design of the Experiment

The first category of questions is the areas of rectangles, the number of rectangles varying from 3 to 6.

The second category of questions is the college size (number of faculty members), the number of colleges varying from 3 to 6.

Pairwise Comparison	Point Allocation
Areas of Rectangles (Group 1)	Areas of Rectangles (Group 2)
College Size (Group 3)	College Size (Group 4)

Each group contains seven graduate students. Directions are given to each group. The detail of the design can be found in Appendix A.

The Data Analysis

Three measures are used to the data analysis, which are discrepancy, disagreement and inconsistency.

Discrepancy is the measure between the actual and subjective value. For m attributes [1]:

$$d = \sqrt{\frac{1}{m} \sum_{j=1}^{m} \left(r_{sub(j)} - r_{act(j)} \right)^2}$$

Disagreement is the measure of total variation in the

judgements of respondents, e.g., for n respondents and m attributes in a category;

$$\text{Disagreement} = \sqrt{\frac{1}{m}\sum_{j=1}^{m}\frac{1}{n}\sum_{i=1}^{n}\left(r_{ij} - r_{sub(j)}\right)^2}$$

Where r_{ij} = relative value assigned to jth attribute by respondent i

$r_{sub(j)}$ = mean subjective relative value of the jth attribute.

Inconsistency is the measure to determine the level of internal consistency in the judgmental comparisons. In this study a software for calculating the relative weights from pairwise comparisons [6]. A computer program is developed for calculating the relative weights, the corresponding discrepancies, disagreements and inconsistencies for individuals and groups (see Appendix B).

Analysis of Experimental Results

The relative weights and the corresponding measures are shown in Appendix C.

Table 1 is a part of the results in Appendix C.

Table 1 Experimental Results of Pairwise Comparison Method (Areas of Rectangles)

	Number of Elements			
	3	4	5	6
Discrepancy	0.025	0.033	0.020	0.015
Disagreement	0.040	0.040	0.025	0.023

Table 2 Experimental Results of Pairwise Comparison Method (College Size)

	Number of Elements			
	3	4	5	6
Discrepancy	0.162	0.135	0.097	0.073
Disagreement	0.075	0.055	0.038	0.038

From the results we can see that with the increase in the number of elements, the accuracy of pairwise comparison methods increases.

Because several misunderstandings of the experiment have been found in the responses in pairwise comparison judgments and the sample size of each group is relatively small, the comparison between pairwise comparison methods and point allocation methods remains to be done in the future.

Concluding Remarks

The experimental study in this paper shows that with the increase in the number of elements (from 3 to 6 in this study), the accuracy of pairwise comparison methods increase. This suggests that the pairwise comparison method is more powerful in dealing with problems having more elements. Because of the noisy experimental data and the relatively small sample size, the comparison between the pairwise comparison method with the point allocation method remains to be studied in the the future.

Reference

[1] Kocaoglu, D. F., "A Participative Approach to Program Evaluation," IEEE Transactions on Engineering Management, vol. EM-30, No. 3, August 1983.

[2] Cleland, D. I. and Kocaoglu, D. F., Engineering Management, New York: McGraw-Hill, 1981.

[3] Saaty, T. L., "A Scaling Method for Priorities in Hierarchical Structures," J. Math. Psychol., pp. 234-281, June 1977.

[4] Saaty, T. L., Analytic Hierarchy Process. New York: McGraw-Hill, 1980.

[5] Schoemaker, P. J. H. and Waid, C. C., "An Experimental Comparison of Different Approaches to Determining Weights in Additive Utility Models," Management Science, vol. 26, no. 2, 1982.

[6] Bailey, B. J., A Software Product for the Pairwise Comparison Method of Judgement Quantification, EMP report (for EMGT 506X), Portland State University, 1990.

APPENDIX A

EXPERIMENTAL DESIGN FOR STUDYING PAIRWISE COMPARISON METHODS AND POINT ALLOCATION METHOD

To: Dr. Kocaoglu
From: Win G. Liu
Date: May 8, 1991
Subject: **A Revised Experimental Design for Comparison between Pairwise Comparison and Point Allocation**

The objective of this study is to compare the pairwise comparison approach and the point allocation method under different number of criteria and different problem characteristics.

The first category of questions is the areas of rectangles, the number of rectangles varying from 3 to 6.

The second category of questions is the college size (number of faculty members), the number of colleges varying from 3 to 6.

Pairwise Comparison	Point Allocation
Areas of Rectangles (Group 1)	Areas of Rectangles (Group 2)
College Size (Group 3)	College Size (Group 4)

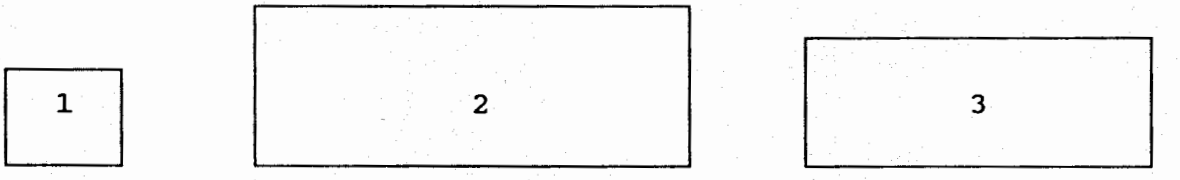
NAME_____ GROUP: 1

Category 1: Areas of Rectangles

Note: Please do not measure the dimensions of the rectangles or calculate the areas. Just indicate what you perceive as the relative areas.

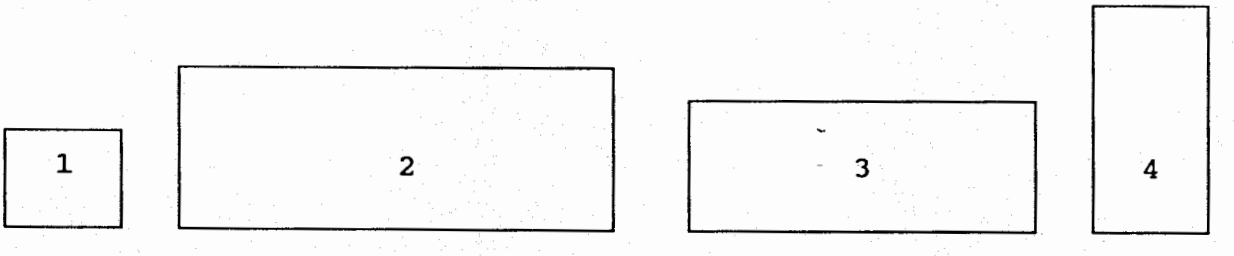
Use the blocks below each group of rectangles to compare two rectangles at a time by dividing a total of 100 points between the rectangles of each pair. For example, if you feel that No.1 is half as large as No.2, give 33 points to No.1, and 67 points to No.2 in the first comparison. Continue with the other comparisons in a similar way.

(1a)



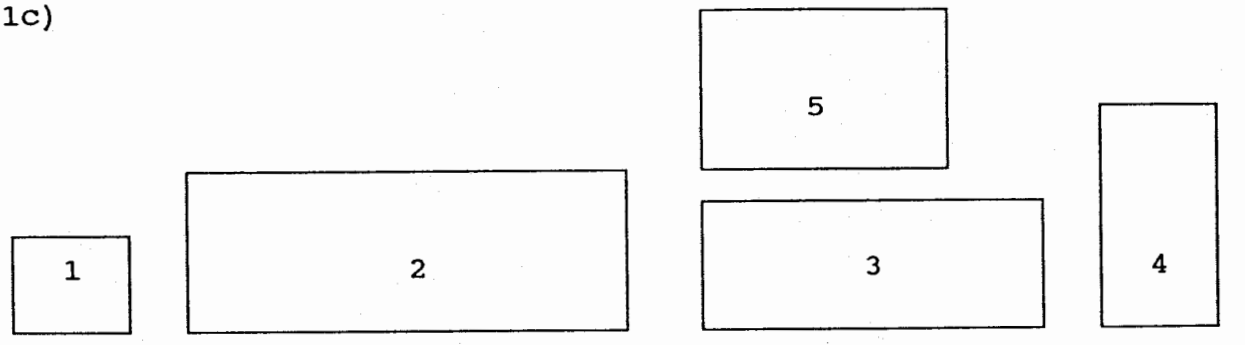
1_____	2_____	2_____	3_____	3_____	1_____

(1b)



2_____	4_____	4_____	1_____	3_____	4_____

1c)



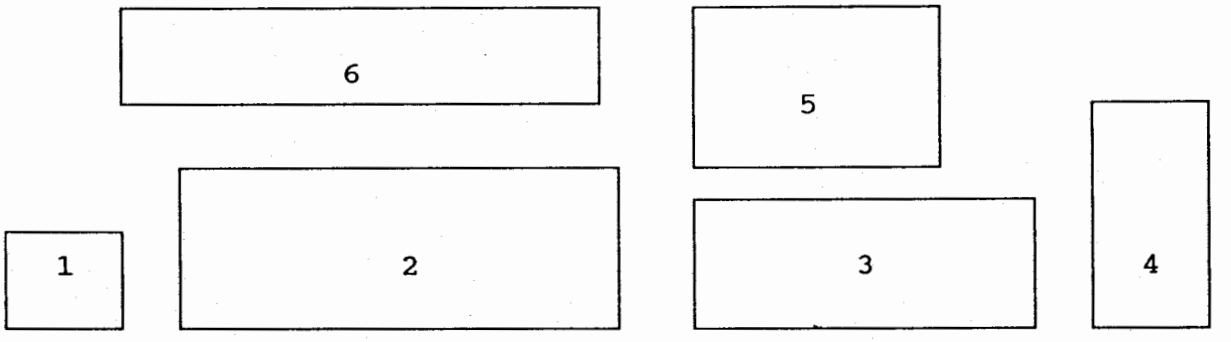
5_____ 1_____

2_____ 5_____

3_____ 5_____

5_____ 4_____

(1d)



1_____ 6_____

6_____ 2_____

3_____ 6_____

6_____ 4_____

5_____ 6_____

NAME_____ GROUP: 2

Category 1: Areas of Rectangles

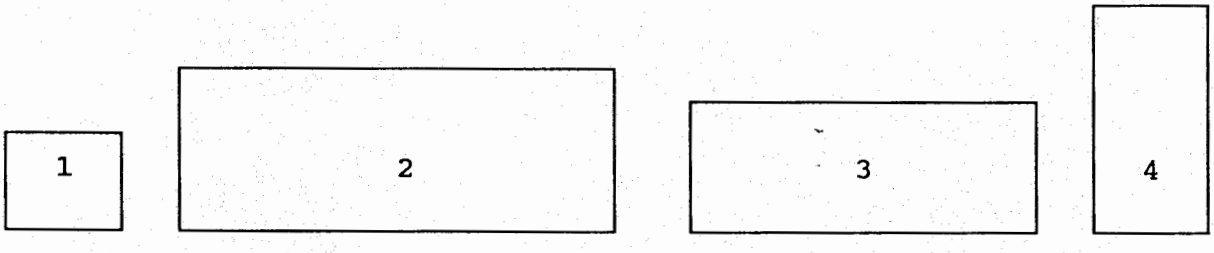
Note: Please do not measure the dimensions of the rectangles or calculate the areas. Just indicate what you perceive as the relative areas.

Use the blocks below each group of rectangles to distribute 100 points among the rectangles to indicate your judgement of their relative areas as a percentage of the total. For example, if you feel that their areas are equal to each other, give 33.3 to each one.

(1a)

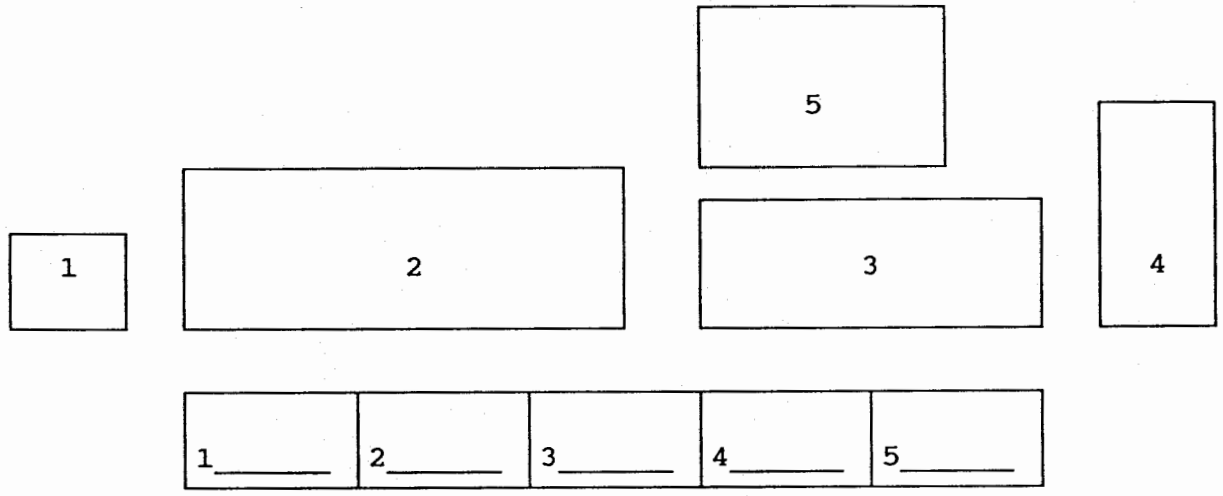
1_____	2_____	3_____

(1b)

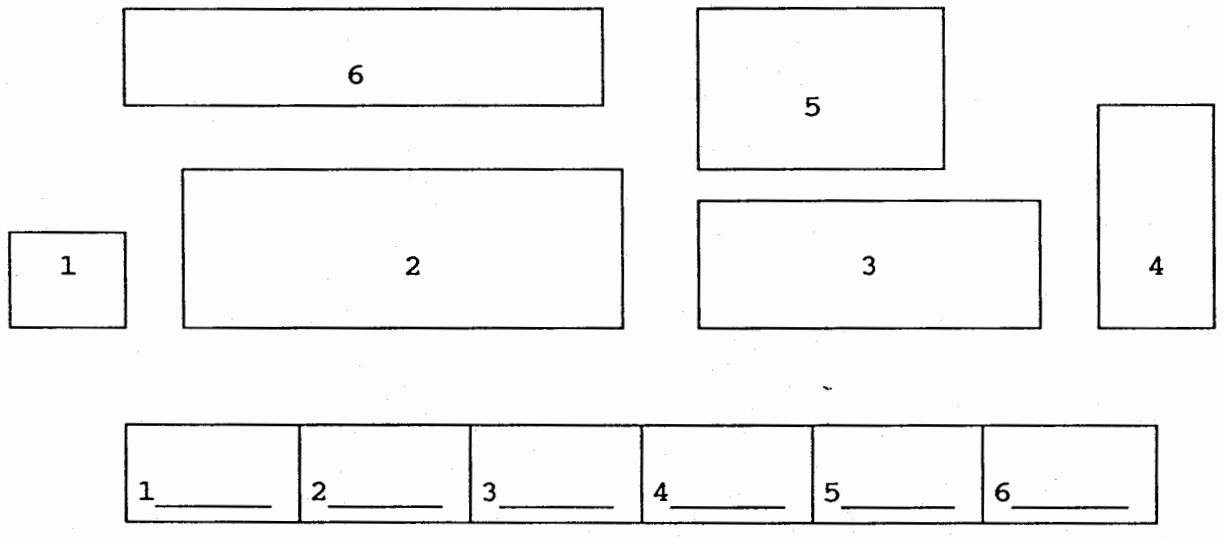


1_____	2_____	3_____	4_____

1c)



(1d)



NAME_____ GROUP: 3

DATE_____

Category 2: College Faculty Size (Number of Faculty Member)

Use the blocks below each group of universities to compare two universities at a time by dividing a total of 100 points between the universities of each pair. For example, if you feel that the first university is half as large as the second university, give 33 points to the first, and 67 points to the second in the first comparison. Continue with the other comparisons in a similar way.

(2a)

1. Oregon State University
2. Portland Community College
3. Portland State University

1_____	2_____	2_____	3_____	3_____	1_____

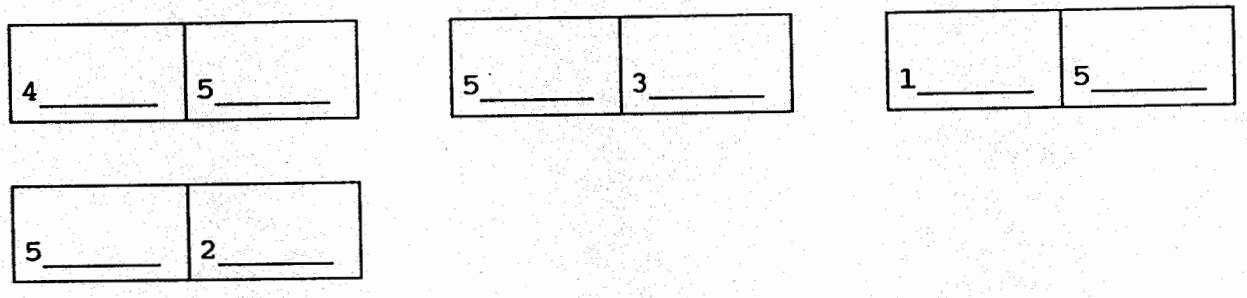
(2b)

1. Oregon State University
2. Portland Community College
3. Portland State University
4. Stanford University

4_____	2_____	4_____	3_____	1_____	4_____

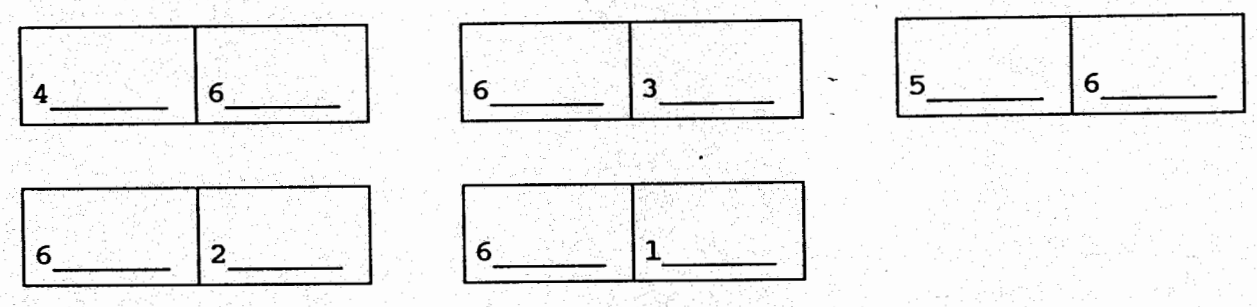
(2c)

1. Oregon State University
2. Portland Community College
3. Portland State University
4. Stanford University
5. University of Oregon



(2d)

1. Oregon State University
2. Portland Community College
3. Portland State University
4. Stanford University
5. University of Oregon
6. University of Washington



NAME_____ GROUP: 4

Category 2: College Faculty Size (Number of Faculty Member)

Use the blocks below each group of universities to distribute 100 points among the universities to indicate your judgement of their relative faculty size as a percentage of the total. For example, if you feel that their sizes are equal to each other, give 33.3 to each one.

(2a)

1. Oregon State University
2. Portland Community College
3. Portland State University

1_____	2_____	3_____

(2b)

1. Oregon State University
2. Portland Community College
3. Portland State University
4. Stanford University

1_____	2_____	3_____	4_____

(2c)

1. Oregon State University
2. Portland Community College
3. Portland State University
4. Stanford University
5. University of Oregon

1_____	2_____	3_____	4_____	5_____

(2d)

1. Oregon State University
2. Portland Community College
3. Portland State University
4. Stanford University
5. University of Oregon
6. University of Washington

1_____	2_____	3_____	4_____	5_____	6_____

APPENDIX B

A COMPUTER PROGRAM FOR PROCESSING THE EXPERIMENTAL DATA OF PAIRWISE COMPARISON METHODS AND POINT ALLOCATION METHOD

```
      DIMENSION AA(4,6),PW(4,6,6),PP(4,6,6),PWA(4,6),PPA(4,6)
     *,DSCPW(4),DSCPP(4),DPW(4,6),DPP(4,6),PWSD(4,6),PPSD(4,6)
     *,DSGPW(4),DSGPP(4)
      OPEN(1,FILE='PA.DAT')
      OPEN(2,FILE='PA.RST',STATUS='NEW')
      DO 10 I=1,4
      READ(1,*)(AA(I,J),J=1,I+2),((PW(I,J,K),J=1,I+2),K=1,6),
     *((PP(I,J,K),J=1,I+2),K=1,6)
10    CONTINUE
      DO 222 I=1,4
      DO 333 J=1,I+2
      AA(I,J)=AA(I,J)/100.
      DO 444 K=1,6
      PW(I,J,K)=PW(I,J,K)/100.
      PP(I,J,K)=PP(I,J,K)/100.
444   CONTINUE
333   CONTINUE
222   CONTINUE
      DO 30 I=1,4
      DSCPW(I)=0.
      DSCPP(I)=0.
      DSGPW(I)=0.
      DSGPP(I)=0.
      DO 40 J=1,6
      PWA(I,J)=0.
      PPA(I,J)=0.
      DPW(I,J)=0.
      DPP(I,J)=0.
      PWSD(I,J)=0.
      PPSD(I,J)=0.
40    CONTINUE
30    CONTINUE
      DO 50 I=1,4
      DO 60 J=1,I+2
      DO 70 K=1,6
      PWA(I,J)=PWA(I,J)+PW(I,J,K)/6.
      PPA(I,J)=PPA(I,J)+PP(I,J,K)/6.
70    CONTINUE
      DSCPW(I)=DSCPW(I)+(PWA(I,J)-AA(I,J))**2
      DSCPP(I)=DSCPP(I)+(PPA(I,J)-AA(I,J))**2
60    CONTINUE
      DSCPW(I)=SQRT(DSCPW(I)/REAL(I+2))
      DSCPP(I)=SQRT(DSCPP(I)/REAL(I+2))
50    CONTINUE
      DO 12 I=1,4
      DO 13 J=1,I+2
      DO 11 K=1,6
      PWSD(I,J)=PWSD(I,J)+(PW(I,J,K)-PWA(I,J))**2
      PPSD(I,J)=PPSD(I,J)+(PP(I,J,K)-PPA(I,J))**2
11    CONTINUE
13    CONTINUE
12    CONTINUE
      DO 14 I=1,4
      DO 15 J=1,I+2
```

```
      DSGPW(I)=DSGPW(I)+PWSD(I,J)/6.
      DSGPP(I)=DSGPP(I)+PPSD(I,J)/6.
      PWSD(I,J)=SQRT(PWSD(I,J)/FLOAT(I+1))
      PPSD(I,J)=SQRT(PPSD(I,J)/FLOAT(I+1))
15    CONTINUE
      DSGPW(I)=SQRT(DSGPW(I)/FLOAT(I+2))
      DSGPP(I)=SQRT(DSGPP(I)/FLOAT(I+2))
14    CONTINUE
      WRITE(2,100) (AA(1,J),J=1,3),
     *(PWA(1,J),J=1,3),(PWSD(1,J),J=1,3),(PPA(1,J),J=1,3),
     *(PPSD(1,J),J=1,3),DSCPW(1),DSGPW(1),DSCPP(1),DSGPP(1)
100   FORMAT(2X,'NUMBER OF ELEMENTS=3, (n=6)',//
     *4X,'ACTUAL VALUES              = ',3(F4.2,2X)//
     *4X,'PCM: PERCEIVED VALUES    = ',3(F4.2,2X)/
     *4X,'PCM: STANDARD DEVIATION = ',3(F4.2,2X)/
     *4X,'PA: PERCEIVED VALUES     = ',3(F4.2,2X)/
     *4X,'PA: STANDARD DEVIATION   = ',3(F4.2,2X)//
     *4X,'PWC: DISCREPANCY =',F5.3,',  DISAGREEMENT =',F5.3,/
     *4X,'PP:  DISCREPANCY =',F5.3,',  DISAGREEMENT =',F5.3,///)
      WRITE(2,300) (AA(2,J),J=1,4),
     *(PWA(2,J),J=1,4),(PWSD(2,J),J=1,4),(PPA(2,J),J=1,4),
     *(PPSD(2,J),J=1,4),DSCPW(2),DSGPW(2),DSCPP(2),DSGPP(2)
300   FORMAT(2X,'NUMBER OF ELEMENTS=4, (n=6)',//
     *4X,'ACTUAL VALUES              = ',4(F4.2,2X)//
     *4X,'PCM: PERCEIVED VALUES    = ',4(F4.2,2X)/
     *4X,'PCM: STANDARD DEVIATION = ',4(F4.2,2X)/
     *4X,'PA: PERCEIVED VALUES     = ',4(F4.2,2X)/
     *4X,'PA: STANDARD DEVIATION   = ',4(F4.2,2X)//
     *4X,'PWC: DISCREPANCY -',F5.3,',  DISAGREEMENT =',F5.3,/
     *4X,'PP:  DISCREPANCY -',F5.3,',  DISAGREEMENT -',F5.3,///)
      WRITE(2,400) (AA(3,J),J=1,5),
     *(PWA(3,J),J=1,5),(PWSD(3,J),J=1,5),(PPA(3,J),J=1,5),
     *(PPSD(3,J),J=1,5),DSCPW(3),DSGPW(3),DSCPP(3),DSGPP(3)
400   FORMAT(2X,'NUMBER OF ELEMENTS=5, (n=6)',//
     *4X,'ACTUAL VALUES              = ',5(F4.2,2X)//
     *4X,'PCM: PERCEIVED VALUES    = ',5(F4.2,2X)/
     *4X,'PCM: STANDARD DEVIATION = ',5(F4.2,2X)/
     *4X,'PA: PERCEIVED VALUES     = ',5(F4.2,2X)/
     *4X,'PA: STANDARD DEVIATION   = ',5(F4.2,2X)//
     *4X,'PWC: DISCREPANCY =',F5.3,',  DISAGREEMENT -',F5.3,/
     *4X,'PP:  DISCREPANCY =',F5.3,',  DISAGREEMENT =',F5.3,///)
      WRITE(2,522) (AA(4,J),J=1,6),
     *(PWA(4,J),J=1,6),(PWSD(4,J),J=1,6),(PPA(4,J),J=1,6),
     *(PPSD(4,J),J=1,6),DSCPW(4),DSGPW(4),DSCPP(4),DSGPP(4)
522   FORMAT(2X,'NUMBER OF ELEMENTS=6, (n=6)',//
     *4X,'ACTUAL VALUES              = ',6(F4.2,2X)//
     *4X,'PCM: PERCEIVED VALUES    = ',6(F4.2,2X)/
     *4X,'PCM: STANDARD DEVIATION = ',6(F4.2,2X)/
     *4X,'PA: PERCEIVED VALUES     = ',6(F4.2,2X)/
     *4X,'PA: STANDARD DEVIATION   = ',6(F4.2,2X)//
     *4X,'PWC: DISCREPANCY -',F5.3,',  DISAGREEMENT =',F5.3,/
     *4X,'PP:  DISCREPANCY =',F5.3,',  DISAGREEMENT -',F5.3,///)
      DO 80 I=1,4
      DO 90 K=1,6
```

```
      DO 101 J=1,I+2
      DPW(I,K)=DPW(I,K)+(PW(I,J,K)-AA(I,J))**2
      DPP(I,K)=DPP(I,K)+(PP(I,J,K)-AA(I,J))**2
101   CONTINUE
      DPW(I,K)=SQRT(DPW(I,K)/FLOAT(I+2))
      DPP(I,K)=SQRT(DPP(I,K)/FLOAT(I+2))
 90   CONTINUE
 80   CONTINUE
      WRITE(2,500)
500   FORMAT(2X,'DISCREPANCY CHANGES FOR EACH SUBJECT BY PCM'//)
      DO 110 K=1,6
      WRITE(2,600) K,(DPW(I,K),I=1,4)
600   FORMAT(4X,'SUBJECT ',I1,2X,4(F5.3,2X)/)
110   CONTINUE
      WRITE(2,700)
700   FORMAT(//2X,'DISCREPANCY CHANGES FOR EACH SUBJECT BY PP'//)
      DO 120 K=1,6
      WRITE(2,800) K,(DPP(I,K),I=1,4)
800   FORMAT(4X,'SUBJECT ',I1,2X,4(F5.3,2X)/)
120   CONTINUE
      STOP
      END
```

APPENDIX C

EXPERIMENTAL RESULTS

OF PAIRWISE COMPARISON METHODS AND POINT ALLOCATION METHOD

Relative Weights
Project Title: a3pW

Users	1	2	3	Disc
Hongbao Ren	0.11	0.59	0.29	0.002
Ning Song	0.07	0.56	0.36	0.000
Guven Iyigu	0.10	0.49	0.41	0.000
K. Gladhill	0.15	0.53	0.32	0.002
Molly Olson	0.19	0.47	0.33	0.001
Doug Lee	0.10	0.52	0.38	0.004
Mean	0.12	0.53	0.35	0.005
Min	0.07	0.47	0.29	
Max	0.19	0.59	0.41	

ESC=Exit, F1=Help, F2=Name/Items, F3=Save, F4=Display, ↵ =Pairs.

Relative Weights
Project Title: a4pW

Users	1	2	3	4	Disc
Hongbao Ren	0.10	0.45	0.24	0.21	0.004
Ning Song	0.06	0.44	0.29	0.22	0.003
Guven Iyigu	0.07	0.42	0.38	0.13	0.033
K. Gladhill	0.11	0.36	0.26	0.26	0.012
Molly Olson	0.14	0.37	0.26	0.23	0.004
Doug Lee	0.14	0.43	0.29	0.14	0.093
Mean	0.10	0.41	0.29	0.20	0.005
Min	0.06	0.36	0.24	0.13	
Max	0.14	0.45	0.38	0.26	

ESC=Exit, F1=Help, F2=Name/Items, F3=Save, F4=Display, ↵ =Pairs.

Relative Weights

Project Title: A5PW

Users	1	2	3	4	5	Disc
REN	0.07	0.37	0.19	0.16	0.21	0.004
NING	0.05	0.32	0.22	0.17	0.23	0.003
GUVEN	0.06	0.36	0.28	0.11	0.20	0.028
KRISTIE	0.09	0.29	0.21	0.20	0.22	0.009
MOLLY	0.10	0.32	0.20	0.18	0.20	0.013
DOUG	0.10	0.34	0.23	0.12	0.21	0.071
Mean	0.08	0.33	0.22	0.16	0.21	0.004
Min	0.05	0.29	0.19	0.11	0.20	
Max	0.10	0.37	0.28	0.20	0.23	

ESC=Exit, F1=Help, F2=Name/Items, F3=Save, F4=Display, ↵ =Pairs.

Relative Weights

Project Title: A6PW

Users	1	2	3	4	5	6	Disc
REN	0.06	0.31	0.16	0.12	0.17	0.17	0.006
NING	0.04	0.26	0.18	0.14	0.19	0.18	0.003
GUVEN	0.05	0.30	0.22	0.08	0.15	0.19	0.022
KRISTIE	0.06	0.23	0.17	0.16	0.18	0.20	0.008
MOLLY	0.07	0.22	0.17	0.14	0.16	0.25	0.024
DOUG	0.08	0.27	0.19	0.11	0.18	0.18	0.061
Mean	0.06	0.27	0.18	0.13	0.17	0.20	0.004
Min	0.04	0.22	0.16	0.08	0.15	0.17	
Max	0.06	0.31	0.22	0.16	0.19	0.25	

ESC=Exit, F1=Help, F2=Name/Items, F3=Save, F4=Display, ↵ =Pairs.

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8.9,55.5,35.6,
11.,59.,29.,
7.,56.,36.,
10.,49.,41.,
15.,53.,32.,
19.,47.,33.,
10.,52.,38.,
10.,60.,30.,
12.5,62.5,25.,
8.,60.,32.,
10.,65.,25.,
10.,60.,30.,
8.3,75.,16.7,
7.4,46.,29.6,17.,
10.,45.,24.,21.,
6.,44.,29.,22.,
7.,42.,38.,13.,
11.,36.,26.,26.,
14.,37.,26.,23.,
14.,43.,29.,14.,
10.,50.,25.,15.,
10.,40.,30.,20.,
6.,56.,24.,12.,
5.,50.,33.,12.,
12.,40.,25.,23.,
5.,50.,30.,15.,
5.8,36.5,23.4,13.5,20.8,
7.,37.,19.,16.,21.,
5.,32.,22.,17.,23.,
6.,36.,28.,11.,20.,
9.,29.,21.,20.,22.,
10.,32.,20.,18.,20.,
10.,34.,23.,12.,21.,
5.,40.,20.,15.,20.,
5.,35.,25.,20.,15.,
5.,40.,22.5,10.,22.5,
6.,35.,22.,15.,22.,
10.,35.,20.,15.,20.,
5.,40.,20.,15.,20.,
4.7,29.3,18.8,10.8,16.7,19.7,
6.,31.,16.,12.,17.,17.,
4.,26.,18.,14.,19.,18.,
5.,30.,22.,8.,15.,19.,
6.,23.,17.,16.,18.,20.,
7.,22.,17.,14.,16.,25.,
8.,27.,19.,11.,18.,18.,
3.,36.,18.,7.,18.,18.,
5.,25.,20.,15.,20.,15.,
4.5,37.5,18.,9.,18.,18.,
5.,30.,20.,12.,20.,18.,
5.,35.,20.,10.,15.,15.,
5.,25.,20.,10.,20.,20.,
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VISUAL JUDGEMENT OF AREAS OF RECTANGLES

NUMBER OF ELEMENTS=3, (n=6)

ACTUAL VALUES	=	.09	.56	.36
PCM: PERCEIVED VALUES	=	.12	.53	.35
PCM: STANDARD DEVIATION	=	.07	.07	.07
PA: PERCEIVED VALUES	=	.10	.64	.26
PA: STANDARD DEVIATION	=	.03	.09	.09

PWC: DISCREPANCY = .025, DISAGREEMENT = .040
PA: DISCREPANCY = .071, DISAGREEMENT = .043

NUMBER OF ELEMENTS=4, (n=6)

ACTUAL VALUES	=	.07	.46	.30	.17
PCM: PERCEIVED VALUES	=	.10	.41	.29	.20
PCM: STANDARD DEVIATION	=	.04	.05	.06	.07
PA: PERCEIVED VALUES	=	.08	.48	.28	.16
PA: STANDARD DEVIATION	=	.04	.09	.05	.06

PWC: DISCREPANCY = .032, DISAGREEMENT = .040
PA: DISCREPANCY = .014, DISAGREEMENT = .043

NUMBER OF ELEMENTS=5, (n=6)

ACTUAL VALUES	=	.06	.37	.23	.14	.21
PCM: PERCEIVED VALUES	=	.08	.33	.22	.16	.21
PCM: STANDARD DEVIATION	=	.02	.03	.04	.04	.01
PA: PERCEIVED VALUES	=	.06	.38	.22	.15	.20
PA: STANDARD DEVIATION	=	.02	.03	.02	.04	.03

PWC: DISCREPANCY = .020, DISAGREEMENT = .025
PA: DISCREPANCY = .012, DISAGREEMENT = .023

NUMBER OF ELEMENTS=6, (n=6)

ACTUAL VALUES	=	.05	.29	.19	.11	.17	.20
PCM: PERCEIVED VALUES	=	.06	.26	.18	.12	.17	.20
PCM: STANDARD DEVIATION	=	.01	.04	.02	.03	.01	.03
PA: PERCEIVED VALUES	=	.05	.31	.19	.11	.19	.17
PA: STANDARD DEVIATION	=	.01	.06	.01	.03	.02	.02

PWC: DISCREPANCY = .015, DISAGREEMENT = .023
PA: DISCREPANCY = .015, DISAGREEMENT = .026

VISUAL JUDGEMENT OF AREAS OF RECTANGLES

CHANGES IN DISCREPANCIES WITHIN SUBJECT
(PCM)

	NUMBER OF ELEMENTS			
	3	4	5	6
SUBJECT 1	.045	.037	.023	.019
SUBJECT 2	.012	.028	.028	.023
SUBJECT 3	.049	.051	.024	.019
SUBJECT 4	.043	.072	.048	.035
SUBJECT 5	.078	.066	.038	.041
SUBJECT 6	.025	.039	.023	.019

CHANGES IN DISCREPANCIES WITHIN SUBJECTS
(PA)

	NUMBER OF ELEMENTS			
	3	4	5	6
SUBJECT 1	.042	.035	.023	.034
SUBJECT 2	.076	.036	.040	.034
SUBJECT 3	.034	.071	.024	.036
SUBJECT 4	.082	.038	.013	.017
SUBJECT 5	.042	.053	.026	.032
SUBJECT 6	.157	.025	.023	.023

Relative Weights
Project Title: C3PW

Users	1	2	3	Disc
NING	0.40	0.20	0.40	0.000
SIDA	0.21	0.33	0.46	0.041
MESUT	0.34	0.27	0.39	0.008
BOB	0.35	0.23	0.43	0.022
RAUMAZAN	0.40	0.27	0.33	0.000
TIM	0.54	0.23	0.23	0.000
Mean	0.37	0.25	0.37	0.009
Min	0.21	0.20	0.23	
Max	0.54	0.33	0.46	

ESC=Exit, F1=Help, F2=Name/Items, F3=Save, F4=Display, ↵ =Pairs.

Relative Weights
Project Title: C4PW

Users	1	2	3	4	Disc
NING	0.25	0.12	0.25	0.37	0.000
SIDA	0.15	0.19	0.26	0.40	0.051
MESUT	0.21	0.14	0.22	0.43	0.013
BOB	0.19	0.10	0.20	0.51	0.019
RAMAZAN	0.26	0.15	0.19	0.40	0.005
TIM	0.38	0.17	0.17	0.28	0.001
Mean	0.24	0.15	0.21	0.40	0.007
Min	0.15	0.10	0.17	0.28	
Max	0.38	0.19	0.26	0.51	

ESC=Exit, F1=Help, F2=Name/Items, F3=Save, F4=Display, ↵ =Pairs.

Relative Weights
Project Title: C6PW

Users	1	2	3	4	5	Disc
NING	0.20	0.10	0.18	0.32	0.20	0.004
SIDA	0.13	0.14	0.20	0.32	0.22	0.045
MESUT	0.18	0.11	0.18	0.36	0.17	0.009
BOB	0.17	0.10	0.17	0.39	0.17	0.024
RAMAZAN	0.22	0.13	0.15	0.32	0.18	0.005
TIM	0.32	0.16	0.16	0.25	0.11	0.003
Mean	0.20	0.12	0.17	0.33	0.17	0.006
Min	0.13	0.10	0.15	0.25	0.11	
Max	0.32	0.16	0.20	0.39	0.22	

ESC=Exit, F1=Help, F2=Name/Items, F3=Save, F4=Display, ↵ =Pairs.

Relative Weights
Project Title: C6PW

Users	1	2	3	4	5	6	Disc
NING	0.15	0.08	0.15	0.23	0.15	0.23	0.000
SIDA	0.11	0.10	0.15	0.24	0.17	0.23	0.041
MESUT	0.13	0.09	0.14	0.31	0.14	0.19	0.013
BOB	0.10	0.06	0.11	0.25	0.11	0.37	0.025
RAMAZAN	0.18	0.10	0.12	0.26	0.14	0.20	0.005
TIM	0.23	0.12	0.12	0.18	0.08	0.26	0.005
Mean	0.15	0.09	0.13	0.24	0.13	0.25	0.006
Min	0.10	0.06	0.11	0.18	0.08	0.19	
Max	0.23	0.12	0.15	0.31	0.17	0.37	

ESC=Exit, F1=Help, F2=Name/Items, F3=Save, F4=Display, ↵ =Pairs.

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56.,27.5,16.5,
40.,20.,40.,
21.,33.,46.,
34.,27.,39.,
35.,23.,43.,
40.,27.,33.,
54.,23.,23.,
50.,20.,30.,
40.,25.,35.,
35.,45.,20.,
35.,45.,30.,
50.,30.,20.,
40.,20.,40.,
42.6,21.,12.5,23.8,
25.,12.,25.,37.,
15.,19.,26.,40.,
21.,14.,22.,43.,
19.,10.,20.,51.,
26.,15.,19.,40.,
38.,17.,17.,28.,
35.,12.,20.,37.,
30.,15.,25.,30.,
20.,30.,15.,35.,
25.,38.,20.,17.,
40.,10.,30.,20.,
25.,12.,25.,38.,
35.4,17.4,10.4,19.8,17.,
20.,10.,18.,32.,20.,
13.,14.,20.,32.,22.,
18.,11.,18.,36.,17.,
17.,10.,17.,39.,17.,
22.,13.,15.,32.,18.,
32.,16.,16.,25.,11.,
25.,10.,15.,40.,10.,
22.,10.,18.,25.,25.,
20.,25.,15.,25.,15.,
20.,30.,17.,15.,18.,
30.,25.,20.,15.,10.,
20.,10.,20.,30.,20.,
23.9,11.8,7.0,13.3,11.4,32.6,
15.,8.,15.,23.,15.,23.,
11.,10.,15.,24.,17.,23.,
13.,9.,14.,31.,14.,19.,
10.,6.,11.,25.,11.,37.,
18.,10.,12.,26.,14.,20.,
23.,12.,12.,18.,8.,26.,
20.,8.,12.,25.,8.,27.,
15.,10.,15.,20.,20.,20.,
20.,19.,10.,20.,9.,22.,
15.,22.,15.,13.,15.,20.,
30.,5.,15.,10.,15.,25.,
16.,8.,16.,24.,16.,20.,
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JUDGEMENTS OF COLLEGE SIZE (NUMBER OF FACULTY)

NUMBER OF ELEMENTS=3, (n=6)

ACTUAL VALUES	=	.56	.28	.17
PCM: PERCEIVED VALUES	=	.37	.26	.37
PCM: STANDARD DEVIATION	=	.17	.07	.13
PA: PERCEIVED VALUES	=	.42	.31	.29
PA: STANDARD DEVIATION	=	.11	.18	.13

PWC: DISCREPANCY = .162, DISAGREEMENT = .075
PA: DISCREPANCY = .112, DISAGREEMENT = .082

NUMBER OF ELEMENTS=4, (n=6)

ACTUAL VALUES	=	.43	.21	.13	.24
PCM: PERCEIVED VALUES	=	.24	.14	.22	.40
PCM: STANDARD DEVIATION	=	.10	.04	.05	.10
PA: PERCEIVED VALUES	=	.29	.19	.23	.30
PA: STANDARD DEVIATION	=	.10	.15	.07	.12

PWC: DISCREPANCY = .135, DISAGREEMENT = .055
PA: DISCREPANCY = .089, DISAGREEMENT = .079

NUMBER OF ELEMENTS=5, (n=6)

ACTUAL VALUES	=	.35	.17	.10	.20	.17
PCM: PERCEIVED VALUES	=	.20	.12	.17	.33	.17
PCM: STANDARD DEVIATION	=	.07	.03	.02	.05	.04
PA: PERCEIVED VALUES	=	.23	.18	.17	.25	.16
PA: STANDARD DEVIATION	=	.04	.10	.03	.11	.07

PWC: DISCREPANCY = .097, DISAGREEMENT = .038
PA: DISCREPANCY = .069, DISAGREEMENT = .062

NUMBER OF ELEMENTS=6, (n=6)

ACTUAL VALUES	=	.24	.12	.07	.13	.11	.33
PCM: PERCEIVED VALUES	=	.15	.09	.13	.25	.13	.25
PCM: STANDARD DEVIATION	=	.05	.02	.02	.04	.03	.07
PA: PERCEIVED VALUES	=	.19	.12	.14	.19	.14	.22
PA: STANDARD DEVIATION	=	.06	.07	.02	.06	.05	.03

PWC: DISCREPANCY = .073, DISAGREEMENT = .038
PA: DISCREPANCY = .059, DISAGREEMENT = .046

COLLEGE SIZE (NUMBER OF FACULTY)

CHANGES IN DISCREPANCIES WITHIN SUBJECTS
(PCM)

	NUMBER OF ELEMENTS			
	3	4	5	6
SUBJECT 1	.170	.134	.101	.077
SUBJECT 2	.266	.174	.125	.089
SUBJECT 3	.182	.156	.115	.107
SUBJECT 4	.197	.192	.127	.082
SUBJECT 5	.133	.124	.086	.081
SUBJECT 6	.047	.043	.046	.041

CHANGES IN DISCREPANCIES WITHIN SUBJECTS
(PA)

	NUMBER OF ELEMENTS			
	3	4	5	6
SUBJECT 1	.096	.096	.113	.063
SUBJECT 2	.142	.099	.088	.084
SUBJECT 3	.159	.134	.083	.063
SUBJECT 4	.176	.132	.096	.084
SUBJECT 5	.043	.106	.071	.062
SUBJECT 6	.170	.137	.100	.087