Chapter 5

5. MULTIVARIATE ANALYSIS

5.1. INTRODUCTION

Chapter 5 focuses on the whole chapter to multivariate data analysis to look at some a few variables that are more related to each other than they are to others. Factor analysis will allow us to look at these groups of variables that tend to be related to each other and estimate what underlying reasons might cause these variables to be more highly correlated with each other and thus able to reflect the actual market situation. Sometimes a variable that is not significant when it is analyzed alone, turned out to be significant when it is in a group when it showed strong correlation with one another.

Section 5.2 looks into factor analysis to group variables based on correlation. Results of the analysis and the interpretation of the results is discussed in sub sections of section 5.2. The factor analysis result is then used to form clusters (Section 5.3). Although 5 factors were obtained, only 2 clusters were set due to very small sample size. The cluster centroids would

be too small to distinguished the difference if there is more than 2 clusters used.

5.2. FACTOR ANALYSIS

The analysis performed here is to group customer service variables based on correlation. Groups of variables that have strong correlations with one another will be groups into several groups. The general purpose of factor analysis is to summarize the information contained in a large number of variables into a smaller number of factors. The statistical purpose of factor analysis is to determine whether there is linear combinations of variables that will help researcher summarize the data and identify underlying relationships (Hair et al., 2000).

In order to assess perceived customer service, several variables of interest must be measured. From the study, friendliness, knowledgeable, courteous HEP personnel would be measured by means of a number or rating questions. 16 attributes that represent the students' perceptions of good customer service variables are presented in Table 5.1. The purpose of the analysis is to:

i. "group" the perceptions

ii. reduce the number of variables to a smaller number of variables that are more meaningful and managable

TABLE 5.1 CUSTOMER SERVICE VARIABLES

Customer Service Variables
Relationship with TNC HEP
Coperation by TNC HEP
Relationship with HEP staff
Cooperation by HEP staff
Relationship with College Head/Supervisor
Cooperation by College Head/Supervisor
Relationship with College staff
Cooperation by College staff
Frequency of interaction with Counsellor
Frequency of interaction with College Head
Frequency of interaction with Supervisor
Overall HEP services
Understanding of instruction of HEP staff
Customer service and friendliness
Helpful towards one another
Shown interest in their daily work
Co-curriculum enthusiast/non-enthusiast

By grouping the selected attributes, we hope that we will be able to see the "big picture" in terms of understanding dimensions of evaluation used by students pertaining to the perceptions of customer service provided by Students Affair Department.

5.3. EXAMINING THE CORRELATION MATRIX

The first step in factor analysis is to assess the factorability of the correlation matrix. Visual examination of the correlations shows the correlation matrix for the 17 perceptions of customer service attributes (Table 5.2). There are relatively high correlations with variables relating to experience of students pertaining to the customer service provided by HEP personnel. We would expect these variables to correlate with the same set of factors. Likewise, there are relatively high correlations among variables relating to customer service provided by college personnel. These variables would be expected to correlate with the similar attributes. The results show some interesting patterns. It provides us more than adequate basis for proceeding to the next level of analysis.

This involves the need to assess the overall significance of the correlation matrix with the Barlett test of sphericity and Kaiser-Meyer-Olkin (KMO) test measure of sampling adequacy.

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TABLE 5.2 CORRELATION MATRIX FOR CUSTOMER SERVICE VARIABLES

	Perhubungan TNC HEP	Kerjasama TNC HEP	Perhubungan dgn kakitangan HEP	kerjasama dgn kakitangan HEP	perhubungan dgn pengetua/penyelia	kerjasama dgn pengetua/ penyelia	perhubungan dgn kakitangan kolej	kerjasama dgn kakitangan kolej	konselor	pengetua	penyelia	perkhidmatan HEP	faham arahan	layanan kemesraan	kakitangan saling bantu	kakitangan tunjuk minat	Ko-kurikulum
Perhubungan TNC HEP	1.000																
Kerjasama TNC HEP	.822	1.000															
Perhubungan dgn kakitangan HEP	.625	.741	1.000														
kerjasama dgn kakitangan HI	.616	.790	.965	1.000													
perhubungan dgn pengetua/penyelia	.219	.356	.449	.426	1.000												
kerjasama dgn pengetua/ penyelia	.237	.423	.424	.475	.915	1.000											
perhubungan dgn kakitangan kolej	.336	.454	.234	.223	.701	.728	1.000										
kerjasama dgn kakitangan kc	.290	.471	.243	.301	.696	.795	.928	1.000									
konselor	-.211	-.317	-.116	-.273	.050	-.109	.022	-.125	1.000								
pengetua	-.326	-.277	-.180	-.211	.077	.066	.107	.102	.469	1.000							
penyelia	-.226	-.145	-.169	-.181	.100	.052	.106	.132	.219	.696	1.000						
perkhidmatan HEP	-.008	-.116	.037	.000	-.086	-.160	-.427	-.409	.275	.241	.073	1.000					
faham arahan	-.378	-.416	-.357	-.364	-.267	-.295	-.495	-.545	.161	.159	.089	.441	1.000				
layanan kemesraan	-.139	-.331	-.351	-.405	-.090	-.168	-.310	-.271	.215	.276	.135	.641	.448	1.000			
kakitangan saling bantu	.006	-.126	-.250	-.284	-.104	-.194	-.267	-.362	-.028	.027	-.056	.451	.481	.663	1.000		
kakitangan tunjuk minat	-.218	-.243	-.315	-.365	.114	-.031	-.064	-.118	.100	.370	.385	.434	.272	.627	.760	1.000	
Ko-kurikulum	.036	-.191	-.023	.000	.053	.099	-.128	-.082	-.171	.022	.028	.102	-.014	.072	.067	.057	1.000

TABLE 5.3 KMO & BARTLETT'S TEST

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.50
Bartlett's Test of Sphericity	Approx. Chi-Square	399.028
	df	136
	Sig.	.000

Bartlett's test of sphericity can be used to test the null hypothesis that the variables are uncorrelated in the population. In other words, the population correlation matrix is an identity matrix. In an identity matrix, all the diagonal terms are 1, and all off-diagonal terms are 0. (Malhotra, 1999). Barlett test shows the sample correlation matrix is significant. At the significance level of 0.05, the nonzero correlations exist. This means that the null hypothesis, that the population correlation matrix is an identity matrix is rejected by the Bartlett's test of sphericity. The approximate chi-square statistic is 399.028 with 136 degrees of freedom which is significant at the 0.05 level.. Another useful statistic is the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. From the table, MSA value of 0.50 indicates the appropriateness of factor analysis. This means that the correlations between pairs of variables can

be explained by other variables and that factor analysis is appropriate to be used.

5.4. FACTOR EXTRACTION

The goal of factor extraction is to reduce the 17 variables to smaller number of variables that will determine the factors needed to represent the data. The 17 variables were factor analysed using Principal Components analysis (PCA) on SPSS. This method of extraction is employed because our primary objective is to predict the number of factors needed to account for the maximum portion of the variance represented in the original set of variables. In order to summarize the information, a smaller number of factors need to be extracted. One of the ways of determining it is through latent root criterion.

Latent root criterion is the most commonly used technique. The rationale for the latent root criterion is that any individual factor should account for the variance of at least a single variable if it is to be retained for interpretation. Each variable contributes a value of 1 to the total eigenvalue. Eigenvalues provide a measure of the percentage of variance in the contributing variables that is "explained" by the factor. The sum of the eigenvalues represents the total among of variance to be explained in the analysis and the ratio of each individual eigenvalue to that sum indicates the percentage of variance explained by the relevant factor (Sudman and Blair,

1998). Only the factors having latent roots or eigenvalues greater than 1 are considered significant; all other factors having latent roots less than 1 are considered insignificant and are not selected (Hair et al., 1998).

Table 5.4 contains the initial statistics for each factor. The total variance explained by each factor is listed in the column labeled Eigenvalue. From the results in Table 5.4, using latent root criterion, only 5 factors will be retained for interpretation. The 5 factors respectively have 5.759, 2.878, 2.356, 1.438 and 1.136 eigenvalues. All these 5 factors have eigenvalues larger than 1.0.

TABLE 5.4 INITIAL COMMUNALITIES

Component	Communality	Initial Eigenvalues Total	% of Variance	Cumulative %
1	1.00000	**5.75851**	33.87	33.87
2	1.00000	**2.87751**	16.93	50.80
3	1.00000	**2.35605**	13.86	64.66
4	1.00000	**1.43836**	8.46	73.12
5	1.00000	**1.13589**	6.68	79.80
6	1.00000	0.95240	5.60	85.40
7	1.00000	0.75131	4.42	89.82
8	1.00000	0.48956	2.88	92.70
9	1.00000	0.44215	2.60	95.30
10	1.00000	0.28250	1.66	96.97
11	1.00000	0.22472	1.32	98.29
12	1.00000	0.09131	0.54	98.83
13	1.00000	0.08763	0.52	99.34
14	1.00000	0.05222	0.31	99.65
15	1.00000	0.03650	0.21	99.86
16	1.00000	0.02127	0.13	99.99
17	1.00000	0.00211	0.01	100.00

Extraction Method: Principal Component Analysis.

We could also apply percentage of variance approach to determine the number of factors that should be extracted. In this approach, the number of factors extracted is determined so that the cumulative percentage of variance

TABLE 5.5 TOTAL VARIANCE EXPLAINED

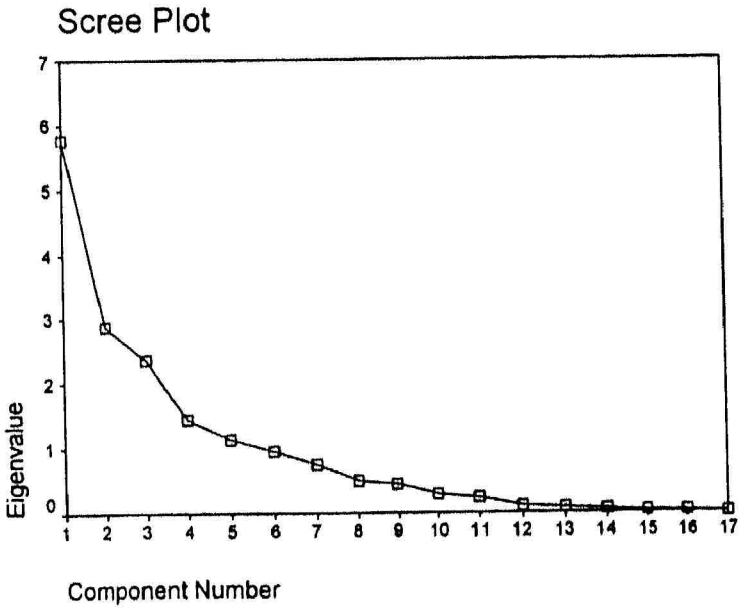
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.759	33.874	33.874	5.759	33.874	33.874	3.761	22.121	22.121
2	2.878	16.927	50.800	2.878	16.927	50.800	3.353	19.722	41.843
3	2.356	13.859	64.659	2.356	13.859	64.659	3.092	18.189	60.033
4	1.438	8.461	73.120	1.438	8.461	73.120	2.196	12.917	72.950
5	1.136	6.682	79.802	1.136	6.682	79.802	1.165	6.852	79.802
6	.952	5.602	85.404						
7	.751	4.419	89.824						
8	.490	2.880	92.703						
9	.442	2.601	95.304						
10	.283	1.662	96.966						
11	.225	1.322	98.288						
12	9.131E-02	.537	98.825						
13	8.763E-02	.515	99.341						
14	5.222E-02	.307	99.648						
15	3.650E-02	.215	99.862						
16	2.127E-02	.125	99.988						
17	2.109E-03	1.241E-02	100.000						

Extraction Method: Principal Component Analysis.

extracted by the factors reaches a satisfactory level. Most books recommended the satisfactory level to be at least 60 percent of the variance. From table 5.4, the five factors collectively account for 79.8% of the total variance in the 17 variables. It is almost 80% of the total variance in the 17 variables. This figure is pretty high. It indicated that the variables contained substantial information that was captured by the five factors. Table 5.5 shows listing of factors, eigenvalues for each factor and variance explained. Another useful method to determine the number of factors is using scree plot.

TABLE 5.6 SCREE TEST FOR COMPONENT ANALYSIS



A scree plot is a plot of the eigenvalues against the number of factors in order of extraction. The scree plot in Table 5.6 plots all 17 factors extracted in the study. Starting from the first factor, the plot slopes downward until it reaches almost a horizontal line. The point where the curve starts to straighten out is considered as an indication to us on the maximum number of factors to extract. Through naked eyes observation, based on the scree plot, 5 factors may be appropriate based on the sudden drop in the eigenvalues. With the three criterions as our guide, the final result shows that only 5 component factors are retained for additional analysis.

Using the three criterions as our guide, the final result shows that only 5 component factors are to be retained for additional analysis. To judge how well the five-factor model describes the original variables, proportion of the variance explained by the five-factor model need to be computed. This proportion of variance is called the communality of the variables. Since a principal components analysis is performed, the initial communalities shown in Table 5.7 are all 1.00, indicating that the full variance of each variable is being used.

TABLE 5.7 INITIAL COMMUNALITIES

Communalities

	Initial	Extraction
Perhubungan TNC HEP	1.000	.705
Kerjasama TNC HEP	1.000	.869
Perhubungan dgn kakitangan HEP	1.000	.922
kerjasama dgn kakitangan HEP	1.000	.936
perhubungan dgn pengetua/penyelia	1.000	.802
kerjasama dgn pengetua/ penyelia	1.000	.846
perhubungan dgn kakitangan kolej	1.000	.915
kerjasama dgn kakitangan kolej	1.000	.923
konselor	1.000	.612
pengetua	1.000	.808
penyelia	1.000	.596
perkhidmatan HEP	1.000	.788
faham arahan	1.000	.509
layanan kemesraan	1.000	.764
kakitangan saling bantu	1.000	.889
kakitangan tunjuk minat	1.000	.809
Ko-kurikulum	1.000	.872

Extraction Method: Principal Component Analysis.

The second column under "Communalities" gives relevant information after the desired number of factors has been extracted. The communalities for the variables under "Extraction" are different from those under "Initial" because all of the variances associated with the variables are not explained unless all the factors are retained. The highest total percentage of variance is the cooperation with the HEP personnel, which accounted for about 94% and followed by cooperation with college staff (92%) and relationship with HEP

staff (92%). The lowest percentage is understanding instruction given by HEP staff, which accounts for only 51%. However, all the variables show strong linear associations. Therefore, none of the variables will be removed from this analysis.

TABLE 5.8 COMPONENT MATRIX

Factor matrix is generated next to obtain a preliminary indication of

Component Matrix[a]

	Component				
	1	2	3	4	5
Perhubungan TNC HEP	.622	-.153	.526	.022	-.129
Kerjasama TNC HEP	.790	-.079	.428	.081	-.220
Perhubungan dgn kakitangan HEP	.728	-.109	.461	.396	.105
kerjasama dgn kakitangan HEP	.770	-.151	.439	.322	.156
perhubungan dgn pengetua/penyelia	.618	.618	.121	-.119	.092
kerjasama dgn pengetua/ penyelia	.696	.548	.059	-.177	.160
perhubungan dgn kakitangan kolej	.709	.520	-.232	-.208	-.212
kerjasama dgn kakitangan kolej	.745	.502	-.238	-.223	-.096
konselor	-.284	.367	-.154	.567	-.228
pengetua	-.273	.697	-.181	.450	.113
penyelia	.622	-.153	.526	.022	-.129
perkhidmatan HEP	.790	-.079	.428	.081	-.220
faham arahan	.728	-.109	.461	.396	.105
layanan kemesraan	.770	-.151	.439	.322	.156
kakitangan saling bantu	.618	.618	.121	-.119	.092
kakitangan tunjuk minat	.696	.548	.059	-.177	.160
Ko-kurikulum	.709	.520	-.232	-.208	-.212

Extraction Method: Principal Component Analysis.

a. 5 components extracted.

the number of factors to extract. Table 5.8 displays factor matrix, which is the matrix of loadings for the 17 variables on the five retained factors.

Factor loadings are the correlations between a factor and the individual variables being analyzed. Variables that have loadings with absolute values larger than 0.5 are said to load highly on the factor and are considered to be members of a group of variables identified by the factor. Variables that have loadings with absolute values of less than 0.5 are usually ignored in interpreting the factor (Sudman and Blair, 1998).

Table 5.8 showed the matrix loadings for the 17 variables on the five retained factors. These loadings show that some variables have strong positive loadings and negative loadings. Although the initial or unrotated factor matrix indicates the relationship between the factors and individual variables, it is difficult to interpret the factor easily as the factors are correlated with many variables. Therefore factor rotation is performed to achieve a simpler structure where loadings are easier to interpret. In rotating the factors, we would like each factor to have nonzero loadings for only some of the variables, if possible with only a few. Rotation does not affect the communalities and the percentage of total variance explained. However, the percentage of variance accounted for by each factor does change. This is seen in Table 5.9. The variance explained by the individual factors is redistributed by rotation.

This permits the factors to be differentiated from each other. The factor matrix was rotated orthogonally using Varimax and the result of the rotated factor matrix is shown in Table 5.9. Rotation by orthogonal is chosen in this analysis and not oblique rotation because the analysis wants to reduce a larger number of variables to a smaller set of uncorrelated variables for subsequent use in regression or other prediction techniques. Oblique solution is appropriate when the ultimate goal of the factor analysis is to obtain several theoretically meaningful factors or constructs.

TABLE 5.9 ROTATED COMPONENT MATRIX

Rotated Component Matrix [a]

	Component				
	1	2	3	4	5
Perhubungan TNC HEP	.209	.740	.026	-.322	-.098
Kerjasama TNC HEP	.360	.787	-.093	-.261	-.208
Perhubungan dgn kakitangan HEP	.149	.927	-.195	-.006	.059
kerjasama dgn kakitangan HEP	.178	.911	-.234	-.084	.117
perhubungan dgn pengetua/penyelia	.810	.311	.081	.152	.135
kerjasama dgn pengetua/ penyelia	.842	.302	-.023	.071	.200
perhubungan dgn kakitangan kolej	.914	.096	-.178	.041	-.191
kerjasama dgn kakitangan kolej	.925	.112	-.221	.026	-.077
konselor	-.127	-.070	.056	.700	-.314
pengetua	.122	-.166	.154	.860	.051
penyelia	.183	-.175	.075	.718	.105
perkhidmatan HEP	-.386	.295	.655	.332	.115
faham arahan	-.452	-.214	.482	.160	.022
layanan kemesraan	-.148	-.158	.829	.171	.015
kakitangan saling bantu	-.117	-.092	.911	-.192	-.024
kakitangan tunjuk minat	.149	-.241	.830	.195	.042
Ko-kurikulum	-.008	-.035	.052	-.052	.930

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 7 iterations.

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From Table 5.9 it can be seen that this resulted in an easier to interpret matrix, where variables loading with value 0.5 or above were retained. The rotated factors are much easier to interpret than the initial factors. These loadings show that all of the variables load moderately well on the first factor, with loadings ranging from strong positive loadings for relationship and co-operation with College personnel, inclusive of the College Head, college staff and supervisor. The second factor has high loadings for co-operation and relationship with TNC HEP and HEP personnel. Third factor is service factor by HEP personnel with high loadings for service provided by HEP, student ability to understand instruction given by HEP officers or staff, customer friendliness, helpfulness towards one another and shown interest in their daily work. The fourth factor has strong positive loadings for number of interactions with counselor, College Head and supervisor and the last factor is clearly a co-curriculum factor. It has very high loading for co-curriculum participation variable.

Table 5.10 shows the factors loadings for each of the items in the respective customer service dimensions.

TABLE 5.10 FACTOR LOADINGS OF SPECIFIC CUSTOMER DIMENSIONS

CORRESPONDING VARIABLE	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Relationship with College Head/Supervisor	0.81				
Cooperation with College Head/Supervisor	0.84				
Relationship with College Administration staff	0.91				
Cooperation with College Administration staff	0.93				
Relationship with TNC HEP		0.74			
Cooperation with TNC HEP		0.79			
Relationship with HEP staff		0.93			
Cooperation with HEP staff		0.91			
Staff helpfulness towards one another			0.66		
Staff shown interest in their daily work			0.48		
Customer service and friendliness			0.83		
Overall HEP staff customer service			0.91		
Understand instruction given			0.83		
Frequency of interaction with counselor				0.70	
Frequency of interaction with College Head				0.86	
Frequency of interaction with Supervisor				0.72	
Enthusisat/Non-enthusiast					0.93

Based on the rotated factor matrix, the 17 original variables can be grouped as follows:

TABLE 5.11 CUSTOMER SERVICE DIMENSIONS

CUSTOMER SERVICE CRITERIA	CORRESPONDING VARIABLE
College Personel	Relationship with College Head/Supervisor Cooperation with College Head/Supervisor Relationship with College Administration staff Cooperation with College Administration staff
HEP Personnel	Relationship with TNC HEP Cooperation with TNC HEP Relationship with HEP staff Cooperation with HEP staff
Staff Characteristics	Staff helpfulness towards one another Staff shown interest in their daily work Customer service and friendliness Overall HEP staff customer service Understand instruction given
Interaction with Student Affairs Personnel	Frequency of interaction with counselor Frequency of interaction with College Head Frequency of interaction with Supervisor
Co-curriculum Participation	Enthusisat/Non-enthusiast

This list does not reflect the importance of these factors in determining level of customer service for any future customer service study. It is just a grouping for 17 variables. Factor 1 comprises of respondents whom are

concerned with the services provided by college personnel. We named them "College Personnel". There are respondents whom are concerned with the services provided by HEP personnel. They tend to judge the customer service based on the services provided by HEP personnel and we named them "HEP personnel". Factor 3 gives priority on different aspects of staff services extended to the students. As such, we like to relate the factor as "Staff Characteristics". Factor 4 reflects the frequency interactions of students with counsels, College Head and Supervisor. We grouped them and named them as "Interaction with Student Affairs Personnel" and lastly Factor 5 reflects the student's participation of co-curriculum. Students who participate actively in co-curriculum tend to give more favourable response on their perception of customer service provided by Student Affairs Department.

5.5. MODEL FIT

Finally, we need to determine the model fit. One of the way is to look at the differences between the observed correlations and the reproduced correlations. These differences are called residuals. If there are many large residuals, the factor model does not provide a good fit to the data and the model should be reconsidered. In Table 5.12, we see that only 36% of the residuals are larger than 0.05, indicating an acceptable model fit.

TABLE 5.12 REPRODUCED CORRELATION MATRIX

Reproduced Correlations

		X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}
REPRODUCED CORRELATIONS	X_1	0.705*	0.759	0.708	0.720	0.339	0.356	0.263	0.270	-0.272	-0.376	-0.331	0.036
	X_2	0.759	0.869*	0.790	0.800	0.461	0.483	0.450	0.451	-0.223	-0.336	-0.288	-0.078
	X_3	0.708	0.790	0.922*	0.923	0.401	0.421	0.248	0.280	-0.117	-0.168	-0.148	0.093
	X_4	0.720	0.800	0.923	0.936*	0.412	0.447	0.266	0.307	-0.195	-0.232	-0.192	0.032
	X_5	0.339	0.461	0.401	0.412	0.802*	0.812	0.737	0.760	-0.056	0.198	0.224	-0.102
	X_6	0.356	0.483	0.421	0.447	0.812	0.846*	0.768	0.804	-0.143	0.120	0.171	-0.205
	X_7	0.263	0.450	0.248	0.266	0.737	0.768	0.915*	0.911	-0.044	0.093	0.147	-0.450
	X_8	0.270	0.451	0.280	0.307	0.760	0.804	0.911	0.923*	-0.095	0.079	0.144	-0.468
	X_9	-0.272	-0.223	-0.117	-0.195	-0.056	-0.143	-0.044	-0.095	0.612*	0.590	0.462	0.262
	X_{10}	-0.376	-0.336	-0.168	-0.232	0.198	0.120	0.093	0.079	0.590	0.808*	0.686	0.205
	X_{11}	-0.331	-0.288	-0.148	-0.192	0.224	0.171	0.147	0.144	0.462	0.686	0.596*	0.191
	X_{12}	0.036	-0.078	0.093	0.032	-0.102	-0.205	-0.450	-0.468	0.262	0.205	0.191	0.284
	X_{13}	-0.294	-0.422	-0.360	-0.399	-0.367	-0.441	-0.517	-0.546	0.205	0.194	0.284	0.187
	X_{14}	-0.183	-0.302	-0.330	-0.377	-0.074	-0.177	-0.294	-0.334	0.191	0.284	0.187	-0.077
	X_{15}	-0.005	-0.143	-0.280	-0.304	-0.082	-0.166	-0.280	-0.322	-0.054	-0.025	-0.077	0.548
	X_{16}	-0.193	-0.272	-0.361	-0.399	0.148	0.056	-0.034	-0.070	0.168	0.356	0.276	0.484
	X_{17}	-0.101	-0.215	0.011	0.067	0.105	0.164	-0.200	-0.096	-0.322	0.016	0.069	0.117
RESIDUALS[a]	X_1		0.063	-0.083	-0.104	-0.120	-0.120	0.073	0.020	0.060	0.049	0.105	-0.044
	X_2	0.063		-0.050	-0.010	-0.106	-0.060	0.004	0.020	-0.094	0.059	0.143	-0.038
	X_3	-0.083	-0.050		0.042	0.048	0.003	-0.014	-0.037	0.001	-0.012	-0.021	-0.055
	X_4	-0.104	-0.010	0.042		0.014	0.028	-0.043	-0.007	-0.079	0.021	0.011	-0.032
	X_5	-0.120	-0.106	0.048	0.014		0.103	-0.036	-0.064	0.106	-0.120	-0.124	0.016
	X_6	-0.120	-0.060	0.003	0.028	0.103		-0.040	-0.010	0.034	-0.054	-0.120	0.045
	X_7	0.073	0.004	-0.014	-0.043	-0.036	-0.040		0.017	0.066	0.013	-0.040	0.023
	X_8	0.020	0.020	-0.037	-0.007	-0.064	-0.010	0.017		-0.030	0.024	-0.012	0.059
	X_9	0.060	-0.094	0.001	-0.079	0.106	0.034	0.066	-0.030		-0.122	-0.243	0.014
	X_{10}	0.049	0.059	-0.012	0.021	-0.120	-0.054	0.013	0.024	-0.122		0.010	-0.056
	X_{11}	0.105	0.143	-0.021	0.011	-0.124	-0.120	-0.040	-0.012	-0.243	0.010		-0.104
	X_{12}	-0.044	-0.038	-0.055	-0.032	0.016	0.045	0.023	0.059	0.014	-0.056	-0.104	
	X_{13}	-0.083	0.007	0.003	0.035	0.100	0.146	0.022	0.001	-0.044	-0.035	-0.019	-0.042
	X_{14}	0.044	-0.029	-0.021	-0.028	-0.016	0.009	-0.016	0.063	0.024	-0.008	-0.051	0.029
	X_{15}	0.010	0.017	0.030	0.020	-0.022	-0.028	0.014	-0.040	0.026	0.052	0.022	-0.097
	X_{16}	-0.026	0.029	0.046	0.033	-0.034	-0.087	-0.030	-0.048	-0.067	0.015	0.109	-0.050
	X_{17}	0.137	0.024	-0.034	-0.067	-0.051	-0.065	0.072	0.013	0.151	0.006	-0.041	-0.014

Extraction Method: Principal Component Analysis.

* Residuals are computed between observed and reproduced correlations. There are 49 (36.0%) nonredundant residuals with absolute values greater than 0.05.

b Reproduced communalities

5.6. CLUSTER ANALYSIS

Cluster analysis is a multivariate procedure for detecting groupings in the data. Upon obtaining the factor analysis, results were saved as variables. Then these variables obtained were used in cluster analysis. The purpose of this analysis is to know whether we can identify groups who care for different things in their perception of customer service.

The clustering is done using SPSS via "k-means cluster" command. This is an efficient clustering routine that requires us to specify in advance the number of clusters that will be obtained. Due to our sample size that is small and some questions has a lot of missing value; only two clusters have been specified for this study.

SPSS output display initial cluster centers and final cluster center. The only cluster we are interested is final cluster centers, which represent the group centroid for the final 2 clusters. The initial cluster centers is the intermediate results that are generated by the software while it goes to generate the final output.

TABLE 5.13 INITIAL CLUSTER CENTERS

Initial Cluster Centers

	Cluster	
	1	2
REGR factor score 1 for analysis 2	1.97799	-1.76229
REGR factor score 2 for analysis 2	-3.24410	.99530
REGR factor score 3 for analysis 2	.87249	-1.02799
REGR factor score 4 for analysis 2	.31939	1.26257
REGR factor score 5 for analysis 2	.54116	1.26623

TABLE 5.14 FINAL CLUSTER CENTERS

Final Cluster Centers

	Cluster	
	1	2
REGR factor score 1 for analysis 2	.98445	-.23439
REGR factor score 2 for analysis 2	-.74808	.17812
REGR factor score 3 for analysis 2	.14739	-.03509
REGR factor score 4 for analysis 2	-.76217	.18147
REGR factor score 5 for analysis 2	.66279	-.15781

The final clusters showed that the sample could be divided into 2 distinct clusters based on the 5 factors obtained earlier in the Factor analysis.

The final cluster centers show each cluster's average value on the 5 factors. An examination of these averages reveals that Cluster 1 has relative higher rating on relationship/cooperation with college personnel, staff conduct and co-curriculum participation. Cluster 2 has a higher score for relationship/cooperation with HEP personnel and number of interaction with Student Affairs Personnel.

TABLE 5.15 NO. OF CASES IN EACH CLUSTER

Number of Cases in each Cluster

Cluster	1	5.000
	2	21.000
Valid		26.000
Missing		76.000

The last table showed the total sample for Cluster 1 comprised of 5 undergraduates while Cluster 2 comprised of 21 undergraduates. Total undergraduates for the cluster analysis are 26 undergraduates with remaining 76 others have some missing values.

Overall, there is a bit of interpretive difference between the two clusters. However, the breakdown of cluster 1 is too small i.e. only 5 respondents. There is also too many missing values (76 in total). Due to the clusters are too small, at this point, the best interpretation will be that

respondents in the study cannot be meaningfully segmented based on their ratings for the customer service criteria (from the earlier Factor Analysis result).