STUDENT LOYALTY AND SATISFACTION:

CONSTRUCTING SCALES USING FACTOR ANALYSIS

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Forman Christian College

Road Map

Introduction

Research Objectives

Demographics

Analysis approach

Factor analysis

Results

Introduction

- When – Intermediate students (high school) completed a survey before graduating
- Who – 80% of the students completed a survey
- What - The survey was about
  - Satisfaction (7 scales in key areas 5- 16 individual questions)
    - Faculty, facilities, studies, food, accounts, etc.

Research Objectives

- This study was conducted to find the relationship between ‘student satisfaction’ and ‘student loyalty’. The main areas which we focused in this study are briefly described as follows:
  - Find the relationship of student satisfaction and student loyalty, considering student satisfaction as independent variable and student loyalty as dependent variable.
  - **Construct a valid and reliable scale to understand the level of student satisfaction.**
  - Suggest some guidelines and proposition to the administration and policy makers, to better market their institution.

Demographics

Intermediate Program	Sample		Population	
	n	%	*N*	%
Foundation in Arts (FA)	258	11	381	13
Foundation in Science (FSc) -Pre-Medical	509	22	616	21
Foundation in Science (FSc) -Pre-Engineering	858	37	1043	36
General Science	217	9	281	10
Intermediate in Computer Science	242	10	308	11
Intermediate in Commerce	225	10	267	9
Total	**2309**	**100**	**2896**	**100**

Response rate is 80%.

Analysis Approach

- Reliability and Validity
  - Correlation between forms **0.882**
- **Factor analysis**
- Regression analysis

Factor Analysis

Definition

A type of statistical procedure that is performed to identify clusters or groups of items that are related called factors of data set.

Factor – Procedure

- Step1:
  - Identify data ready for factorization
- Step2:
  - Determine the factor by exploring factor analysis
- Step3:
  - Reliability of factor

Factor – Procedure Step 1

Step1:

- Prior to running factor analysis:
  - General Rule of thumb:
    - Sample size greater than 100
    - At least 3 items per factor

Factor – Procedure Step 1

Step1:

- Data authentication:
  - Kaiser-Meyer-Okline Measure – KMO
    - **0.6** ***or greater*** ***(for sampling adequacy)***
  - Bartlett's Test of Sphericity
    - **p <= 0.05** ***(R-matrix is not identity matrix therefore, there are some relationship between variables)***

Factor – Procedure Step 1

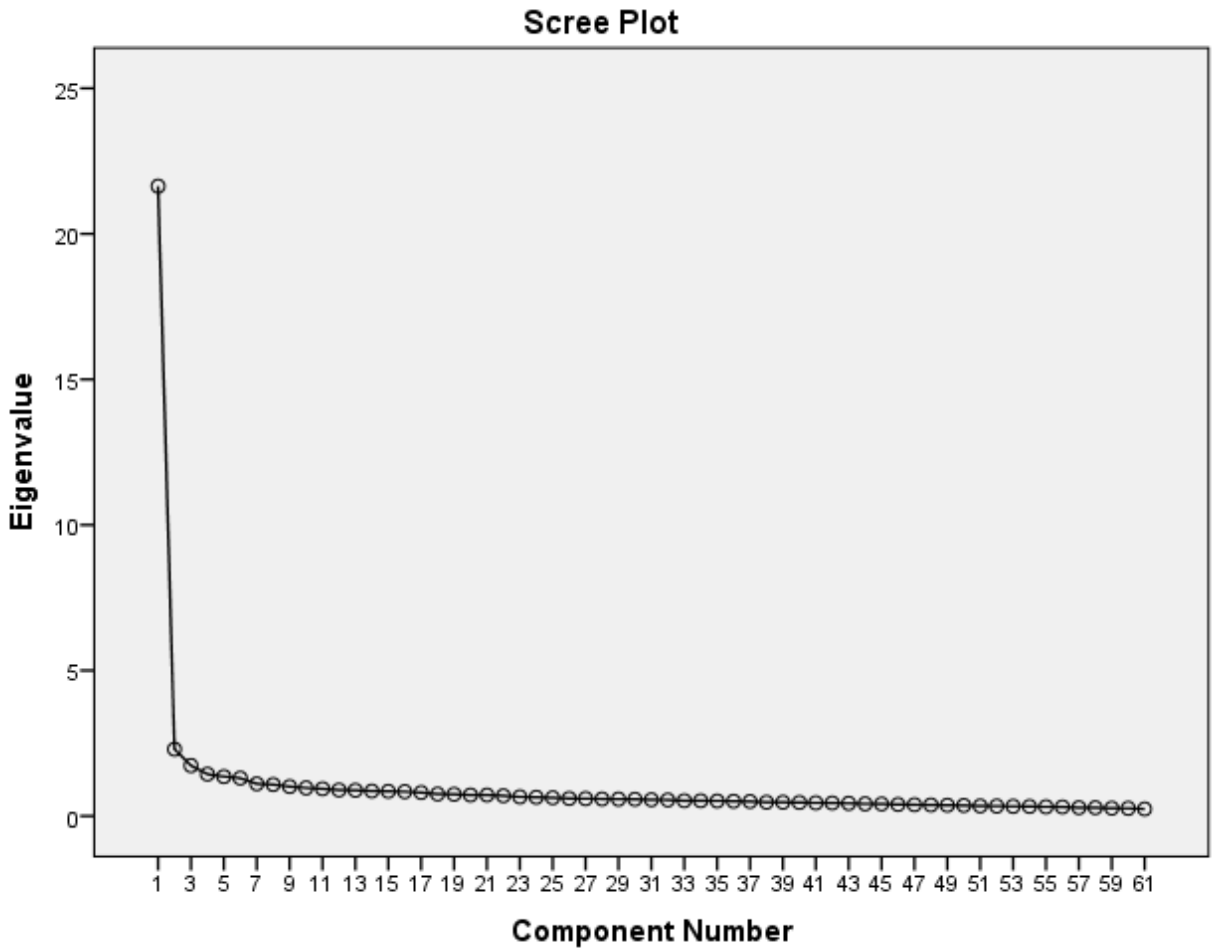
KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.974
Bartlett's Test of Sphericity	Approx. Chi-Square	29486.41
	Df	1830
	Sig.	0.000

Factor – Procedure Step 2

Step2:

- **Factor Extraction**
  - **Scree Plot**
  - **Eigen Value greater than 1**
  - **Principle component analysis**
    - **Varimax**
  - **Option**
    - **Sorted by size**
    - **Suppress small coefficients**

Factor – Procedure Step 2



Factor – Procedure Step 2

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	21.637	35.471	35.471	21.637	35.471	35.471	6.359	10.424	10.424
2	2.295	3.762	39.232	2.295	3.762	39.232	5.799	9.507	19.931
3	1.734	2.843	42.075	1.734	2.843	42.075	4.894	8.024	27.955
4	1.438	2.358	44.433	1.438	2.358	44.433	4.006	6.567	34.522
5	1.357	2.225	46.658	1.357	2.225	46.658	3.433	5.627	40.149
6	1.301	2.133	48.791	1.301	2.133	48.791	2.743	4.497	44.646
7	1.107	1.814	50.605	1.107	1.814	50.605	2.689	4.408	49.054
8	1.081	1.773	52.378	1.081	1.773	52.378	1.672	2.742	51.796
9	1.011	1.657	54.035	1.011	1.657	54.035	1.366	2.239	54.035
Extraction Method: Principal Component Analysis.									

Factor – Procedure Step 2

Factor Loading	Factor Name and Items
	Satisfaction with College Administration
0.7	4. My money is handled accurately by the Accounts Office.
0.6	49. The Accounts Office answers my questions accurately.
0.5	17. The administration is cooperative.
0.4	11. Fines are given in a fair way when students break the rules.
0.2	12. Events on campus are well organized.

Factor – Procedure Step 2

Factor Loading	Factor Name and Items
	Satisfaction with College faculty
0.6	57. Teachers use English for teaching.
0.5	20. Faculty members are well qualified and experienced.
0.4	28. Faculty members convey knowledge to students in a good way.
0.3	13. Monthly exams grading are fair.
0.3	69. Faculty respect students from different backgrounds.
0.3	50. Faculty members are cooperative.
0.3	58. Teachers provide fair feedback on my progress.
0.3	67. Faculty members are punctual in attending class.
0.2	63. Teachers return tests in a timely way.
0.2	68. Faculty effectively manage difficult students.
0.2	25. Teachers complete the syllabus in time.
0.2	71. Teachers speak respectfully to students
0.2	61. Teachers make their expectations clear to students.

Factor – Procedure Step 3

Step3:

- **Reliability of factors**

Factor Name	Cronbach Alpha Reliability	Items	Number of Items
Satisfaction with College Administration	0.702	4, 49, 17, 11, 12	5
Satisfaction with Discipline and Values	0.780	38, 45, 34, 44, 37, 64	6
Satisfaction with Courses and instruction	0.803	54, 60, 55, 40, 70, 66, 7	7
Satisfaction with College facilities	0.902	5, 42, 9, 24, 22, 27, 6, 31, 19, 26, 8, 18, 14, 53, 32, 47, 41, 46,51	19
Satisfaction with College faculty	0.902	57, 20, 28, 13, 69, 50, 58, 67, 63, 68, 25, 71, 61	13
Satisfaction with harmony	0.748	21, 33, 15, 62, 59, 39	6
Satisfaction with Skills development	0.817	23, 16, 43, 29, 48	5

Results – Mean

Factor Name (Satisfaction with)	Mean	Standard Deviation
Skills development	4.20	0.595
Harmony	4.19	0.544
Courses and instruction	4.14	0.572
College facilities	4.13	0.513
College faculty	4.07	0.563
Discipline and Values	3.99	0.630
College Administration	3.80	0.729

Results – Regression

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7$$

Y: student loyalty
X_1: Satisfaction with the college administration,
X_2: Satisfaction with Discipline and Values,
X_3: Satisfaction with courses and instruction,
X_4: Satisfaction with College facilities,
X_5: Satisfaction with College faculty,
X_6: Satisfaction with Harmony,
X_7: Satisfaction with the Skills development

Results – Regression

$$Y = 1.023 + 0.151\ X_1 + 0.078\ X_2 + 0.162\ X_3 + 0.018\ X_4 + 0.059\ X_5 + 0.096\ X_6 + 0.157\ X_7$$

Variable		Beta	t	Sig.
Name	Symbol			
(Constant)	β_0	1.023	11.056	0.000
Satisfaction with College Administration	β_1	0.151	6.393	0.000
Satisfaction with Discipline and Values	β_2	0.078	2.822	0.005
Satisfaction with Courses and instruction	β_3	0.162	5.092	0.000
Satisfaction with College facilities	β_4	0.018	0.521	0.602
Satisfaction with College faculty	β_5	0.059	1.707	0.088
Satisfaction with Harmony	β_6	0.096	3.297	0.001
Satisfaction with Skills development	β_7	0.157	5.606	0.000
$R = 0.618$ Adjusted $R^2 = 0.381$				

Result – Conclusion

- **Five out of Seven factors:**
  - Courses and instruction
  - Skills development
  - Administration
  - Harmony
  - Discipline and Values
- **Attracting Students:**
  - Highlighting things in these areas
  - Positive word of mouth

Thank You

What Questions
do you have

Note: Email me at
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for getting a copy of presentation and primer for using factor analysis.

Primer using "Factor Analysis" in constructing scales

By

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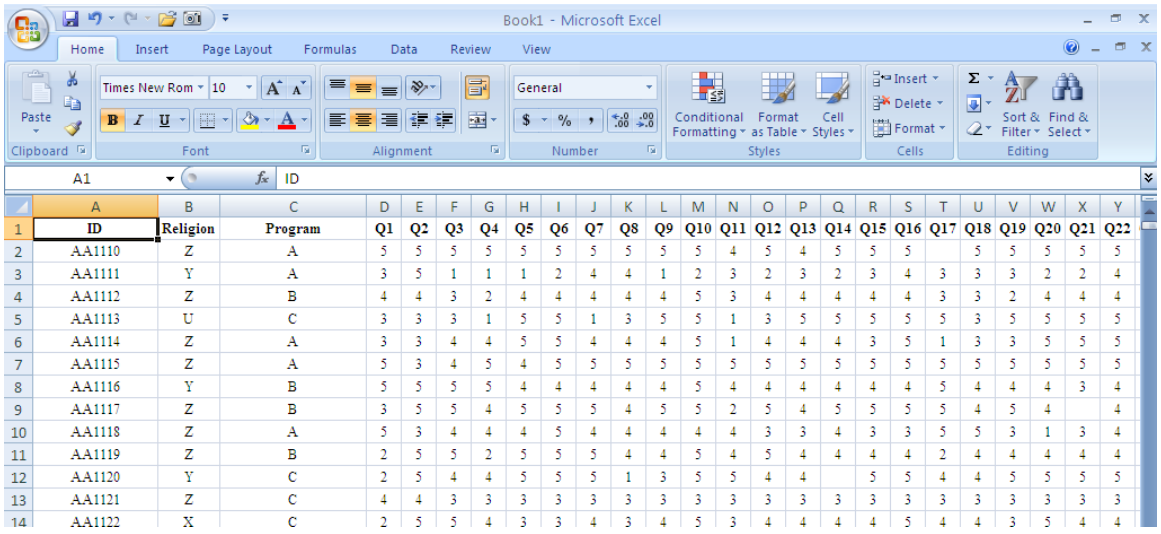
Factor analysis:

A type of statistical procedure that is performed to identify clusters or groups of items that are related called factors of data set. The purpose of factor analysis is to combine the items and make factors from them. So, that instead of looking at 10 individual items we can see two or three factors made from these items to interpret the finding.

Procedure:

The following procedure details how to run factor analysis on SPSS. Firstly, we need to create an excel file having cases listed in one column and against them questions listed in the top row followed by the response. The following screen shot shows how data should look like before uploading it in SPSS.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	ID	Religion	Program	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22
2	AA1110	Z	A	5	5	5	5	5	5	5	5	5	5	4	5	4	5	5	5		5	5	5	5	5
3	AA1111	Y	A	3	5	1	1	1	2	4	4	1	2	3	2	3	2	3	4	3	3	3	2	2	4
4	AA1112	Z	B	4	4	3	2	4	4	4	4	4	5	3	4	4	4	4	4	3	3	2	4	4	4
5	AA1113	U	C	3	3	3	1	5	5	1	3	5	5	1	3	5	5	5	5	5	3	5	5	5	5
6	AA1114	Z	A	3	3	4	4	5	5	4	4	4	5	1	4	4	4	3	5	1	3	3	5	5	5
7	AA1115	Z	A	5	3	4	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
8	AA1116	Y	B	5	5	5	5	4	4	4	4	4	5	4	4	4	4	4	4	5	4	4	4	3	4
9	AA1117	Z	B	3	5	5	4	5	5	5	4	5	5	2	5	4	5	5	5	5	4	5	4		4
10	AA1118	Z	A	5	3	4	4	4	5	4	4	4	4	4	3	3	4	3	3	5	5	3	1	3	4
11	AA1119	Z	B	2	5	5	2	5	5	5	4	4	5	4	5	4	4	4	4	2	4	4	4	4	4
12	AA1120	Y	C	2	5	4	4	5	5	5	1	3	5	5	4	4		5	5	4	4	5	5	5	5
13	AA1121	Z	C	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
14	AA1122	X	C	2	5	5	4	3	3	4	3	4	5	3	4	4	4	4	5	4	4	3	5	4	4

Once the data is entered in the SPSS then we can run the factor analysis on the data to make construct from the items. Following steps show how to run the factor analysis:

Step 1:

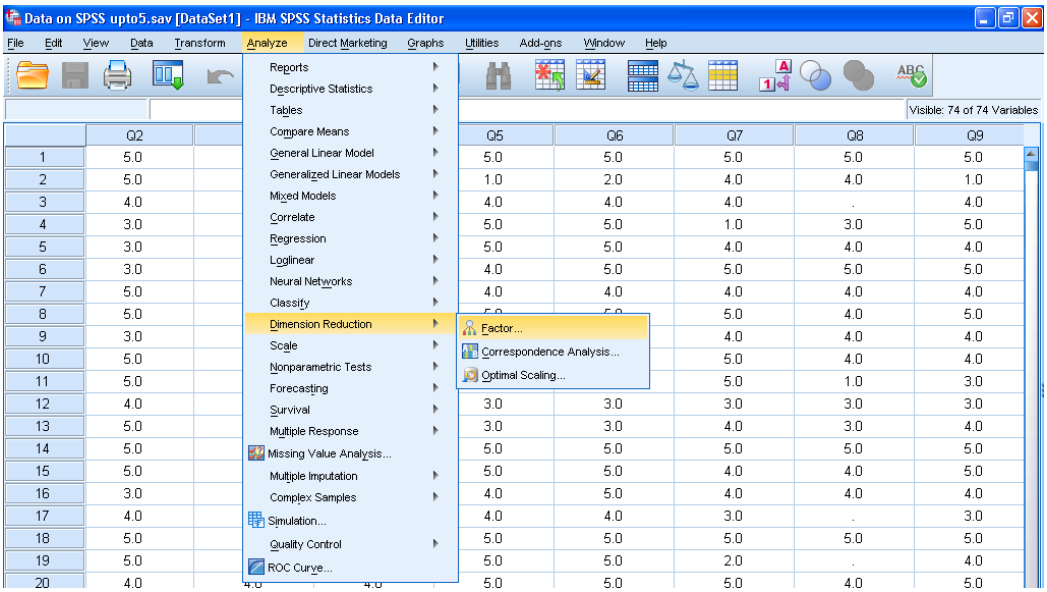
In this step we determine either data is ready to run the factor analysis, before even thinking of running the factor analysis general rule of thumb is:

- Sample size greater than 100
- At least 3 items per factors

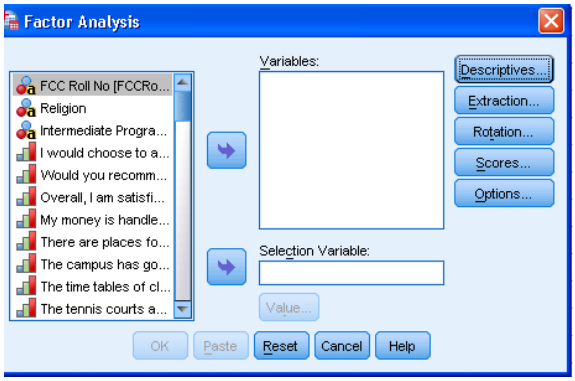
Following tests needs to be performed in order to measure the data authenticity:

- Kaiser-Meyer-Okline Measure – KMO
- Bartlett's Test of Sphericity

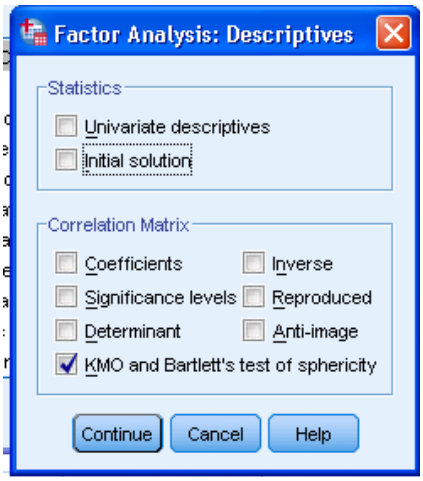
To perform these tests go to "Analyze" then click on "Data reduction" then click on "Factor" as shown below:



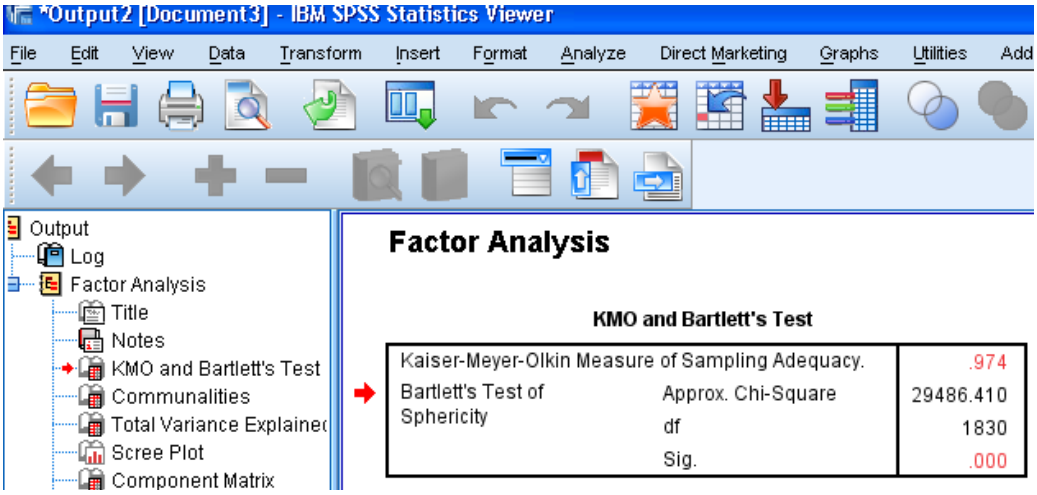
The following dialog box will open after clicking on the "factor":



Click on the "descriptive", after clicking on it following dialog box will appear. Check the "KMO and Bartlett's test of sphericity" as shown below:



The result of the following test is as follows:

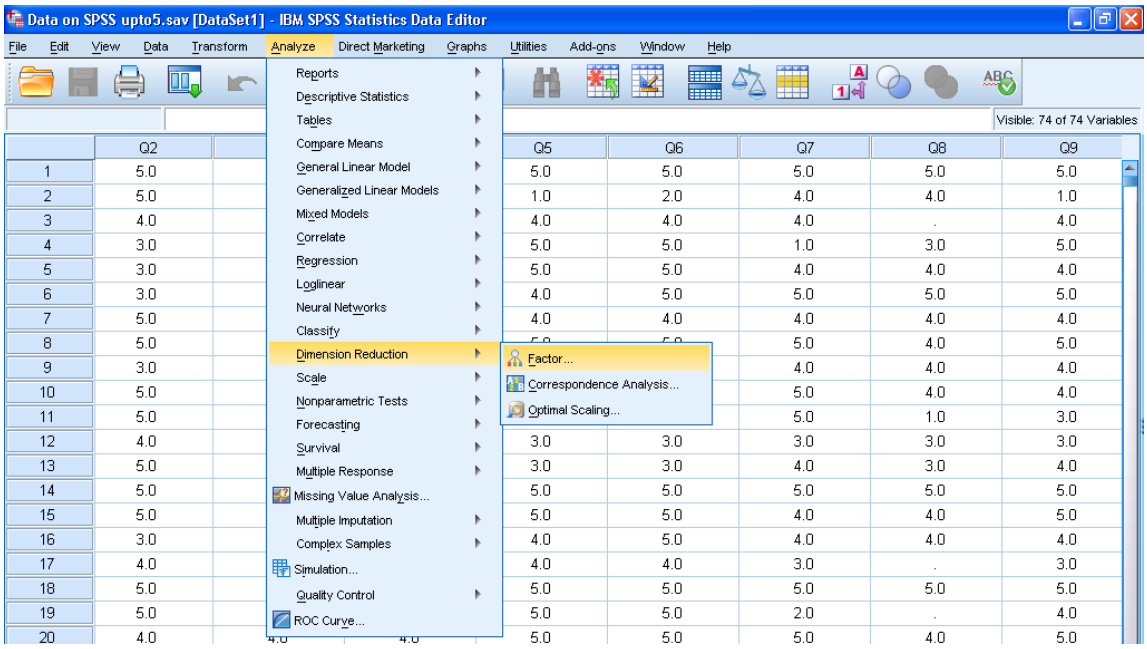


Generally, Kaiser-Meyer-Okline Measure – KMO value greater than 0.6 is consider to be good for running the factor analysis and Bartlett's Test of Sphericity significance value less than equal to 0.05 is consider good this test shows that, the R-matrix is not identity matrix therefore, there are some relationship between items[1].

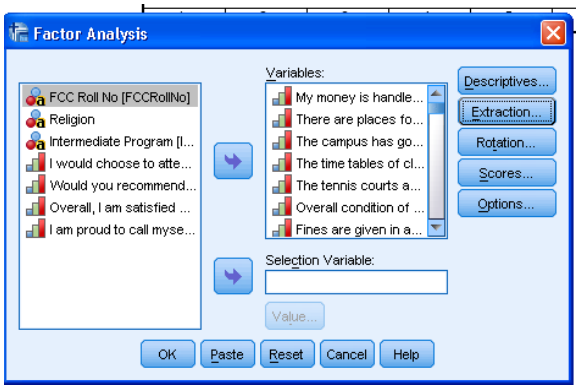
[1] Eyduran, E., Karakus, K., Karakus, S., & Cengiz, F. (2009). Usage of factor scores for determining relationships among body weight and somebody measurements. *Bulgarian Journal of Agricultural Science, 15(4)*, 373-377.

Step 2:

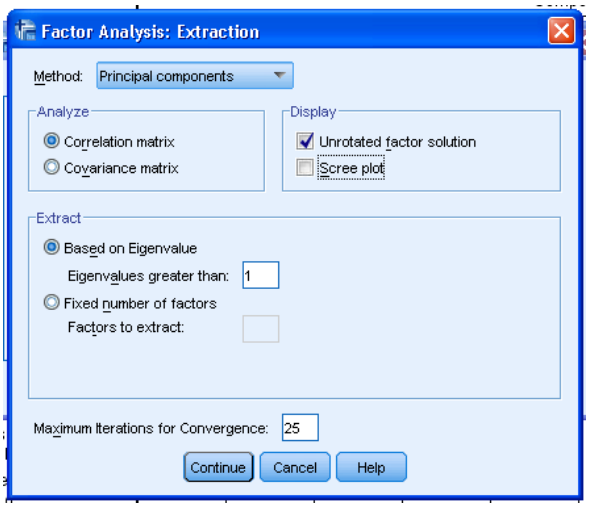
Factor extraction is performed in this step to make constructs from the items. To perform these tests go to "Analyze" then click on "Data reduction" then click on "Factor" as shown below:



The following dialog box will open after clicking on the "factor":



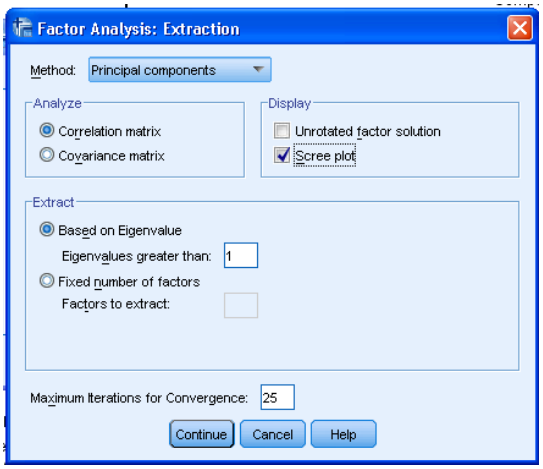
Select the items on which factor analysis need to be performed, and move them to the right side of the dialog box from the left side of the dialog box as shown above. Click on the "Extraction" tab, after that the following dialog box will appear:



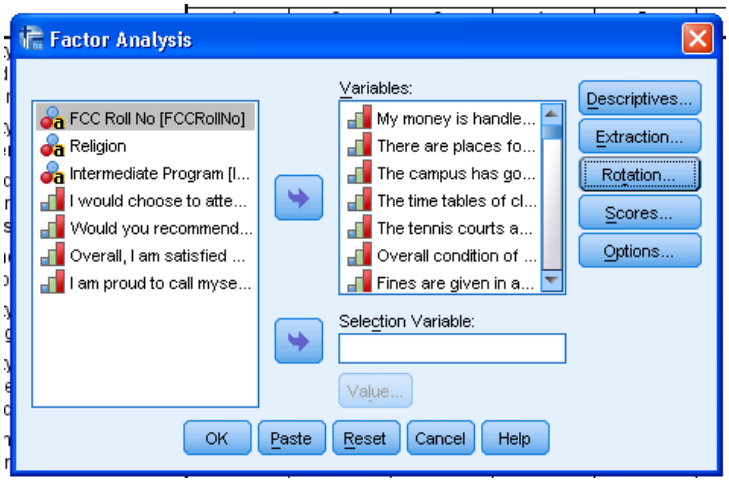
In the above dialog box click on the "method" and select the method you want to use for extraction.

- Mostly, "Principal Components" or "Principal axis factoring" is used as extraction methods. We will use "Principal Components" matrix in this analysis.
- Uncheck the "Unrotated factor solution", as it gives unnecessary information for our factor analysis.
- Check the "Scree plot", this will guide in determining how many factors needs to considered.
- The default "Eigen value greater than 1" is used in determining how many factors to include. The other option to this is that we can even specify the number of factors to be made as opposed to making factors on eigen value greater than 1. But it is recommended that let SPSS decide for you.

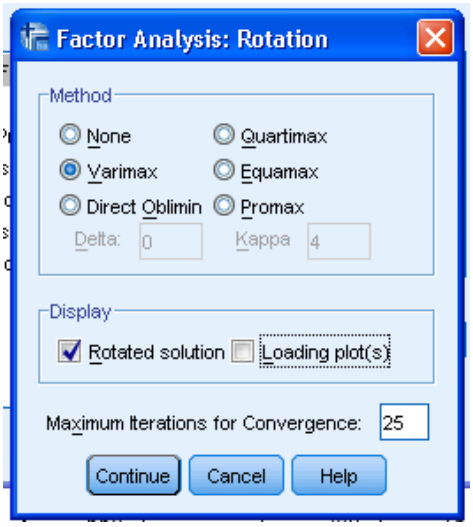
When options are selected the dialog box will look as follows, then click on "continue":



After clicking on continue, the following dialog box will appear:

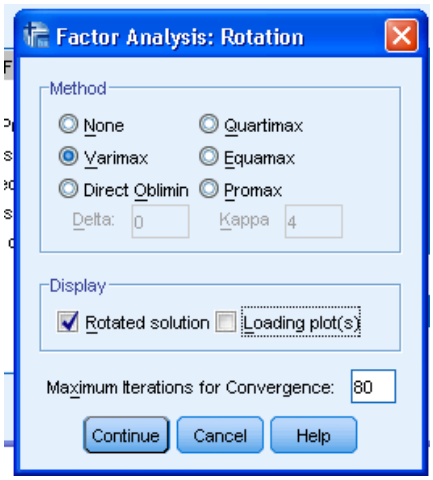


Click on the "Rotation" tab, the following dialog box will appear:

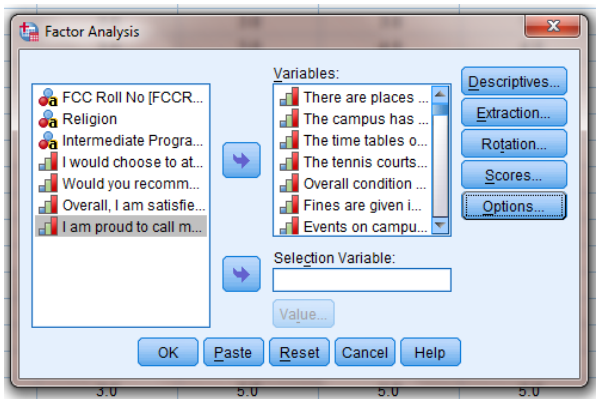


- The dialog box as shown above will allow choosing "rotation method" for factor analysis. We can choose one of the following solutions for rotation "orthogonal" (used when factors are not highly correlated with each other) or "Oblique" (used when factors are correlated with each other). In SPSS "Direct Oblimin" is used for oblique solution others are used for orthogonal solution. Mostly, with principal component "Varimax" rotation is used.
- Check on the "rotated solution", the rotated solution gives factor loadings for each individual item, which can be used for interpreting the meaning of factors that can help in giving names to the factors.
- Click on "continue".

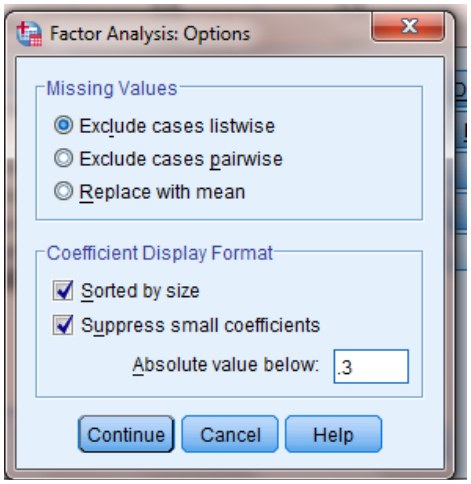
When options are selected the dialog box will look as follows, then click on “continue”:



After clicking on continue then the following dialog box will appear:



Click on the “options” tab in the above mentioned dialog box, the following dialog box will appear:



- Check the "sorted by size" option; this will list the items by factor loading.
- Check the "suppress small coefficients", this will not show factor loading less than mentioned in the "absolute vale below". 0.4 is recommended in many literatures but for behavioral and social sciences studies 0.3 is recommended for retaining the items in the factors[2].
- Click on "continue"

After selecting all the options, in the main dialog box click "ok" to see the output:

Factor analysis output:

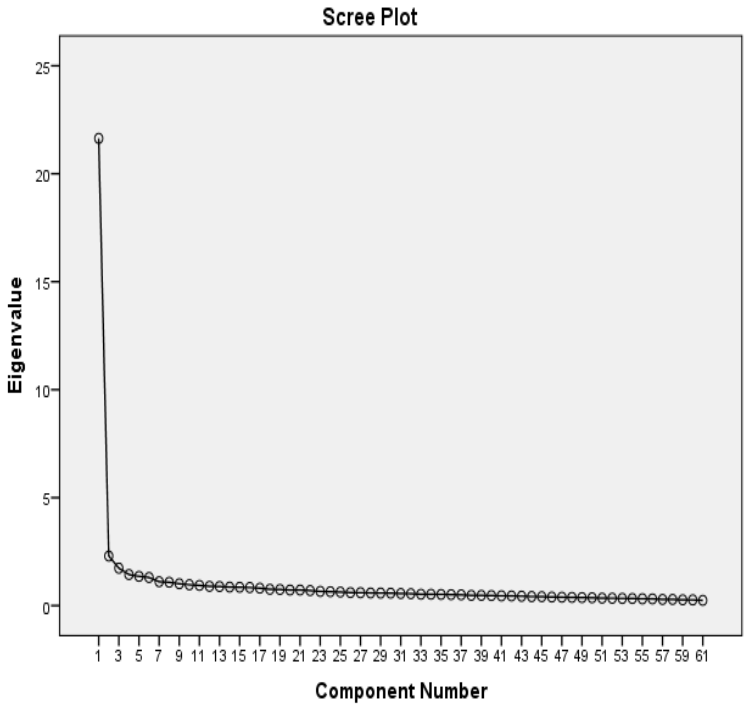
Total Variance Explained

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	21.637	35.471	35.471	21.637	35.471	35.471	6.359	10.424	10.424
2	2.295	3.762	39.232	2.295	3.762	39.232	5.799	9.507	19.931
3	1.734	2.843	42.075	1.734	2.843	42.075	4.894	8.024	27.955
4	1.438	2.358	44.433	1.438	2.358	44.433	4.006	6.567	34.522
5	1.357	2.225	46.658	1.357	2.225	46.658	3.433	5.627	40.149
6	1.301	2.133	48.791	1.301	2.133	48.791	2.743	4.497	44.646
7	1.107	1.814	50.605	1.107	1.814	50.605	2.689	4.408	49.054
8	1.081	1.773	52.378	1.081	1.773	52.378	1.672	2.742	51.796
9	1.011	1.657	54.035	1.011	1.657	54.035	1.366	2.239	54.035
10	.966	1.584	55.618						
11	.936	1.534	57.153						
12	.895	1.467	58.620						
13	.885	1.452	60.072						
14	.857	1.404	61.476						
15	.849	1.392	62.868						
16	.837	1.372	64.239						
17	.807	1.323	65.562						
18	.755	1.238	66.801						
19	.746	1.222	68.023						
20	.722	1.184	69.207						

Extraction Method: Principal Component Analysis.

This table shows the number of factors extracted. The section labeled as "rotation sum of squared loadings" shows those factors which met the criteria of eigenvalues greater than 1. In the above shown table we can see 9 factors were extracted which explains a total of 54.035% of variability and one can see their individual contribution also.

[2] MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. Psychological Methods, 4(1), 84-99.



This can also be seen in the “scree plot” diagram. If we look in the above diagram after point 9 the line levels out.

In order to see the items included in the factors with factor loading. We look at the “rotated component matrix(a) table as shown below:

Rotated Component Matrix[a]

	Component								
	1	2	3	4	5	6	7	8	9
Q13	.8								
Q16	.7								
Q5	.6								
Q9	.5								
Q1	.4								
Q7		.7							
Q2		.6							
Q24		.6							
Q11		.5							
Q19		.4							
Q8		.4							
Q32			.7						
Q25			.6						
Q15			.5						
Q6			.4						
Q18			.3						
Q21			.3						
Q29			.3						

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 16 iterations.

The factor loading of each item can be seen in the above table. The first factor mentioned in the top row includes the following items such as Q13, 16, 5, 9 and 1 as shown above. And the factor loading are mentioned against them. We can give names to the factors basing on the nature of items, for instance the first factor items were on the college administration I called this factor “satisfaction with college administration”. Similarly, second factor items were on college faculty I called this factor “satisfaction with faculty” and so on.

Step 3:

In this step we conducted cronbach alpha reliability of the factors which were created through factor analysis. This measures the internal consistency of the items and it shows the conformity of the factor grouping. The cronbach alpha values greater than 0.9 is considered excellent, 0.9 to 0.8 considered good, 0.8 to 0.7 considered acceptable, 0.7 to 0.6 considered questionable, 0.6 to 0.5 considered poor and less than 0.5 is considered unacceptable[3].

[3] Chiu, J. M., & Liu, W. L. (2008). A Study of the Feasibility of Network Tutorial System in Taiwan. Educational Technology & Society, 11(1), 208-225