

Research Methods

Factor Analysis with JASP

Andy Gillett

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Factor Analysis

Factor analysis is a statistical technique for analysing the correlations between a number of variables in order to reduce them to a smaller number of underlying dimensions, called factors, and to determine the correlation of each of the original variables with each factor.

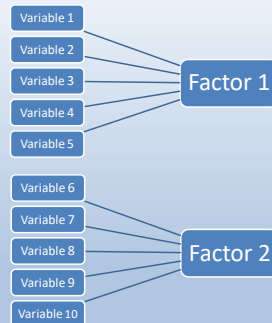
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Factor Analysis

- Variable 1
- Variable 2
- Variable 3
- Variable 4
- Variable 5
- Variable 6
- Variable 7
- Variable 8
- Variable 9
- Variable 10

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Factor Analysis



The amount of the total variance explained by that factor is called the **eigenvalue** of a factor.

The extent to which a particular variable contributes to a given factor is the **factor loading** of a variable.

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Factor Analysis

Job Satisfaction

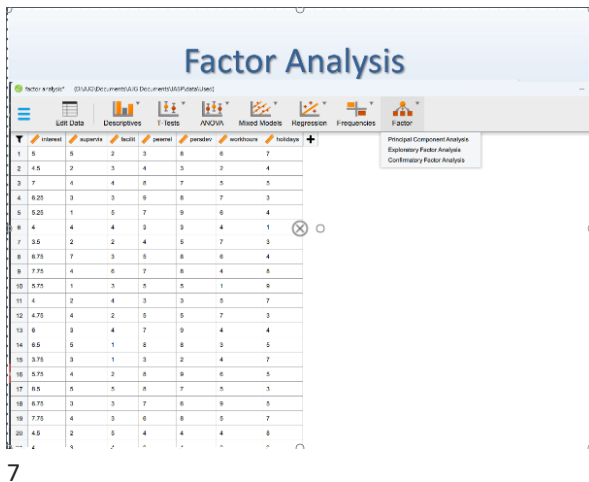
interest	Job Interest
supervis	Relationship with Supervisor
facilit	Facilities in the Workplace
peerrel	Relationship with Peers/Colleagues
persdev	Opportunities for Personal Development & Promotion
workhours	Hours of Work
holidays	Holidays

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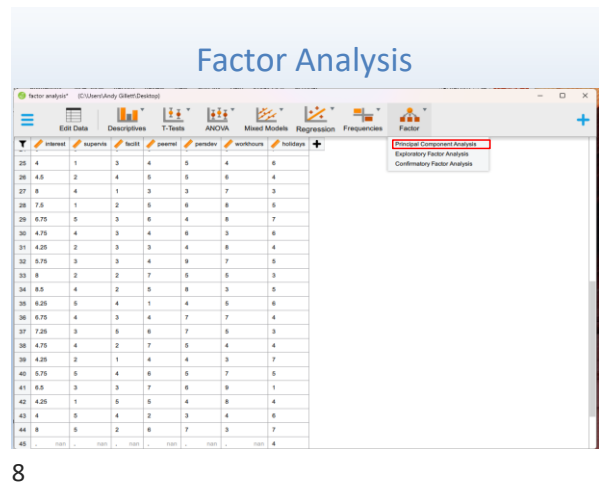
Factor Analysis

	interest	supervis	facilit	peerrel	persdev	workhours	holidays
1	5	5	2	3	5	5	7
2	4.5	2	3	4	3	2	4
3	7	4	4	6	7	5	5
4	6.25	3	3	5	6	7	3
5	5.25	1	5	7	9	5	4
6	4	4	4	3	3	4	1
7	3.5	2	2	4	5	7	3
8	5.75	7	3	5	6	6	4
9	7.75	4	6	7	6	4	6
10	5.75	1	3	5	5	1	5
11	4	2	4	3	3	5	7
12	4.75	4	2	5	5	7	3
13	6	3	4	7	9	4	4
14	6.5	5	1	6	8	3	5
15	3.75	3	1	3	2	4	7
16	5.75	4	2	6	9	6	5
17	4.5	5	5	6	7	5	3
18	5.75	3	3	7	6	5	6
19	7.75	4	3	6	6	5	7
20	4.5	2	5	4	4	4	6

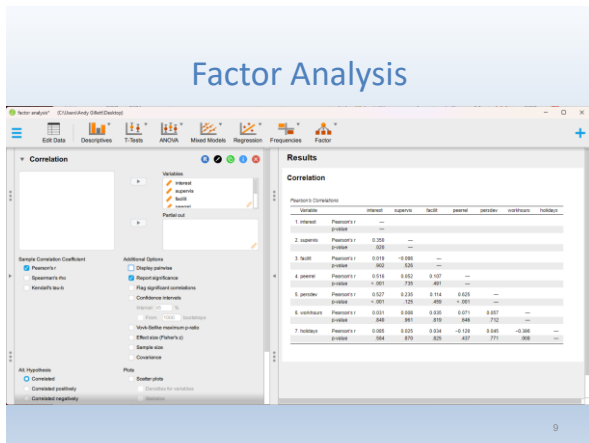
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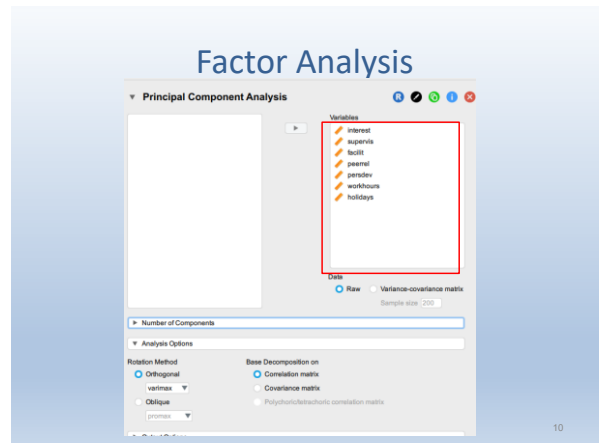
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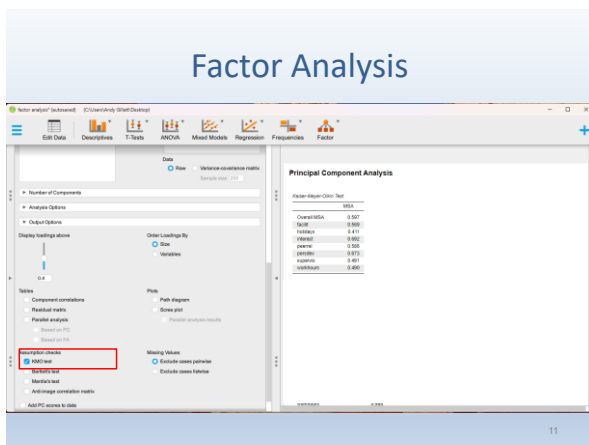
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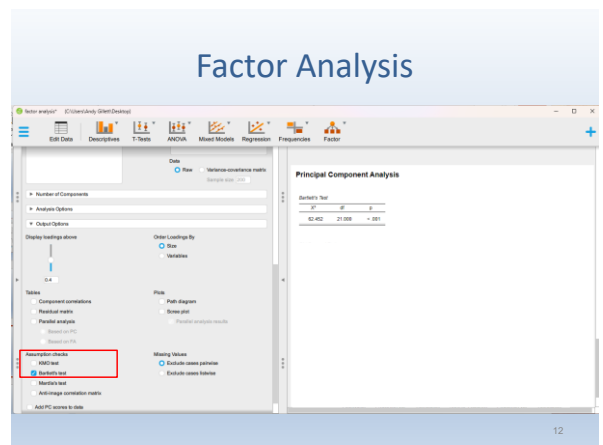
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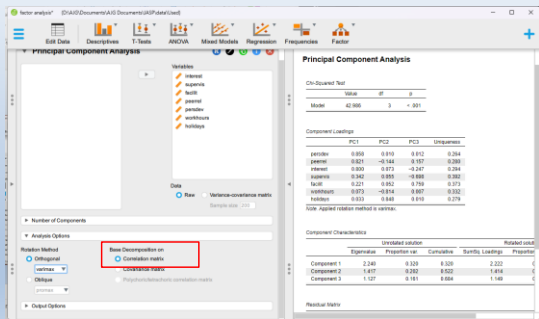


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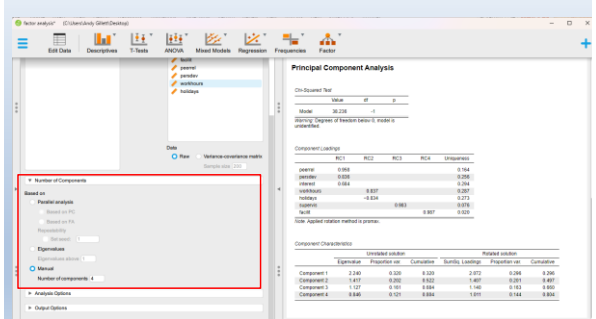
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Factor Analysis



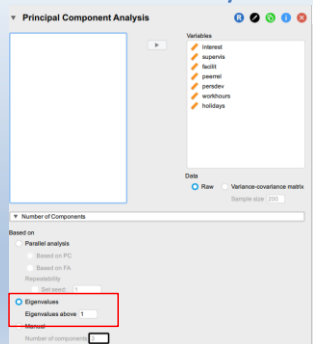
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Factor Analysis



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Factor Analysis



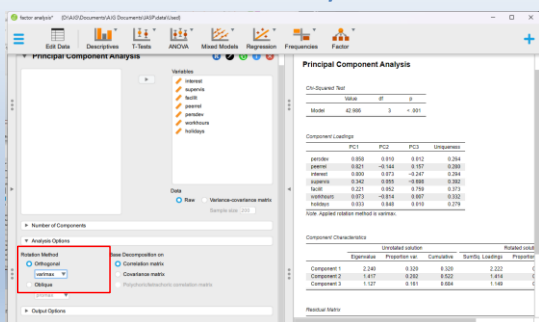
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Factor Analysis



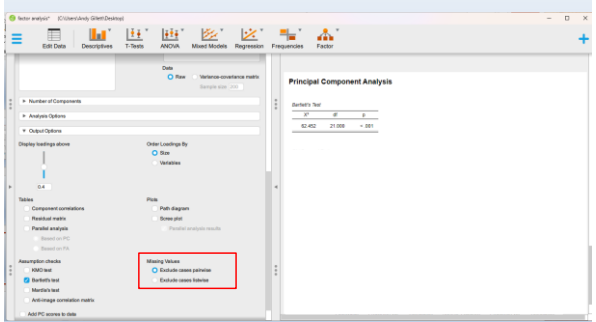
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Factor Analysis



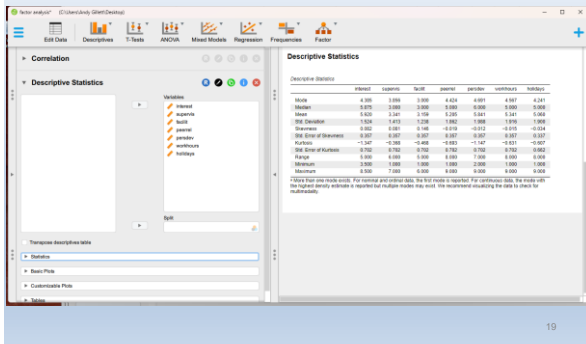
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Factor Analysis



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Factor Analysis



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Factor Analysis

Pearson's Correlations

Variable	interest	supervis	facilit	peerrel	persdev	workhours	holidays
1. interest	Pearson's r	—					
	p-value	—					
2. supervis	Pearson's r	0.350	—				
	p-value	.020	—				
3. facilit	Pearson's r	0.019	-0.098	—			
	p-value	.902	.526	—			
4. peerrel	Pearson's r	0.516	0.052	0.107	—		
	p-value	< .001	.735	.491	—		
5. persdev	Pearson's r	0.527	0.235	0.114	0.625	—	
	p-value	< .001	.125	.459	< .001	—	
6. workhours	Pearson's r	0.031	0.008	0.035	0.071	0.057	—
	p-value	.840	.961	.819	.646	.712	—
7. holidays	Pearson's r	0.085	0.025	0.034	-0.120	0.045	-0.396
	p-value	.584	.870	.825	.437	.771	.008

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Factor Analysis

Pearson's Correlations

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	p-value	.584	.870	.825	.437	.771	.008

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Factor Analysis

Kaiser-Meyer-Olkin Test

MSA	
Overall MSA	0.654
facilit	0.569
holidays	0.411
interest	0.692
peerrel	0.586
persdev	0.673
supervis	0.491
workhours	0.490

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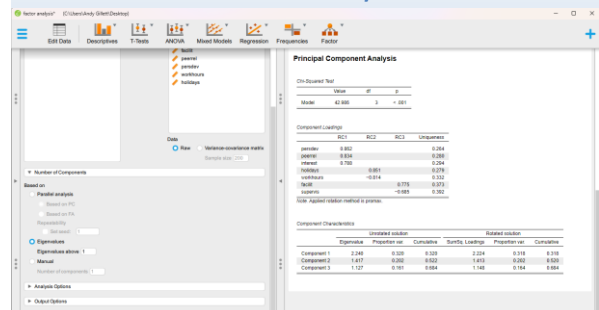
Factor Analysis

Bartlett's Test

X ²	df	p
62.452	21.000	< .001

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Factor Analysis



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Factor Analysis

▼ Number of Components

Based on

- ☐ Parallel analysis
 - ☐ Based on PC
 - ☐ Based on FA
- ☒ Eigenvalues
 - Eigenvalues above 1
- ☐ Manual
 - Number of components

Repeatability

Set seed:

Above 1 is good. Below 1 then the factor is not explaining as much as the original variables. (Kaiser, 1960)

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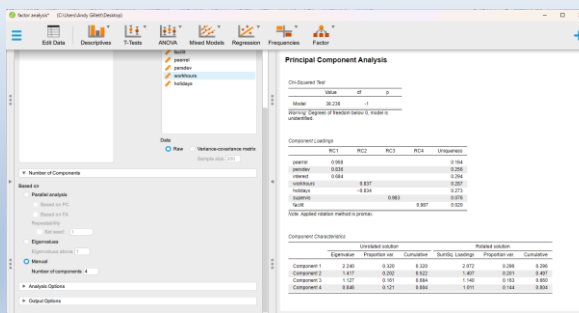
Factor Analysis

Component Characteristics

	Unrotated solution			Rotated solution		
	Eigenvalue	Proportion var	Cumulative	SumSq Loadings	Proportion var	Cumulative
Component 1	2.240	0.320	0.320	2.222	0.317	0.317
Component 2	1.417	0.202	0.522	1.414	0.202	0.519
Component 3	1.127	0.161	0.684	1.149	0.164	0.684

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Factor Analysis



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Factor Analysis

Component Characteristics

	Unrotated solution			Rotated solution		
	Eigenvalue	Proportion var	Cumulative	SumSq Loadings	Proportion var	Cumulative
Component 1	2.240	0.320	0.320	2.224	0.318	0.318
Component 2	1.417	0.202	0.522	1.413	0.202	0.520
Component 3	1.127	0.161	0.684	1.148	0.164	0.684

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Factor Analysis

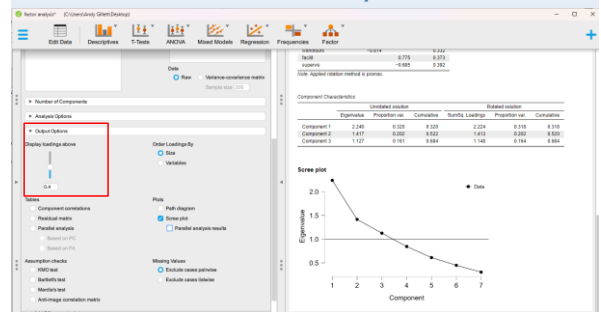
Component Loadings

	PC1	PC2	PC3	Uniqueness
persdev	0.858			0.264
peerrel	0.821			0.280
interest	0.800			0.294
holidays		0.848		0.279
workhours		-0.814		0.332
facilit			0.759	0.373
supervis			-0.698	0.392

Note: Applied rotation method is varimax.

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Factor Analysis



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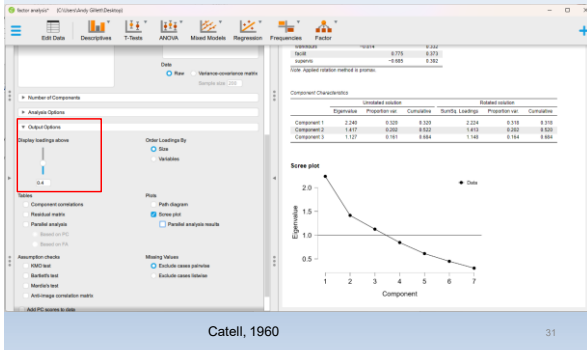
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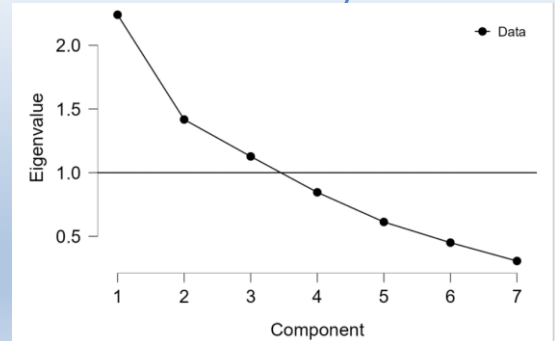
Factor Analysis



Catell, 1960

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Factor Analysis



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Factor Analysis

Factor analysis, using principal components extraction and varimax rotation, was performed on the data. Three factors were extracted, Factor 1 explaining 32% of the variance in the original measures; Factor 2 explaining 20% and Factor 3 explaining an additional 16% cent of the variance. The job interest, relationship with colleagues and opportunities for personal development variables were found to have high factor loadings (.80, .82 & .86) on Factor 1, hours of work and holidays had high factor loadings (.81 - .85) on Factor 2 and facilities and relationship with supervisor had quite high loadings on Factor 3 (.70 - .76).

Based on Colman & Pulford (2008).

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Factor Analysis

Factor Analysis with JASP - 2

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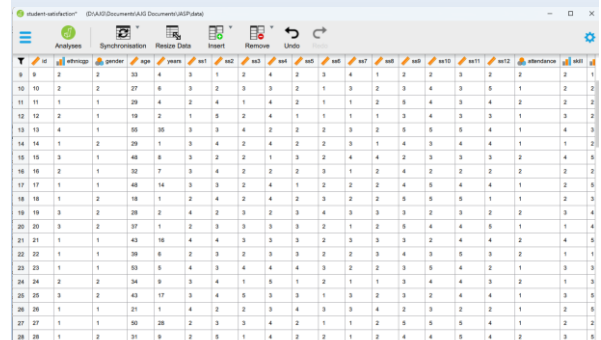
Factor Analysis

Student Satisfaction

id	Identity
ethnigcp	Ethnic Group
age	Age
gender	Gender
years	Number of Years in Institution
ss1-ss12	Twelve Measures of Satisfaction of Course
attendance	Number of Hours Attending
skill	Initial Skill Level
participation	Class Participation
quality	Quality of Work
absence	Number of Absences

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Factor Analysis



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Factor Analysis

Pearson's Correlations													
Variable	ss1	ss2	ss3	ss4	ss5	ss6	ss7	ss8	ss9	ss10	ss11	ss12	
1. ss1	Pearson's r	—											
	p-value	—											
2. ss2	Pearson's r	-0.267	—										
	p-value	.025	—										
3. ss3	Pearson's r	0.368	-0.270	—									
	p-value	.002	.024	—									
4. ss4	Pearson's r	-0.417	0.451	-0.543	—								
	p-value	< .001	< .001	< .001	—								
5. ss5	Pearson's r	0.563	-0.457	0.497	-0.406	—							
	p-value	< .001	< .001	< .001	< .001	—							
6. ss6	Pearson's r	0.367	-0.549	0.244	-0.299	0.480	—						
	p-value	.002	< .001	.042	.012	< .001	—						
7. ss7	Pearson's r	0.506	-0.340	0.330	-0.295	0.413	0.349	—					
	p-value	< .001	.004	.005	.013	< .001	.003	—					
8. ss8	Pearson's r	0.489	-0.382	0.294	-0.534	0.676	0.380	0.449	—				
	p-value	< .001	.001	.013	< .001	< .001	.001	< .001	—				
9. ss9	Pearson's r	-0.365	0.504	-0.351	0.404	-0.358	-0.439	-0.205	-0.355	—			
	p-value	.002	< .001	.011	< .001	.002	< .001	.017	.003	—			
10. ss10	Pearson's r	-0.382	0.428	-0.224	0.414	-0.324	-0.379	-0.311	-0.282	0.695	—		
	p-value	< .001	< .001	.062	< .001	.006	.001	.009	.018	< .001	—		
11. ss11	Pearson's r	-0.361	0.385	-0.284	0.360	-0.327	-0.353	-0.153	-0.298	0.790	0.625	—	
	p-value	.002	.001	.017	< .001	.006	.003	.265	.012	< .001	< .001	—	
12. ss12	Pearson's r	-0.200	0.410	-0.247	0.263	-0.323	-0.523	-0.138	-0.238	0.725	0.510	0.630	—
	p-value	.012	< .001	.039	.018	.006	< .001	.262	.040	< .001	< .001	< .001	—

Factor Analysis

Kaiser-Meyer-Olkin Test

MSA	
Overall MSA	0.803
ss1	0.870
ss10	0.884
ss11	0.869
ss12	0.854
ss2	0.839
ss3	0.661
ss4	0.721
ss5	0.748
ss6	0.872
ss7	0.774
ss8	0.722
ss9	0.817

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Factor Analysis

Bartlett's Test

X ²	df	p
417.694	66.000	< .001

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Factor Analysis

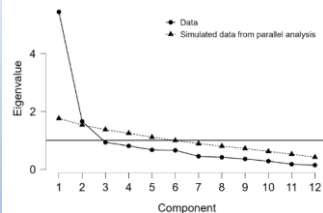
Component Characteristics

	Unrotated solution			Rotated solution		
	Eigenvalue	Proportion var.	Cumulative	SumSq. Loadings	Proportion var.	Cumulative
Component 1	5.439	0.453	0.453	3.558	0.297	0.297
Component 2	1.656	0.138	0.591	3.536	0.295	0.591

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Factor Analysis

Scree plot



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Factor Analysis

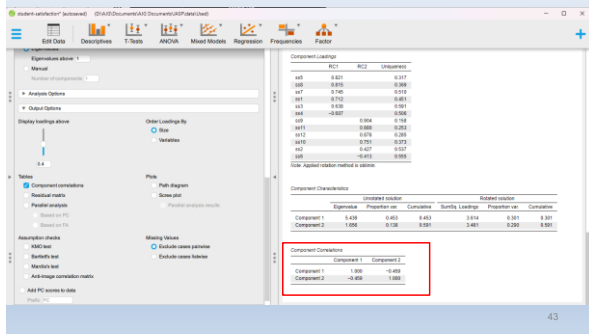
Component Loadings

	RC1	RC2	Uniqueness
ss5	0.821		0.317
ss6	0.815		0.369
ss7	0.745		0.510
ss1	0.712		0.451
ss3	0.638		0.591
ss4	-0.607		0.506
ss9		0.904	0.158
ss11		0.880	0.253
ss12		0.878	0.285
ss10		0.751	0.373
ss2		0.427	0.537
ss8		-0.413	0.555

Note. Applied rotation method is oblimin.

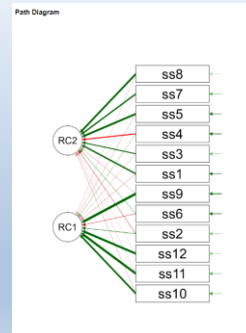
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Factor Analysis



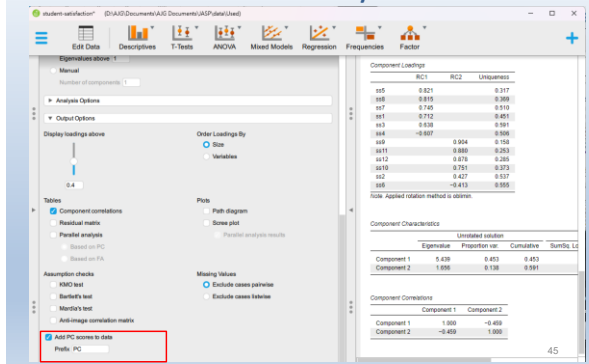
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Factor Analysis



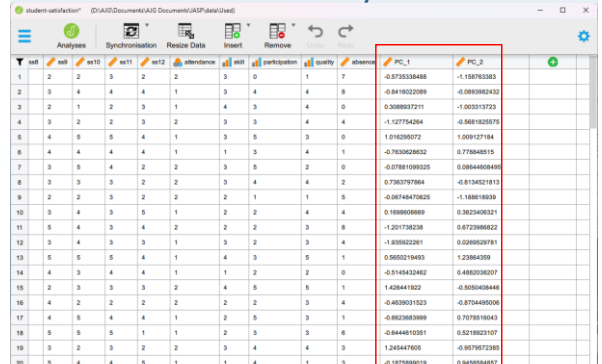
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Factor Analysis



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Factor Analysis



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Factor Analysis

The 12 items of the Student Satisfaction Scale were subjected to factor analysis with PCA and oblimin rotation using JASP version 0.9.5.4 Prior to performing the factor analysis, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of several coefficients of .3 and above. The Kaiser-Meyer-Olkin value was .80, exceeding the recommended value of .6 (Kaiser 1960) and Bartlett's Test of Sphericity (Bartlett 1954) reached statistical significance, supporting the factorability of the correlation matrix.

Factor analysis revealed the presence of two components with eigenvalues exceeding 1, explaining 30% & 29% of the variance respectively. An inspection of the screeplot revealed a clear elbow after the second component. Using Cattell's (1966) scree test, it was decided to retain two components for further investigation.

The two solution explained a total of 59% of the variance, with Component 1 contributing 30% and Component 2 adding another 29%. To aid in the interpretation of these three components, varimax rotation was performed. The rotated solution revealed the presence of a simple structure, with all components showing a number of strong loadings and most variables loading substantially on only one component.

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References & Further Reading

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