Multivariate Statistical Techniques Assignment 1 2024

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1 Question 1

After four experiments were conducted to determine the moisture content of samples of a powder, each person/observer took a sample from each of six consignments.

In analysis of the data, we have four Observers, six consignment and twenty-four Moisture-content

a.

Tests of Between-Subjects Effects

Dependent Variable: Moisture_content

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	2817.875[a]	9	313.097	357.825	<.001
Observers	13.125	3	4.375	5.000	.013
Consignments	9.708	5	1.942	2.219	.106
Error	13.125	15	.875		
Total	2831.000	24			

a. R Squared = .995 (Adjusted R Squared = .993)

(i)Hypothesis:

H0: No significant difference among consignments.
H1: There is significant difference among consignments.

conclusion: Since is 0.106 $>$ 0.05 significant level, we fail to reject the null hypothesis(H0) and conclude that there is no significant difference among consignments.

[

(ii)Hypothesis:

H0: No significant difference between consignments.

H1: There is significant difference between consignments.

conclusion: Since is $0.013 < 0.05$ significant level, we reject the null hypothesis(H0) and conclude that there is significant difference among observers.

b.

An R-squared value of 0.995 (or 95.5%) means that about 95% of the total variation in Moisture content is explained by the Observers and Consignments in the regression model. Conversely, about 0.5% of the variation in Moisture content is not explained by the model.

c.

Post Hoc Tests

Observers

Homogeneous Subsets

Moisture_content

Tukey B[a,b]

Observers	N	Subset 1	Subset 2
1	6	10.0000	
2	6	10.5000	10.5000
3	6	10.6667	10.6667
4	6		12.0000

Means for groups in homogeneous subsets are displayed.
Based on observed means.
The error term is Mean Square(Error) = 1.142.

a. Uses Harmonic Mean Sample Size = 6.000.

b. Alpha = .05.

Since there is a significant difference in Observation, Homogeneous subset in the Post-Hoc test above determines where the difference is. We notice that the is a significant difference between Observer 1 and 4.

2 Question 2

a.

Frequencies

[DataSet5] C:\Users\36076724\Desktop\BSC Hons Statistic\STA4814_Multivariate\2024\anorectic.sav

Statistics

		Body Weight	Menstruation	Restriction of food intake (fasting)	Binge eating	Vomiting	Purging	Hyperactivity	Family relations
N	Valid	217	217	217	217	217	217	217	217
	Missing	0	0	0	0	0	0	0	0
Mean		2.52	1.90	2.47	3.48	3.72	3.31	2.39	2.35
Std. Deviation		1.337	.907	1.202	1.089	.854	1.183	.665	.761
Skewness		-.056	.202	.063	-1.727	-2.861	-1.263	-.628	-.675
Std. Error of Skewness		.165	.165	.165	.165	.165	.165	.165	.165
Kurtosis		-1.784	-1.762	-1.538	1.124	6.345	-.231	-.645	-.966
Std. Error of Kurtosis		.329	.329	.329	.329	.329	.329	.329	.329

Family relations	Emancipation from family	Friends	School/employment record	Sexual attitude	Sexual behavior	Mental state (mood)	Preoccupation with food and weight	Body perception
217	217	217	217	217	217	217	217	217
0	0	0	0	0	0	0	0	0
2.35	2.30	2.53	2.28	2.28	2.27	2.59	2.09	2.21
.761	.731	.752	.810	.815	.656	.689	.743	.727
-.675	-.533	-1.225	-.557	-.549	-.351	-1.380	-.142	-.349
.165	.165	.165	.165	.165	.165	.165	.165	.165
-.966	-.970	-.117	-1.257	-1.280	-.739	.478	-1.173	-1.050
.329	.329	.329	.329	.329	.329	.329	.329	.329

b.

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	217	100.0
	Excluded[a]	0	.0
	Total	217	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.848	16

With a Cronbach's Alpha value of 0.848, the reliability analysis shows that the set of 16 variables/data is reliable and has good internal consistency. This

suggests that the variables are closely related and can be considered a reliable measure or scale for the study.

c.

Factor Analysis

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Body Weight	2.52	1.337	217
Menstruation	1.90	.907	217
Restriction of food intake (fasting)	2.47	1.202	217
Binge eating	3.48	1.089	217
Vomiting	3.72	.854	217
Purging	3.31	1.183	217
Hyperactivity	2.39	.665	217
Family relations	2.35	.761	217
Emancipation from family	2.30	.731	217
Friends	2.53	.752	217
School/employment record	2.28	.810	217
Sexual attitude	2.28	.815	217
Sexual behavior	2.27	.656	217
Mental state (mood)	2.59	.689	217
Preoccupation with food and weight	2.09	.743	217
Body perception	2.21	.727	217

Correlation Matrix

		Body Weight	Menstruation	Restriction of food intake (fasting)	Binge eating	Vomiting	Purging	Hyperactivity	Family relations	Emancipation from family	Friends
Correlation	Body Weight	1.000	.452	.576	-.037	.094	.103	.376	.300	.342	.143
	Menstruation	.452	1.000	.545	.059	.131	.090	.219	.386	.395	.276
	Restriction of food intake (fasting)	.576	.545	1.000	.077	.181	.230	.310	.348	.297	.200
	Binge eating	-.037	.059	.077	1.000	.319	.678	.162	-.018	.056	.183
	Vomiting	.094	.131	.181	.319	1.000	.442	.247	-.009	.156	.186
	Purging	.103	.090	.230	.678	.442	1.000	.301	-.001	.166	.138
	Hyperactivity	.376	.219	.310	.162	.247	.301	1.000	.238	.360	.180
	Family relations	.300	.386	.348	-.018	-.009	-.001	.238	1.000	.445	.342
	Emancipation from family	.342	.395	.297	.056	.156	.166	.360	.445	1.000	.283
	Friends	.143	.276	.200	.183	.186	.138	.180	.342	.283	1.000
	School/employment record	.390	.310	.253	.113	.126	.131	.321	.270	.482	.302
	Sexual attitude	.318	.326	.212	.078	.190	.089	.220	.278	.435	.372
	Sexual behavior	.403	.350	.407	.178	.333	.249	.416	.321	.457	.298
	Mental state (mood)	.281	.288	.331	.207	.237	.220	.109	.133	.064	.149
	Preoccupation with food and weight	.429	.466	.586	.268	.294	.343	.278	.347	.360	.273
	Body perception	.300	.370	.383	.203	.333	.236	.289	.344	.272	.293
Sig. (1-tailed)	Body Weight		<.001	<.001	.293	.083	.066	<.001	<.001	<.001	.017
	Menstruation	.000		.000	.193	.027	.094	.001	.000	.000	.000
	Restriction of food intake (fasting)	.000	.000		.131	.004	.000	.000	.000	.000	.002
	Binge eating	.293	.193	.131		.000	.000	.008	.394	.208	.003
	Vomiting	.083	.027	.004	.000		.000	.000	.448	.011	.003
	Purging	.066	.094	.000	.000	.000		.000	.495	.007	.021

Friends	School/employment record	Sexual attitude	Sexual behavior	Mental state (mood)	Preoccupation with food and weight	Body perception
.143	.390	.318	.403	.281	.429	.300
.276	.310	.326	.350	.288	.466	.370
.200	.253	.212	.407	.331	.586	.383
.183	.113	.078	.178	.207	.268	.203
.186	.126	.190	.333	.237	.294	.333
.138	.131	.089	.249	.220	.343	.236
.180	.321	.220	.416	.109	.278	.289
.342	.270	.278	.321	.133	.347	.344
.283	.482	.435	.457	.064	.360	.272
1.000	.302	.372	.298	.149	.273	.293
.302	1.000	.786	.430	.176	.182	.166
.372	.786	1.000	.465	.197	.197	.229
.298	.430	.465	1.000	.271	.416	.412
.149	.176	.197	.271	1.000	.414	.305
.273	.182	.197	.416	.414	1.000	.556
.293	.166	.229	.412	.305	.556	1.000
.017	<.001	<.001	<.001	<.001	<.001	<.001
.000	.000	.000	.000	.000	.000	.000
.002	.000	.001	.000	.000	.000	.000
.003	.049	.126	.004	.001	.000	.001
.003	.032	.002	.000	.000	.000	.000
.021	.027	.096	.000	.001	.000	.000

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KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.837
Bartlett's Test of Sphericity	Approx. Chi-Square	1341.664
	df	120
	Sig.	<.001

Communalities

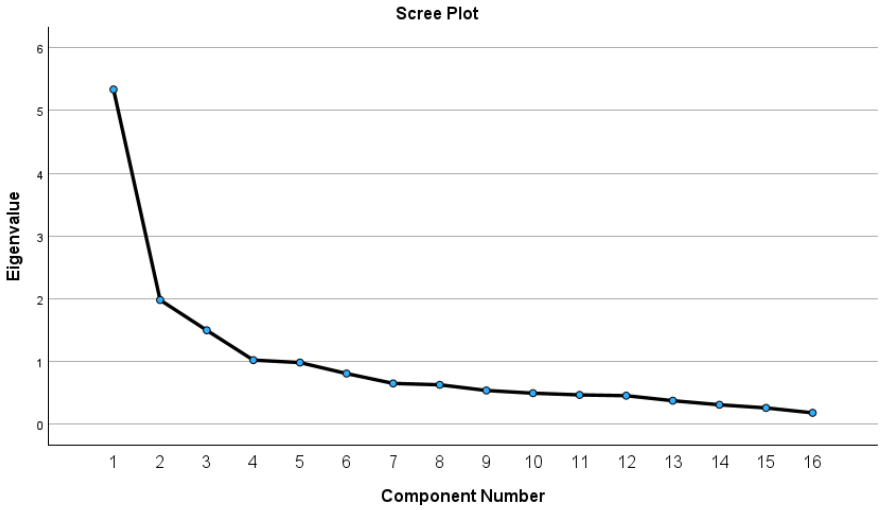
	Initial	Extraction
Body Weight	1.000	.713
Menstruation	1.000	.558
Restriction of food intake (fasting)	1.000	.700
Binge eating	1.000	.697
Vomiting	1.000	.481
Purging	1.000	.748
Hyperactivity	1.000	.454
Family relations	1.000	.595
Emancipation from family	1.000	.528
Friends	1.000	.662
School/employment record	1.000	.796
Sexual attitude	1.000	.751
Sexual behavior	1.000	.550
Mental state (mood)	1.000	.337
Preoccupation with food and weight	1.000	.711
Body perception	1.000	.558

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.337	33.356	33.356	5.337	33.356	33.356	3.216	20.103	20.103
2	1.981	12.382	45.738	1.981	12.382	45.738	2.807	17.544	37.647
3	1.498	9.363	55.101	1.498	9.363	55.101	2.313	14.453	52.100
4	1.023	6.394	61.495	1.023	6.394	61.495	1.503	9.394	61.495
5	.984	6.148	67.643						
6	.808	5.053	72.696						
7	.651	4.071	76.767						
8	.629	3.933	80.700						
9	.539	3.368	84.068						
10	.495	3.097	87.165						
11	.468	2.925	90.090						
12	.456	2.848	92.938						
13	.376	2.349	95.287						
14	.311	1.943	97.230						
15	.261	1.630	98.860						
16	.182	1.140	100.000						

Extraction Method: Principal Component Analysis.



Component Matrix[a]

	Component			
	1	2	3	4
Sexual behavior	.719			
Preoccupation with food and weight	.714			
Restriction of food intake (fasting)	.679			
Menstruation	.649			
Body Weight	.635			
Emancipation from family	.633			
Body perception	.629			
School/employment record	.608		.538	
Sexual attitude	.603		.536	
Hyperactivity	.547			
Family relations	.539			
Mental state (mood)				
Purging		.726		
Binge eating		.726		
Vomiting		.525		
Friends				.604

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
Restriction of food intake (fasting)	.814			
Preoccupation with food and weight	.735			
Body Weight	.700			
Menstruation	.640			
Body perception	.548			
Mental state (mood)				
School/employment record		.880		
Sexual attitude		.821		
Emancipation from family		.612		
Sexual behavior		.548		
Hyperactivity				
Purging			.844	
Binge eating			.826	
Vomiting			.657	
Friends				.747
Family relations				.588

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

a. Rotation converged in 5 iterations.

Component Transformation Matrix

Component	1	2	3	4
1	.672	.577	.331	.326
2	-.031	-.404	.904	-.138
3	-.717	.638	.272	.074
4	-.183	-.312	-.004	.932

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

Factor Analysis

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Body Weight	2.52	1.337	217
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Family relations	2.35	.761	217
Emancipation from family	2.30	.731	217
Friends	2.53	.752	217
School/employment record	2.28	.810	217
Sexual attitude	2.28	.815	217
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Mental state (mood)	2.59	.689	217
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Body perception	2.21	.727	217

The descriptive statistics provide an overview of the distribution and characteristics of the variables being analyzed.
We have a samples size 217 which is considered enough to provide reliability for our analysis.
The mean provides us with the measure of the central tendency or typical value of the data.
The standard deviation measures indicates the spread or dispersion of a dataset around its mean value. providing us with information about the typical distance of the data points from the mean.
The mean of every variable has its corresponding standard deviation measuring the distance of the data points from the mean.
For example, the variable "Body Weight" has a mean of 2.52 corresponding to the standard deviation of 1.37,

d.(i)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.837
Bartlett's Test of Sphericity	Approx. Chi-Square	1341.664
	df	120
	Sig.	<.001

Communalities

	Initial	Extraction
Body Weight	1.000	.713
Menstruation	1.000	.558
Restriction of food intake (fasting)	1.000	.700
Binge eating	1.000	.697
Vomiting	1.000	.481
Purging	1.000	.748
Hyperactivity	1.000	.454
Family relations	1.000	.595
Emancipation from family	1.000	.528
Friends	1.000	.662
School/employment record	1.000	.796
Sexual attitude	1.000	.751
Sexual behavior	1.000	.550
Mental state (mood)	1.000	.337
Preoccupation with food and weight	1.000	.711
Body perception	1.000	.558

Extraction Method: Principal Component Analysis.

KMO measures the proportion of variance in the variable that might be caused by an underlying factor. KMO test whether the partial correlations among the 16 symptoms/ variable are small. From the table above, KMO value is $0.837 > 0.5$ and is considered excellent result which insures us this study may conduct a factor analysis.

Bartlett's test whether the correlation is an identity matrix(the diagonal values are 1s and the off-diagonals values are 0s). This condition just means that the variables are completely independent of each other, and thus the factor model is Inappropriate. Identity matrix can be ruled out if the p-value of the test is less than 0.005.

In our case we notice that sig. $< .005$ meaning that factors that form the variable is satisfactory,The outcome reveals that there is no strong correlation among the 16 symptoms/variable.

Communalities table: In the context of factor analysis, a communalities table provides information about the amount of variance in each variable that is accounted for by the extracted factors. It ranges from 0 to 1, with 1 indicating that the variable is fully explained by the factors, and 0 indicating that the variable is not explained at all by the factors.

So in this case the extraction values are generally high which suggests that a large portion of the variance in that variable is accounted for by the extracted factors therefore this is a good extraction. However the extraction corresponding to mental state/mood is less than 0.5(close to 0), indicating that the extracted factors do not explain much of the variance in that variable(mental state/mood).

(ii)

Correlation Matrix

		Body Weight	Menstruation	Restriction of food intake (fasting)	Binge eating	Vomiting	Purging	Hyperactivity	Family relations	Emancipation from family	Friends
Correlation	Body Weight	1.000	.452	.576	-.037	.094	.103	.376	.300	.342	.143
	Menstruation	.452	1.000	.545	.059	.131	.090	.219	.386	.395	.276
	Restriction of food intake (fasting)	.576	.545	1.000	.077	.181	.230	.310	.348	.297	.200
	Binge eating	-.037	.059	.077	1.000	.319	.678	.162	-.018	.056	.183
	Vomiting	.094	.131	.181	.319	1.000	.442	.247	-.009	.156	.186
	Purging	.103	.090	.230	.678	.442	1.000	.301	-.001	.166	.138
	Hyperactivity	.376	.219	.310	.162	.247	.301	1.000	.238	.360	.180
	Family relations	.300	.386	.348	-.018	-.009	-.001	.238	1.000	.445	.342
	Emancipation from family	.342	.395	.297	.056	.156	.166	.360	.445	1.000	.283
	Friends	.143	.276	.200	.183	.186	.138	.180	.342	.283	1.000
	School/employment record	.390	.310	.253	.113	.126	.131	.321	.270	.482	.302
	Sexual attitude	.318	.326	.212	.078	.190	.089	.220	.278	.435	.372
	Sexual behavior	.403	.350	.407	.178	.333	.249	.416	.321	.457	.298
	Mental state (mood)	.281	.288	.331	.207	.237	.220	.109	.133	.064	.149
	Preoccupation with food and weight	.429	.466	.586	.268	.294	.343	.278	.347	.360	.273
	Body perception	.300	.370	.383	.203	.333	.236	.289	.344	.272	.293
Sig. (1-tailed)	Body Weight		<.001	<.001	.293	.083	.066	<.001	<.001	<.001	.017
	Menstruation	.000		.000	.193	.027	.094	.001	.000	.000	.000
	Restriction of food intake (fasting)	.000	.000		.131	.004	.000	.000	.000	.000	.002
	Binge eating	.293	.193	.131		.000	.000	.008	.394	.208	.003
	Vomiting	.083	.027	.004	.000		.000	.000	.448	.011	.003
	Purging	.066	.094	.000	.000	.000		.000	.495	.007	.021

Friends	School/employment record	Sexual attitude	Sexual behavior	Mental state (mood)	Preoccupation with food and weight	Body perception
.143	.390	.318	.403	.281	.429	.300
.276	.310	.326	.350	.288	.466	.370
.200	.253	.212	.407	.331	.586	.383
.183	.113	.078	.178	.207	.268	.203
.186	.126	.190	.333	.237	.294	.333
.138	.131	.089	.249	.220	.343	.236
.180	.321	.220	.416	.109	.278	.289
.342	.270	.278	.321	.133	.347	.344
.283	.482	.435	.457	.064	.360	.272
1.000	.302	.372	.298	.149	.273	.293
.302	1.000	.786	.430	.176	.182	.166
.372	.786	1.000	.465	.197	.197	.229
.298	.430	.465	1.000	.271	.416	.412
.149	.176	.197	.271	1.000	.414	.305
.273	.182	.197	.416	.414	1.000	.556
.293	.166	.229	.412	.305	.556	1.000
.017	<.001	<.001	<.001	<.001	<.001	<.001
.000	.000	.000	.000	.000	.000	.000
.002	.000	.001	.000	.000	.000	.000
.003	.049	.126	.004	.001	.000	.001
.003	.032	.002	.000	.000	.000	.000
.021	.027	.096	.000	.001	.000	.000

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A correlation matrix is a table that displays the correlation coefficients between all possible pairs of variables in a dataset. The correlation matrix above represent the correlation among each 16 symptoms of the given data.This matrix shows the correlation coefficients between each pair of variables with the diagonal elements (1.000) representing the correlation of each variable with itself, which is always 1 and off-diagonal elements showing the correlation coefficients between different variables. We notice there is positive correlation among most of the variables(e.g Menstruation and body weight;Restriction of food intake/fasting and sexual behavior; etc...) which means that When one variable increases, the other variable also tends to increase. Similarly there are few negative correlation among variables (e.g Binge eating and body weight; Binge eating and family relation; etc...) meaning when one variable decreases, the other variable also tends to decrease.

We notice there is a strong positive relationship between sexual behavior and school/employment record and a moderate positive relationship between Binge eating and purging. In overall there weak correlation between variables.

(iii)

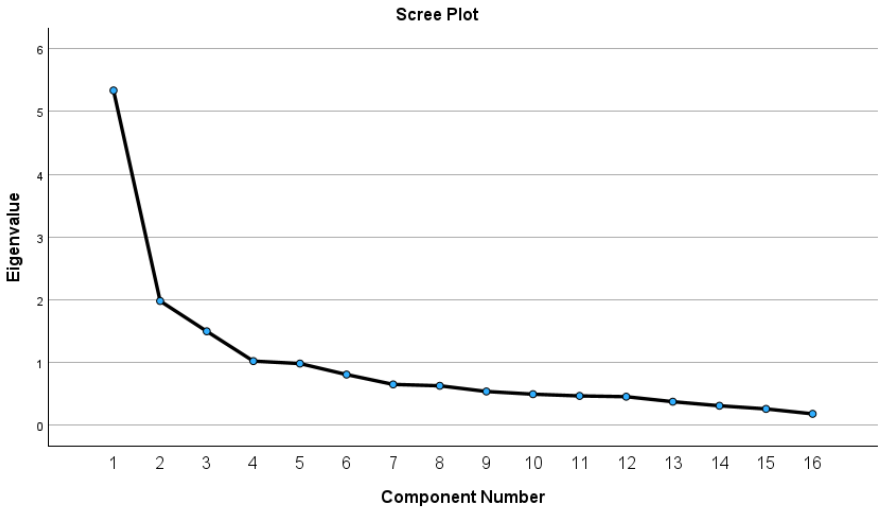
Total Variance Explained

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	5.337	33.356	33.356	5.337	33.356	33.356	3.216	20.103	20.103
2	1.981	12.382	45.738	1.981	12.382	45.738	2.807	17.544	37.647
3	1.498	9.363	55.101	1.498	9.363	55.101	2.313	14.453	52.100
4	1.023	6.394	61.495	1.023	6.394	61.495	1.503	9.394	61.495
5	.984	6.148	67.643						
6	.808	5.053	72.696						
7	.651	4.071	76.767						
8	.629	3.933	80.700						
9	.539	3.368	84.068						
10	.495	3.097	87.165						
11	.468	2.925	90.090						
12	.456	2.848	92.938						
13	.376	2.349	95.287						
14	.311	1.943	97.230						
15	.261	1.630	98.860						
16	.182	1.140	100.000						

Extraction Method: Principal Component Analysis.

The Total Variance Explained table above provides information about the total variance in the data that is accounted for by the principal components (or factors) extracted from the analysis. For example, the first principal component has a total eigenvalue of 5.337, which accounts for 33.356% of the total variance. In conclusion, About 61% of the total variation is explained by the three principal component(or factors)

(iv)



The Scree Plot displays the eigenvalues (also called the "Eigengrowth") on the y-axis, plotted against the component number on the x-axis. Eigenvalues represent the amount of variance in the data that is explained by each principal component.
The plot shows the eigenvalues for the 16 principal components extracted from the data. The eigenvalues generally decrease as the component number increases, forming a 'scree' or sloping line. The point at which the slope of the line changes dramatically, often referred to as the "elbow" or "inflection point", is used to determine the optimal number of principal components to retain. In this case, the plot shows a clear elbow after the first 3-4 components, indicating that these initial components explain the majority of the variance in the data. The subsequent components have much smaller eigenvalues and contribute less to the overall variance explained.

(v)

Component Matrix[a]

	Component			
	1	2	3	4
Sexual behavior	.719			
Preoccupation with food and weight	.714			
Restriction of food intake (fasting)	.679			
Menstruation	.649			
Body Weight	.635			
Emancipation from family	.633			
Body perception	.629			
School/employment record	.608		.538	
Sexual attitude	.603		.536	
Hyperactivity	.547			
Family relations	.539			
Mental state (mood)				
Purging		.726		
Binge eating		.726		
Vomiting		.525		
Friends				.604

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

Component Matrix, which is a key output of Principal Component Analysis (PCA). The Component Matrix displays the factor loadings, which represent the correlations between the original variables and the extracted principal components.

The variable "Sexual behavior" has a factor loading of 0.719 on the first principal component, indicating a strong positive correlation. The variable "Purging" has a factor loading of 0.726 on the third principal component, indicating a strong positive correlation. The variable "Friends" has a factor loading of 0.604 on the fourth principal component, indicating a moderately strong positive correlation.

(vi)

Rotated Component Matrix[a]

	Component			
	1	2	3	4
Restriction of food intake (fasting)	.814			
Preoccupation with food and weight	.735			
Body Weight	.700			
Menstruation	.640			
Body perception	.548			
Mental state (mood)				
School/employment record		.880		
Sexual attitude		.821		
Emancipation from family		.612		
Sexual behavior		.548		
Hyperactivity				
Purging			.844	
Binge eating			.826	
Vomiting			.657	
Friends				.747
Family relations				.588

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

a. Rotation converged in 5 iterations.

The Rotated Component Matrix as another key output of Principal Component Analysis, provides the factor loadings of the variables on the rotated principal components. The Varimax Rotation method is are used to enhance the interpretability of the principal components by maximizing the loading of each variable on one component while minimizing its loadings on the other components.

The variable "Restriction of food intake (fasting)" has a high factor loading of 0.814 on the first rotated principal component, indicating a strong positive correlation with this component. The variable "Purging" has a high factor loading of 0.844 on the third rotated principal component, indicating a strong positive correlation with this component. The variable "Friends" has a factor loading of 0.747 on the fourth rotated principal component, indicating a moderately strong positive correlation with this component.

(vi)

Component Transformation Matrix

Component	1	2	3	4
1	.672	.577	.331	.326
2	-.031	-.404	.904	-.138
3	-.717	.638	.272	.074
4	-.183	-.312	-.004	.932

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

The Component Transformation Matrix represents the coefficients used to transform the original principal components into the rotated principal components. In this case the coefficient 0.672 for the transformation from the first original component to the first rotated component indicates a strong positive contribution of the first original component to the first rotated component. The coefficient -0.404 for the transformation from the second original component to the second rotated component indicates a moderate negative contribution of the second original component to the second rotated component.
The coefficient 0.932 for the transformation from the fourth original component to the fourth rotated component indicates a strong positive contribution of the fourth original component to the fourth rotated component.

e.

i

Sample size: The sample size is generally, a larger sample size which is preferred to ensure the reliability and stability of the results.

ii

Form the Rotated Component Matrix, we can see that there are several variables with relatively high factor loadings (e.g., 0.814, 0.844, 0.747), indicating the presence of correlation between the variables.
This suggests that the data may be suitable for factor analysis, as the variables appear to be related and share common underlying factors.

iii

Looking at the communalities table, All the variables have an initial communality of 1.000, which indicates that the factor analysis model is able to account for 100% of the variance in each variable initially. This suggests that the variables are highly correlated and likely share common underlying factors, making the data suitable for factor analysis.

iv

From the total variation explained, The proportion of total variance explained by the extracted factors is also an important consideration. Higher explained variance (e.g., 60% or more) suggests that the factor analysis model is capturing a substantial amount of the original data's variability.

v

Our Factor analysis typically retains factors with eigenvalues greater than 1 and these factors are considered to be meaningful and significant.

f.

The essence of the rotated factor solution in this context is to provide a more interpretable and meaningful representation of the underlying factors in the our dataset.
In factor analysis, the initial extracted factors often exhibit complex structure, with many variables loading significantly on multiple factors. The rotation of the factor solution aims to transform the initial factor structure into a simpler, more interpretable form.
Rotation seeks to align the factors with the original variables in a way that maximizes the loadings of each variable on a single factor.
The rotation process adjusts the orientation of the factors to maximize the factor loadings of the variables. High factor loadings indicate a strong relationship between the variable and the corresponding factor. By maximizing the factor loadings, the rotated solution highlights the most important relationships between the variables and the factors.
where in our case we use the Orthogonal rotation (varimax) which assumes that the factors are uncorrelated (independent) with each other