Homework

A researcher seeks to examine the data from a questionnaire to uncover its underlying structure. The questionnaire consists of 20 questions, completed by 200 participants. The assignment requires you to carry out the following tasks and provide explanations for each:
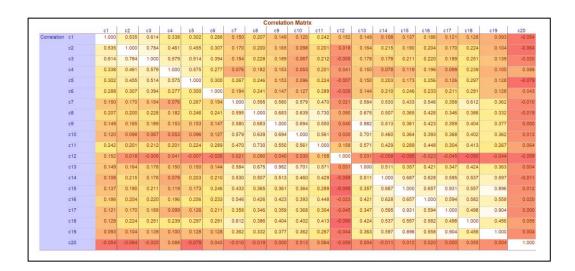
1. **Perform an exploratory factor analysis (EFA) in SPSS/JASP to determine how many factors can be derived from the 20 items and identify which items correspond to each factor.**

   Principle Axis Factoring was used to perform an EFA, the number of factors extracted is based on <u>Parallel analysis</u>, rotation method is Promax. <u>3 factors</u> were derived from the 20 items. C13/9/8/10/11/7 corresponded to Factor 1, C15/17/19/16/14/18 corresponded to Factor 2, C23/2/4/1/5/6 corresponded to Factor 3. However, C12 and C20 had no positive correlation with any of the three factors.

Factor Loadings ▼				
	Factor 1	Factor 2	Factor 3	Uniqueness
c13	0.9609			0.1828
c9	0.9450			0.1994
c8	0.8177			0.3272
c10	0.8102			0.3812
c11	0.7005			0.4754
c7	0.6370			0.4693
c15		0.9908		0.0181
c17		0.9273		0.1380
c19		0.8861		0.2019
c16		0.5241		0.4541
c14		0.5142		0.4096
c18		0.4106		0.5418
c3			0.9341	0.1579
c2			0.7939	0.3799
c4			0.6585	0.5726
c1			0.6062	0.6204
c5			0.6060	0.6027
c6			0.4017	0.7819
c12				0.9761
c20				0.9990

   Note. Applied rotation method is promax.

2. Assess which items are not suitable for the inclusion in the questionnaire and suggest ways to improve it.

Check correlation matrix below, and easily C12 and C20 were identified to have low correlation with other items.

Correlation Matrix

Correlation	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c12	c13	c14	c15	c16	c17	c18	c19	c20
c1	1.000	0.535	0.614	0.338	0.302	0.288	0.150	0.207	0.149	0.120	0.242	0.152	0.149	0.108	0.137	0.186	0.121	0.128	0.093	-0.054
c2	0.535	1.000	0.784	0.461	0.455	0.307	0.170	0.200	0.165	0.098	0.201	0.018	0.164	0.215	0.190	0.204	0.170	0.224	0.104	-0.064
c3	0.614	0.784	1.000	0.579	0.514	0.394	0.154	0.228	0.189	0.067	0.212	-0.005	0.178	0.178	0.211	0.220	0.189	0.251	0.139	-0.020
c4	0.338	0.461	0.579	1.000	0.575	0.277	0.076	0.182	0.153	0.053	0.201	0.041	0.150	0.078	0.119	0.196	0.099	0.239	0.100	0.088
c5	0.302	0.455	0.514	0.575	1.000	0.300	0.267	0.246	0.153	0.096	0.224	-0.007	0.150	0.203	0.173	0.256	0.126	0.297	0.128	-0.079
c6	0.288	0.307	0.394	0.277	0.300	1.000	0.194	0.241	0.147	0.127	0.289	-0.026	0.144	0.210	0.246	0.233	0.211	0.291	0.128	0.043
c7	0.150	0.170	0.154	0.076	0.267	0.194	1.000	0.595	0.580	0.579	0.470	0.021	0.584	0.530	0.433	0.546	0.358	0.612	0.362	-0.010
c8	0.207	0.200	0.228	0.182	0.246	0.241	0.595	1.000	0.683	0.639	0.730	0.090	0.675	0.507	0.365	0.426	0.346	0.386	0.332	-0.019
c9	0.149	0.165	0.189	0.153	0.153	0.147	0.580	0.683	1.000	0.694	0.550	0.040	0.982	0.513	0.361	0.423	0.359	0.404	0.377	0.000
c10	0.120	0.098	0.067	0.053	0.096	0.127	0.579	0.639	0.694	1.000	0.561	0.030	0.701	0.460	0.364	0.393	0.368	0.402	0.362	0.013
c11	0.242	0.201	0.212	0.201	0.224	0.289	0.470	0.730	0.550	0.561	1.000	0.158	0.571	0.429	0.289	0.448	0.304	0.413	0.267	0.064
c12	0.152	0.018	-0.005	0.041	-0.007	-0.026	0.021	0.090	0.040	0.030	0.158	1.000	0.031	-0.058	-0.095	-0.023	-0.045	-0.090	-0.044	-0.059
c13	0.149	0.164	0.178	0.150	0.150	0.144	0.584	0.675	0.982	0.701	0.571	0.031	1.000	0.511	0.357	0.421	0.347	0.424	0.363	0.004
c14	0.108	0.215	0.178	0.078	0.203	0.210	0.530	0.507	0.513	0.460	0.429	-0.058	0.511	1.000	0.687	0.628	0.595	0.537	0.597	-0.011
c15	0.137	0.190	0.211	0.119	0.173	0.246	0.433	0.365	0.361	0.364	0.289	-0.095	0.357	0.687	1.000	0.657	0.931	0.557	0.896	0.012
c16	0.186	0.204	0.220	0.196	0.256	0.233	0.546	0.426	0.423	0.393	0.448	-0.023	0.421	0.628	0.657	1.000	0.594	0.582	0.558	0.020
c17	0.121	0.170	0.189	0.099	0.126	0.211	0.358	0.346	0.359	0.368	0.304	-0.045	0.347	0.595	0.931	0.594	1.000	0.498	0.904	0.000
c18	0.128	0.224	0.251	0.239	0.297	0.291	0.612	0.386	0.404	0.402	0.413	-0.090	0.424	0.537	0.557	0.582	0.498	1.000	0.456	0.055
c19	0.093	0.104	0.139	0.100	0.128	0.128	0.362	0.332	0.377	0.362	0.267	-0.044	0.363	0.597	0.896	0.558	0.904	0.456	1.000	0.004
c20	-0.054	-0.064	-0.020	0.088	-0.079	0.043	-0.010	-0.019	0.000	0.013	0.064	-0.059	0.004	-0.011	0.012	0.020	0.000	0.055	0.004	1.000

Having excluded C12 and C20, the correlation matrix seemed acceptable(see below).

Correlation Matrix

Correlation	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c13	c14	c15	c16	c17	c18	c19
c1	1.000	0.535	0.614	0.338	0.302	0.288	0.150	0.207	0.149	0.120	0.242	0.149	0.108	0.137	0.186	0.121	0.128	0.093
c2	0.535	1.000	0.784	0.461	0.455	0.307	0.170	0.200	0.165	0.098	0.201	0.164	0.215	0.190	0.204	0.170	0.224	0.104
c3	0.614	0.784	1.000	0.579	0.514	0.394	0.154	0.228	0.189	0.067	0.212	0.178	0.178	0.211	0.220	0.189	0.251	0.139
c4	0.338	0.461	0.579	1.000	0.575	0.277	0.076	0.182	0.153	0.053	0.201	0.150	0.078	0.119	0.196	0.099	0.239	0.100
c5	0.302	0.455	0.514	0.575	1.000	0.300	0.267	0.246	0.153	0.096	0.224	0.150	0.203	0.173	0.256	0.126	0.297	0.128
c6	0.288	0.307	0.394	0.277	0.300	1.000	0.194	0.241	0.147	0.127	0.289	0.144	0.210	0.246	0.233	0.211	0.291	0.128
c7	0.150	0.170	0.154	0.076	0.267	0.194	1.000	0.595	0.580	0.579	0.470	0.584	0.530	0.433	0.546	0.358	0.612	0.362
c8	0.207	0.200	0.228	0.182	0.246	0.241	0.595	1.000	0.683	0.639	0.730	0.675	0.507	0.365	0.426	0.346	0.386	0.332
c9	0.149	0.165	0.189	0.153	0.153	0.147	0.580	0.683	1.000	0.694	0.550	0.982	0.513	0.361	0.423	0.359	0.404	0.377
c10	0.120	0.098	0.067	0.053	0.096	0.127	0.579	0.639	0.694	1.000	0.561	0.701	0.460	0.364	0.393	0.368	0.402	0.362
c11	0.242	0.201	0.212	0.201	0.224	0.289	0.470	0.730	0.550	0.561	1.000	0.571	0.429	0.289	0.448	0.304	0.413	0.267
c13	0.149	0.164	0.178	0.150	0.150	0.144	0.584	0.675	0.982	0.701	0.571	1.000	0.511	0.357	0.421	0.347	0.424	0.363
c14	0.108	0.215	0.178	0.078	0.203	0.210	0.530	0.507	0.513	0.460	0.429	0.511	1.000	0.687	0.628	0.595	0.537	0.597
c15	0.137	0.190	0.211	0.119	0.173	0.246	0.433	0.365	0.361	0.364	0.289	0.357	0.687	1.000	0.657	0.931	0.557	0.896
c16	0.186	0.204	0.220	0.196	0.256	0.233	0.546	0.426	0.423	0.393	0.448	0.421	0.628	0.657	1.000	0.594	0.582	0.558
c17	0.121	0.170	0.189	0.099	0.126	0.211	0.358	0.346	0.359	0.368	0.304	0.347	0.595	0.931	0.594	1.000	0.498	0.904
c18	0.128	0.224	0.251	0.239	0.297	0.291	0.612	0.386	0.404	0.402	0.413	0.424	0.537	0.557	0.582	0.498	1.000	0.456
c19	0.093	0.104	0.139	0.100	0.128	0.128	0.362	0.332	0.377	0.362	0.267	0.363	0.597	0.896	0.558	0.904	0.456	1.000

Factor analysis(Principle Axis Factoring) was performed on the remaining 18 items, and it was noted that the difference in cross loadings of C18 and C14 (see right) was less than 0.2, so they were deleted. The remaining 16 items passed the KMO test, Bartlett's test, and the MSA values also met the requirements, with the difference of cross loadings greater than 0.2 and the maximum factor loading of each item greater than 0.4.

Pattern Matrix[a]

Factor

	1	2	3
c13	0.958	-0.079	-0.050
c9	0.940	-0.065	-0.045
c8	0.809	-0.032	0.076
c10	0.801	0.031	-0.120
c11	0.687	-0.031	0.125
c7	0.620	0.168	0.016
c15	-0.106	1.045	0.001
c17	-0.088	0.982	-0.027
c19	-0.054	0.941	-0.080
c16	0.240	0.543	0.097
c14	0.334	0.536	-0.002
c18	0.284	0.413	0.145
c3	-0.078	-0.008	0.947
c2	-0.038	-0.006	0.798
c4	-0.009	-0.043	0.667
c1	0.035	-0.049	0.613
c5	0.043	0.012	0.611
c6	0.060	0.099	0.402

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser
a. Rotation converged in 5 iterations.

Check the Factor correlations matrix, and the result showed that using promax to rotate the axis is appropriate.

Factor Correlation Matrix

Factor	1	2	3
1	1.000	.476	.290
2	.476	1.000	.244
3	.290	.244	1.000

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.

3. **Conduct the factor analysis again, excluding the items that were deemed inadequate.**

Exclude C12/C20/C14/C18 and conduct the factor analysis again. The correlation matrix has been shown above, overall MSA is 0.833, each item's MSA was larger than 0.5, and the result of Bartlett's Test and Chi-squared Tess were significant.

Factor loadings are represented below, which clearly shows that 16 items were divided into three groups, each of them corresponding to a latent factor.

Pattern Matrix[a]

	Factor		
	1	2	3
c13	0.948	-0.060	-0.042
c9	0.932	-0.044	-0.037
c8	0.804	-0.019	0.086
c10	0.797	0.043	-0.112
c11	0.681	-0.023	0.131
c7	0.618	0.141	0.026
c15	-0.035	0.996	0.023
c17	-0.034	0.976	-0.011
c19	-0.001	0.930	-0.063
c16	0.272	0.492	0.112
c3	-0.069	0.000	0.945
c2	-0.031	-0.006	0.798
c4	-0.003	-0.035	0.659
c1	0.039	-0.031	0.611
c5	0.050	0.002	0.607
c6	0.069	0.088	0.402

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

4. **Use the regression method to compute factor scores and check their correlations.**

The factor correlation matrix which was calculated by SPSS is shown below. So the promax method is appropriate in this case.

Factor Correlation Matrix

Factor	1	2	3
1	1.000	0.476	0.290
2	0.476	1.000	0.244
3	0.290	0.244	1.000

Extraction Method: Principal Axis Factoring.