



LCDB7011 Quantitative Research Methods

Week 6&7 – Moving beyond the Basics
Validity and Reliability

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Agenda

Upon completion of the class, you should be able to understand

➤ Validity of Data

- Correlation Analysis (for Construct validity), and
- Factor Analysis

➤ Reliability of Data

Cronbach's Alpha

Validity of Data

“Validity determines whether the research truly measures what it was intended to measure or how truthful the research results are. In other words, does the research instrument allow you to hit “the bull’s eye” of your research object?” (Joppe, 2000, p.1).

To achieve validity, two forms of analyses would be carried out:

- Correlation Analysis (for Construct validity), and
- Factor Analysis

Correlation Analysis

- Understanding how to run Correlation Analysis
- Correlation ranges between -1 and +1
 - +ve correlation = X correlates positively with Y
 - ve correlation = X correlates negatively with Y

Correlation Analysis

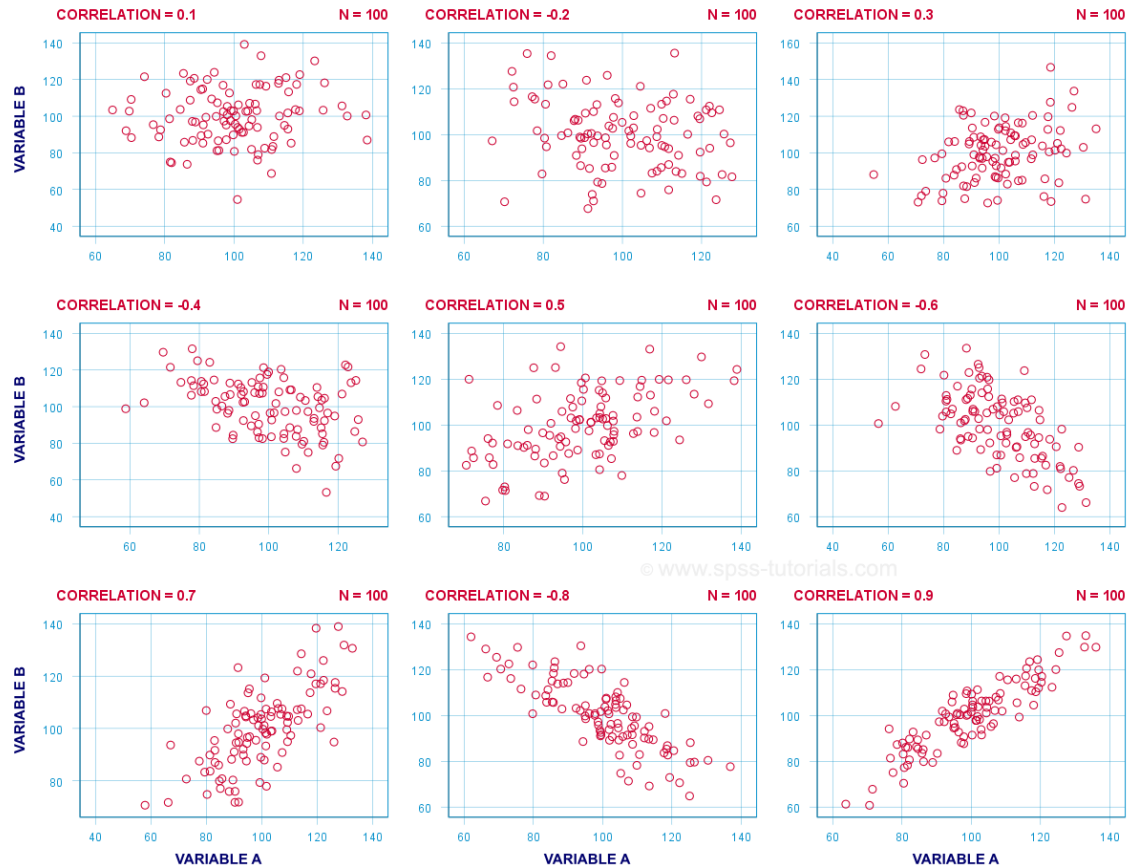
- Correlation Analysis can be used to:
 1. Understand inter-item correlation of measurement items (or variables) for a construct. Checking the commonality between the items (variables) for a construct (factor).
 2. To understand the degree of correlation between the constructs.

Correlation Analysis

- Correlation analysis of the measurement variables should be done before doing the factor analysis (Rummel, 1970; Rietveld & Van Hout, 1993).
- The correlation technique should be used to check the strength and direction of associations between variables, and validate data to ensure parsimony towards (Hair et al, 1992):
 - ❑ Checking the strength of the relationships,
 - ❑ Examining the statistical significance of the relationships
- Near zero values indicate weak relationships, while values nearer to +1 or -1 suggest stronger relationship (Field, 2005)

Correlations

(PEARSON CORRELATIONS) VISUALIZED AS SCATTERPLOTS



- A Pearson correlation is a number between -1 and +1 that indicates to what extent 2 metric variables are linearly related.
- A Pearson's correlation coefficient (r) is a **measure of the strength of the association** between the two variables.
- It does not matter which measuring units the variables are in (can be different scales) as long as the relation is linear

04 Correlation in SPSS – SPSS for Beginners

Correlations

The correlation between two variables X and Y is defined as the **covariance** of X with Y (covarXY) divided by the product of the standard deviation of X (stdevX) and the standard deviation of Y (stdevY):

$$r = \text{covarXY} / (\text{stdevX} \cdot \text{stdevY}).$$

$$r = \text{covarX,Y} / \sigma_X \sigma_Y$$

- Variance: the mean value of all the differences from the mean multiplied by themselves (=squared)
- Covariance: The mean value of all the pairs of differences from the mean for X multiplied by the differences from the mean for Y.
- If X and Y aren't closely related to each other, they don't *co-vary*, so the covariance is small, so the correlation is small.

Correlations

		Wechsel IQ Test Score	Depression Test Score	Anxiety Test Score	Social Functioning Test Score	Ge Beir
Wechsel IQ Test Score	Pearson Correlation	1	.121	.152	-.151	
	Sig. (2-tailed)		.194	.110	.104	
	N	122	116	112	117	
Depression Test Score	Pearson Correlation	.121	1	.282**	-.328**	
	Sig. (2-tailed)	.194		.003	.000	
	N	116	122	112	116	
Anxiety Test Score	Pearson Correlation	.152	.282**	1	-.534**	
	Sig. (2-tailed)	.110	.003		.000	
	N	112	112	117	111	
Social Functioning Test Score	Pearson Correlation	-.151	-.328**	-.534**	1	
	Sig. (2-tailed)	.104	.000	.000		
	N	117	116	111	122	
Generall Well Being Test Score	Pearson Correlation	-.080	-.801**	-.296**	.333**	
	Sig. (2-tailed)	.393	.000	.001	.000	
	N	117	117	113	117	

The correlations on the main diagonal are the correlations between each variable and itself - which is why they are all 1 and not interesting at all.

The 10 correlations *below* the diagonal are what we need. As a rule of thumb, a correlation is statistically significant if its “Sig. (2-tailed)” < 0.05.

You would report a correlation like this:

** . Correlation is significant at the 0.01 level (2-tailed). © 2017 www.spss-tutorials.com

Table X. Pearson Correlations Among Psychological Test Scores

	1	2	3	4	5
1. Wechsel IQ Test Score	-				
2. Depression Test Score	.082	-			
3. Anxiety Test Score	.378**	.222*	-		
4. Social Functioning Test Score	-.077	-.328**	-.405**	-	
5. Generall Well Being Test Score	-.037	-.801**	-.226*	.333**	-

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed). © 2017 www.spss-tutorials.com

Correlation Analysis can also be used to:

To gauge relationship (association) between two factors. In other words, to test hypotheses.

- Correlation Analysis is not adequate for testing hypotheses because it does not consider associated multi-collinearity factors. Thus, discriminant validity cannot be ensured.

Factor Analysis

- As Gorsuch (1983) commented, “all scientists are united in a common goal: they seek to summarise data so that the empirical relationships can be grasped by the human mind” (p. 2).
- Factor Analysis:
 1. Analytical approach designed to analyze interrelationships (Reyment & Joreskog, 1993),
 2. a number of related statistical techniques which help determine characteristics that go together (Bryman & Cramer, 1990).

Factor Analysis

- In other words, factor analysis involves a set of procedures and enables the reduction of number of variables into a smaller set of factors. It involves determining the latent variables for a factor (Field, 2009)
- Factor analysis enables the researcher: (1) gain a clear view of the data, and (2) use the output in subsequent analyses (Rummel, 1970; Field, 2000; Rietveld & Van Hout, 1993; Field, 2005). [factor analysis spss - Google Search](#)

Factor Analysis

The screenshot shows the SPSS software interface. The 'Analyze' menu is open, and the 'Dimension Reduction' option is highlighted with a red oval. A sub-menu is also open for 'Dimension Reduction', with the 'Factor...' option highlighted by another red oval. The background shows a data table with columns 'id', 'JS1', 'OC1', 'EP2', 'EP3', 'AC1', 'EP4', and 'JS2'.

id	JS1	OC1	EP2	EP3	AC1	EP4	JS2
1	5	3	0	5	1	6	4
2	3	0	0	10	2	7	4
3	4	6	0	10	1	7	2
4	4	7	0	9	2	7	5
5	5	2	9	10	1	6	4
6	6	5	0	7	1	7	6
7	2	6	9	9	2	6	3
8	2	4	0	10	1	7	2
9	4	9	3	8	3	3	5
10	5	5	0	8	2	7	3
11	4	9	0	9	4	7	7
12	5	4	0	9	4	7	4
13	2	1	9	8	1	5	4
14	4	0	3	8	1	5	4
15	4	7					4
16	4	4					4
17	3	4					4
18	5	7					6
19	3	7					2
20	5	6	0	9	1	7	4

Statistics

- ☐ Univariate descriptives
☒ Initial solution

Correlation Matrix

- ☒ Coefficients ☐ Inverse
☒ Significance levels ☐ Reproduced
☒ Determinant ☐ Anti-image
☒ KMO and Bartlett's test of sphericity

☐ Covariance matrix

Continue

Cancel

Help

Factor Analysis: Extraction

Method: Principal components

Analyze

- ☒ Correlation matrix
☐ Covariance matrix

Display

- ☒ Unrotated factor solution
☒ Scree plot

Extract

- ☒ Based on Eigenvalue

Eigenvalues greater than: 1

- ☐ Fixed number of factors

Factors to extract:

Maximum iterations for Convergence: 25

Continue

Cancel

Help

Factor Analysis: Options

Missing Values

☒ Exclude cases listwise

☐ Exclude cases pairwise

☐ Replace with mean

Coefficient Display Format

☒ Sorted by size

☐ Suppress small coefficients

Absolute value below: .10

Continue Cancel Help

Determinant
>.000001

Correlation Matrix ^a																									
		JS1	OC1	OC2	EP1	OC3	OC4	EP2	EP3	EP4	JS2	JS3	JS4	JS5	SI3	SI4	AC1	AC2	SI1	SI2	AC3	AC4	EXP - Experience in Years	JP - Performance	
Correlation	JS1	1.000	.063	.142	.065	.159	.162	.123	.104	.094	.557	.514	.511	.550	.046	.141	.041	.003	.114	.114	-.019	.020	.045	.037	
	OC1	.063	1.000	.524	.111	.444	.484	.229	.122	.229	.055	.075	.059	.083	.136	.176	.056	.104	.183	.190	.093	.128	.010	.205	
	OC2	.142	.524	1.000	.251	.558	.738	.373	.348	.332	.089	.132	.101	.188	.363	.459	.264	.211	.432	.473	.272	.288	.085	.239	
	EP1	.065	.111	.251	1.000	.236	.279	.596	.504	.567	.167	.146	.114	.159	.330	.377	.140	.159	.342	.371	.156	.153	-.020	.205	
	OC3	.159	.444	.558	.236	1.000	.566	.370	.315	.370	.110	.084	.130	.140	.202	.261	.134	.089	.226	.281	.121	.161	.061	.239	
	OC4	.162	.484	.738	.279	.566	1.000	.378	.290	.328	.091	.112	.095	.173	.304	.414	.151	.170	.379	.387	.206	.243	.049	.225	
	EP2	.123	.229	.373	.596	.370	.378	1.000	.614	.649	.168	.120	.115	.140	.347	.452	.173	.175	.349	.390	.164	.226	.019	.251	
	EP3	.104	.122	.348	.504	.315	.290	.614	1.000	.666	.157	.148	.113	.209	.299	.363	.186	.131	.293	.323	.151	.186	-.010	.240	
	EP4	.094	.229	.332	.567	.370	.328	.649	.666	1.000	.162	.149	.124	.153	.360	.391	.136	.158	.396	.369	.125	.201	.031	.267	
	JS2	.557	.055	.089	.167	.110	.091	.168	.157	.162	1.000	.498	.524	.559	.105	.151	-.004	-.015	.124	.126	-.027	.008	.057	.130	
	JS3	.514	.075	.132	.146	.084	.112	.120	.148	.149	.498	1.000	.509	.473	.161	.180	.044	.011	.150	.105	-.008	.068	.066	.135	
	JS4	.511	.059	.101	.114	.130	.095	.115	.113	.124	.524	.509	1.000	.513	.146	.168	.047	.013	.119	.090	.047	.051	.069	.143	
	JS5	.550	.083	.188	.159	.140	.173	.140	.209	.153	.559	.473	.513	1.000	.130	.213	.110	.078	.179	.171	.050	.115	.082	.141	
	SI3	.046	.136	.363	.330	.202	.304	.347	.299	.360	.105	.161	.146	.130	1.000	.670	.203	.166	.580	.625	.200	.195	.087	.107	
	SI4	.141	.176	.459	.377	.261	.414	.452	.363	.391	.151	.180	.168	.213	.670	1.000	.203	.205	.670	.725	.246	.254	.135	.092	
	AC1	.041	.056	.264	.140	.134	.151	.173	.186	.136	-.004	.044	.047	.110	.203	.203	1.000	.673	.230	.200	.691	.670	.061	.045	
	AC2	.003	.104	.211	.159	.089	.170	.175	.131	.158	-.015	.011	.013	.078	.166	.205	.673	1.000	.196	.192	.690	.671	.070	.015	
	SI1	.114	.183	.432	.342	.226	.379	.349	.293	.396	.124	.150	.119	.179	.580	.670	.230	.196	1.000	.733	.206	.207	.124	.071	
	SI2	.114	.190	.473	.371	.281	.387	.390	.323	.369	.126	.105	.090	.171	.625	.725	.200	.192	.733	1.000	.211	.225	.141	.093	
	AC3	-.019	.093	.272	.156	.121	.206	.164	.151	.125	-.027	-.008	.047	.050	.200	.246	.691	.690	.206	.211	1.000	.675	.079	.045	
	AC4	.020	.128	.288	.153	.161	.243	.226	.186	.201	.008	.068	.051	.115	.195	.254	.670	.671	.207	.225	.675	1.000	.212	.117	
	EXP - Experience in Years	.045	.010	.085	-.020	.061	.049	.019	-.010	.031	.057	.066	.069	.082	.087	.135	.061	.070	.124	.141	.079	.212	1.000	.107	
	JP - Performance	.037	.205	.239	.205	.239	.225	.251	.240	.267	.130	.135	.143	.141	.107	.092	.045	.015	.071	.093	.045	.117	.107	1.000	
Sig. (1-tailed)	JS1		.106	.002	.096	<.001	<.001	.007	.019	.031	<.001	<.001	<.001	<.001	.178	.002	.209	.475	.012	.011	.349	.345	.183	.229	
	OC1		.106		.000	.013	.000	.000	.007	.000	.138	.067	.122	.049	.003	.000	.132	.019	.000	.000	.031	.005	.424	.000	
	OC2		.002	.000		.000	.000	.000	.000	.000	.037	.004	.022	.000	.000	.000	.000	.000	.000	.000	.000	.000	.045	.000	
	EP1		.096	.013	.000		.000	.000	.000	.000	.000	.002	.011	.001	.000	.000	.003	.001	.000	.000	.001	.001	.345	.000	
	OC3		.001	.000	.000	.000		.000	.000	.000	.000	.014	.047	.005	.002	.000	.004	.037	.000	.000	.008	.001	.113	.000	
	OC4		.001	.000	.000	.000	.000		.000	.000	.000	.035	.012	.029	.000	.000	.001	.000	.000	.000	.000	.000	.166	.000	
	EP2		.007	.000	.000	.000	.000	.000		.000	.000	.000	.008	.011	.003	.000	.000	.000	.000	.000	.001	.000	.356	.000	
	EP3		.019	.007	.000	.000	.000	.000	.000		.000	.001	.002	.012	.000	.000	.000	.005	.000	.000	.001	.000	.419	.000	
	EP4		.031	.000	.000	.000	.000	.000	.000	.000		.001	.001	.006	.001	.000	.000	.003	.001	.000	.006	.000	.266	.000	
	JS2		.000	.138	.037	.000	.014	.035	.000	.001	.001		.000	.000	.000	.018	.001	.471	.383	.007	.006	.297	.436	.128	
	JS3		.000	.067	.004	.002	.047	.012	.008	.002	.001	.000		.000	.000	.001	.000	.192	.413	.001	.018	.435	.087	.096	
	JS4		.000	.122	.022	.011	.005	.029	.011	.012	.006	.000	.000		.000	.002	.000	.176	.395	.009	.037	.176	.156	.085	
	JS5		.000	.049	.000	.001	.002	.000	.003	.000	.001	.000	.000	.000		.005	.000	.014	.060	.000	.000	.160	.011	.051	
	SI3		.178	.003	.000	.000	.000	.000	.000	.000	.000	.018	.001	.002	.005		.000	.000	.000	.000	.000	.000	.041	.016	
	SI4		.002	.000	.000	.000	.000	.000	.000	.000	.000	.001	.000	.000	.000	.000		.000	.000	.000	.000	.000	.003	.033	
	AC1		.209	.132	.000	.003	.004	.001	.000	.000	.003	.471	.192	.176	.014	.000	.000		.000	.000	.000	.000	.111	.184	
	AC2		.475	.019	.000	.001	.037	.000	.000	.005	.001	.383	.413	.395	.060	.000	.000	.000		.000	.000	.000	.081	.381	
	SI1		.012	.000	.000	.000	.000	.000	.000	.000	.000	.007	.001	.009	.000	.000	.000	.000	.000		.000	.000	.007	.079	
	SI2		.011	.000	.000	.000	.000	.000	.000	.000	.000	.006	.018	.037	.000	.000	.000	.000	.000	.000		.000	.002	.032	
	AC3		.349	.031	.000	.001	.008	.000	.001	.001	.006	.297	.435	.176	.160	.000	.000	.000	.000	.000	.000		.000	.058	.187
	AC4		.345	.005	.000	.001	.001	.000	.000	.000	.000	.436	.087	.156	.011	.000	.000	.000	.000	.000	.000	.000		.000	.010
	EXP - Experience in Years		.183	.424	.045	.345	.113	.166	.356	.419	.266	.128	.096	.085	.051	.041	.003	.111	.081	.007	.002	.058	.000		.016
	JP - Performance		.229	.000	.000	.000	.000	.000	.000	.000	.000	.005	.004	.002	.002	.016	.033	.184	.381	.079	.032	.187	.010	.016	
a. Determinant = 1.091E-5																									

Determinant $>.00001$

❑ Determinant value:

- Interpretation
- ~ 1.0 No correlation among variables
- < 0.00001 Severe multicollinearity, problematic
- Between $0.00001-1$ Usually acceptable for factor analysis

❑ What to do if determinant is too low?

If you see a determinant below 0.00001 , consider :

- ✓ Removing variables that are highly correlated (check the correlation matrix).
- ✓ Combining similar items.
- ✓ Running collinearity diagnostics.

Factor Analysis

KMO is used to measure the proportion of variance among variables SHOULD BE GREATER THAN 0.7

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.877
Bartlett's Test of Sphericity	Approx. Chi-Square	4354.035
	df	210
	Sig.	<.001

No. of factor groupings
By eigenvalues

Component	Total Variance Explained								
	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	6.386	27.767	27.767	6.386	27.767	27.767	3.124	13.584	13.584
2	2.959	12.865	40.632	2.959	12.865	40.632	3.121	13.569	27.152
3	2.371	10.311	50.943	2.371	10.311	50.943	3.086	13.418	40.570
4	1.708	7.425	58.367	1.708	7.425	58.367	2.919	12.691	53.261
5	1.563	6.798	65.165	1.563	6.798	65.165	2.680	11.650	64.911
6	1.046	4.547	69.712	1.046	4.547	69.712	1.104	4.801	69.712
7	.780	3.392	73.104						
8	.600	2.607	75.711						
9	.556	2.417	78.128						
10	.529	2.299	80.427						
11	.515	2.240	82.666						
12	.467	2.029	84.695						
13	.430	1.871	86.566						
14	.427	1.857	88.423						
15	.397	1.727	90.150						
16	.356	1.550	91.700						
17	.345	1.499	93.199						
18	.315	1.368	94.567						
19	.296	1.286	95.853						
20	.276	1.202	97.054						
21	.240	1.043	98.097						
22	.234	1.016	99.113						
23	.204	.887	100.000						

Extraction Method: Principal Component Analysis.

Total Variance Explained in SPSS tells you:

How much of the total variability in your data is captured by each extracted factor or component.

- It shows **eigenvalues** and **% of variance** each factor accounts for.
- Helps you decide **how many factors to keep**.

Example:

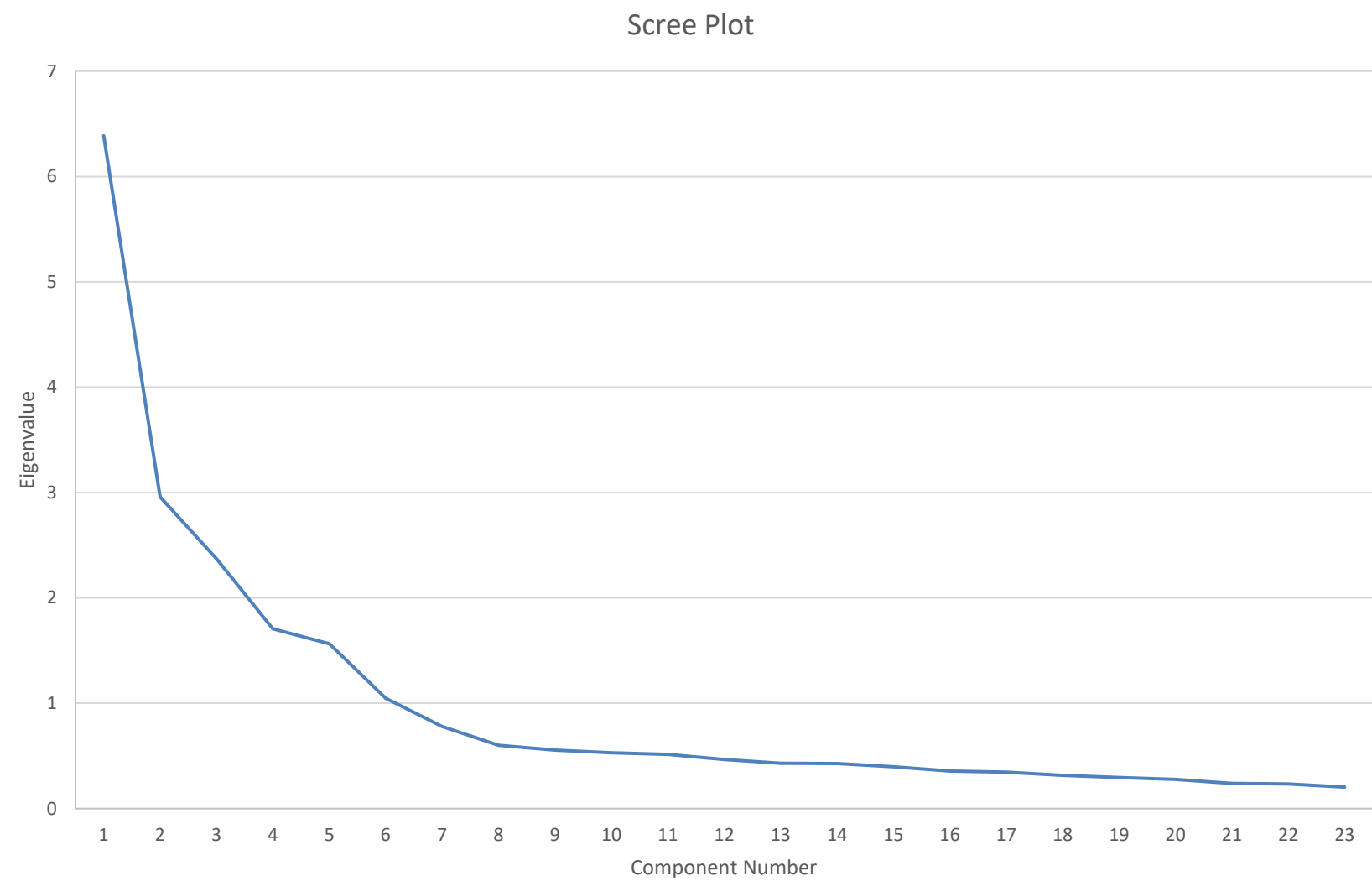
- Factor 1 explains 40% of variance.
- Factor 2 explains 20%.
- Together = 60% of the total variability.

✓ In short:

Total Variance Explained = How much of your data the factors summarize



No. of Groupings by screen plot



Number of Groupings by Scree Plot

What is it?

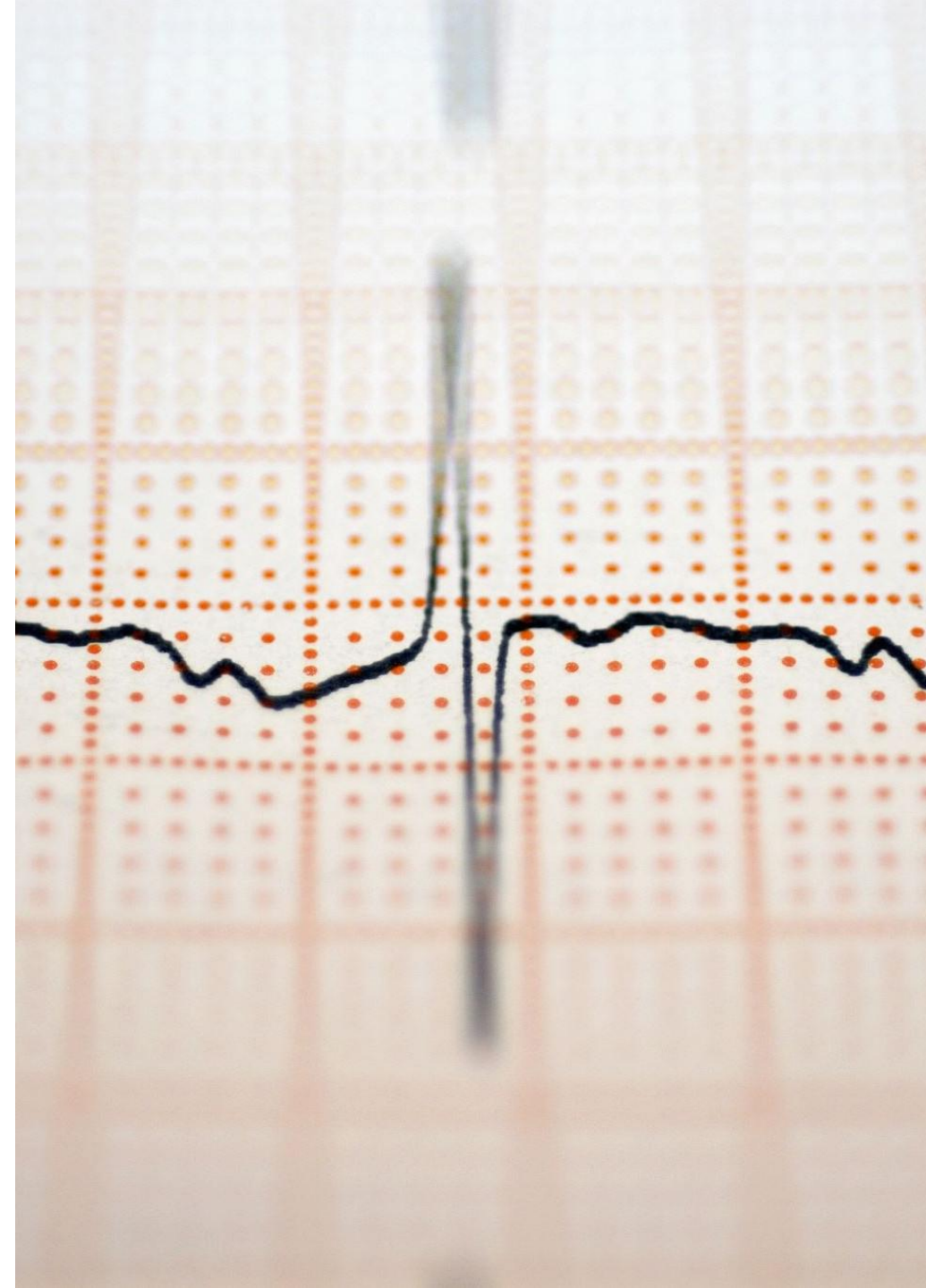
- A scree plot shows **eigenvalues vs. components**.

How to use it?

- Look for the **elbow** (the point where the curve bends).
- Keep all components **before the curve flattens**.

➤ In simple words:

**Count the points before the line levels off.
That's your number of groupings (factors).**



Factor Analysis

Component Matrix
Loading factor should
be greater than $>.4$

Component Matrix^a

Component
1

Salary	.794
Job Satisfaction	.927
Motivation	.562

Extraction Method: Principal
Component Analysis.

a. 1 components
extracted.

What is the Component Matrix?

- This shows the initial correlations (“loadings”) between your original variables and each extracted component.
- But often, the first solution is hard to interpret because the loadings are spread across components.



Factor Analysis

How many factor groups should
be categorized ?
Initial Elgenvalues >1

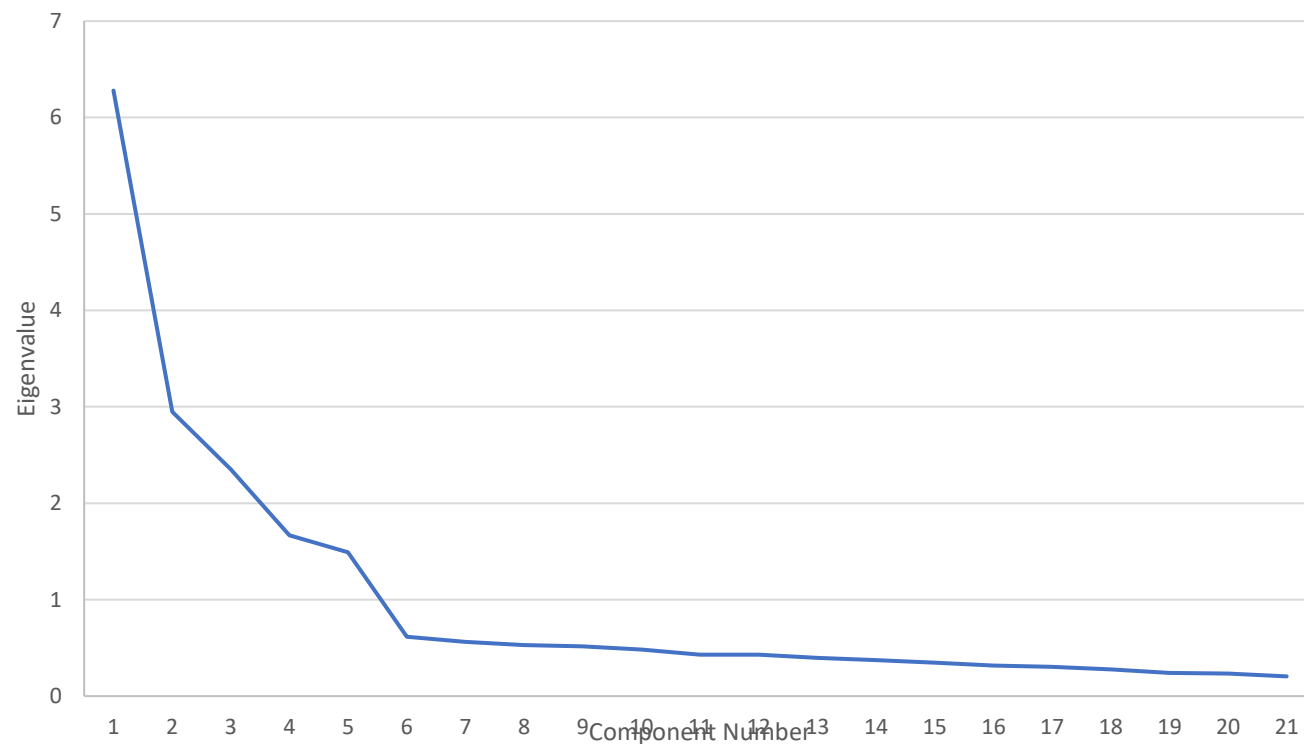
Total Variance Explained								Rotation Sums of Squared Loadings ^a
Component	Total	Initial Eigenvalues % of Variance	Cumulative %	Extraction Sums of Squared Loadings Total	% of Variance	Cumulative %	Total	
1	6.280	29.904	29.904	6.280	29.904	29.904	4.487	
2	2.947	14.033	43.937	2.947	14.033	43.937	3.408	
3	2.350	11.191	55.127	2.350	11.191	55.127	3.600	
4	1.667	7.936	63.063	1.667	7.936	63.063	3.575	
5	1.491	7.098	70.161	1.491	7.098	70.161	4.188	
6	.615	2.930	73.091					
7	.563	2.683	75.774					
8	.529	2.519	78.293					
9	.517	2.463	80.757					
10	.482	2.294	83.051					
11	.431	2.055	85.105					
12	.430	2.047	87.152					
13	.398	1.894	89.046					
14	.374	1.779	90.825					
15	.348	1.656	92.481					
16	.317	1.510	93.992					
17	.304	1.445	95.437					
18	.278	1.324	96.761					
19	.241	1.150	97.911					
20	.234	1.114	99.025					
21	.205	.975	100.000					

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

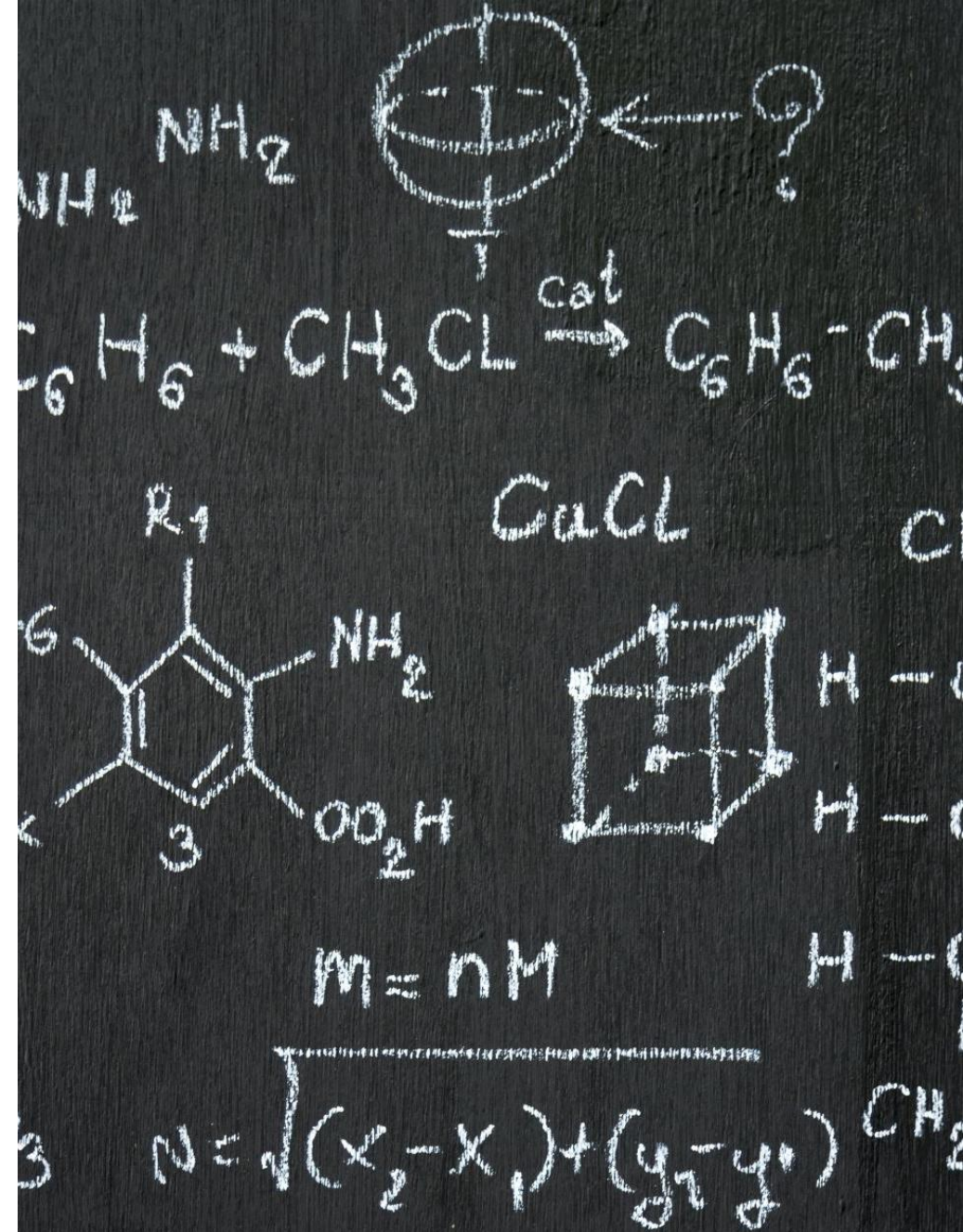
How many factor groups should
be categorized ?
Initial Eigenvalues >1

Scree Plot



What is the Rotated Component Matrix?

- This is the adjusted (rotated) version of the component matrix, created to make interpretation easier.
- Rotation redistributes the variance so that:
 - Each variable loads strongly onto only one component.
 - Weakly onto the others.
- This makes it clearer which variables belong together.



Component Matrix^a

	Component					
	1	2	3	4	5	6
SI4	.733	-.035	-.149	-.374	-.282	-.011
OC2	.706	-.090	-.158	.395	-.290	-.070
SI2	.704	-.077	-.197	-.366	-.339	.000
EP2	.680	.007	-.270	-.035	.423	-.004
SI1	.678	-.061	-.155	-.376	-.330	-.027
EP4	.662	.036	-.291	-.058	.452	.046
OC4	.651	-.040	-.206	.438	-.254	-.100
SI3	.628	-.062	-.161	-.415	-.257	.001
EP3	.614	.044	-.224	-.059	.507	-.009
EP1	.586	.029	-.228	-.186	.448	-.041
OC3	.550	.031	-.223	.514	-.070	-.024
JS2	.320	.668	.311	-.031	.056	-.022
JS1	.301	.643	.361	.063	-.076	-.141
JS4	.316	.607	.371	-.003	-.012	.007
JS3	.330	.598	.328	-.031	-.009	-.002
JS5	.396	.573	.376	.012	-.013	-.026
AC1	.442	-.480	.568	.014	.094	-.086
AC2	.418	-.514	.554	.022	.103	-.086
AC3	.440	-.532	.536	.036	.056	-.065
AC4	.489	-.471	.531	.082	.078	.126
OC1	.408	-.018	-.198	.592	-.230	-.080
EXP - Experience in Years	.152	-.018	.147	-.049	-.227	.846
JP - Performance	.318	.117	-.105	.315	.239	.498

Extraction Method: Principal Component Analysis.

a. 6 components extracted.

Rotated Component Matrix^a

	Component					
	1	2	3	4	5	6
JS1	.803	.038	-.007	-.014	.112	-.071
JS2	.793	.042	-.047	.129	.004	.029
JS5	.774	.088	.077	.083	.079	.042
JS4	.772	.050	.022	.049	.028	.067
JS3	.748	.083	.001	.075	.024	.054
SI2	.059	.836	.102	.194	.191	.047
SI4	.127	.813	.129	.239	.167	.038
SI1	.088	.813	.115	.174	.160	.019
SI3	.065	.772	.098	.212	.083	.034
AC3	-.021	.119	.865	.054	.087	-.005
AC2	-.003	.086	.864	.075	.049	-.031
AC1	.038	.102	.862	.077	.052	-.026
AC4	.028	.098	.837	.102	.117	.192
EP4	.075	.222	.061	.800	.182	.057
EP3	.103	.154	.096	.794	.130	-.001
EP2	.072	.232	.100	.773	.218	.014
EP1	.083	.249	.080	.744	.042	-.042
OC4	.078	.276	.113	.161	.783	.005
OC1	.024	.033	.027	.040	.782	.013
OC2	.077	.344	.187	.146	.770	.040
OC3	.087	.074	.043	.256	.733	.064
EXP - Experience in Years	.050	.181	.091	-.121	-.036	.869
JP - Performance	.101	-.141	-.012	.376	.281	.529

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Factor analysis

How to facilitate the groupings ?

Exclude those factor loadings and re-run the factor analysis again.

Factor analysis

Groupings after
excluding those factor
loadings below 0.4

Rotated Component Matrix^a

	Component					
	1	2	3	4	5	6
JS1	.803					
OC1					.782	
OC2					.770	
EP1				.744		
OC3					.733	
OC4					.783	
EP2				.773		
EP3				.794		
EP4				.800		
JS2	.793					
JS3	.748					
JS4	.772					
JS5	.774					
SI3		.772				
SI4		.813				
AC1			.862			
AC2			.864			
SI1		.813				
SI2		.836				
AC3			.865			
AC4			.837			
EXP - Experience in Years						.869
JP - Performance						.529

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Reliability (Internal Consistency)

Reliability (internal consistency) is not sufficient in confirming a good measurement, because a reliable measure may not necessarily be valid. If an instrument shows satisfactory reliability, then it would be expected that satisfactory validity estimates would also be achievable. So, it is important to ensure validity of data (Froman, 2000; Hair et al, 2003)

Reliability

- Once you have created your summative or composite variables, check for reliability using the **Cronbach Alpha** score $\alpha = \frac{N \cdot \bar{c}}{\bar{v} + (N-1) \cdot \bar{c}}$

- Where:

N = the number of items.

$\bar{c}$ = average covariance between item-pairs.

$\bar{v}$ = average variance.

Reliability

Covariance vs. Variance

- Covariance and variance are used to measure the distribution of points in a data set.
- However, variance is typically used in data sets with **only one variable** and indicates how closely those data points are clustered around the average.
- Covariance measures the direction of **the relationship between two variables**. A positive covariance means that both variables tend to be high or low at the same time. A negative covariance means that when one variable is high, the other tends to be low.

Reliability

Reliability in SPSS

- Step 1: Click “Analyze,” then click “Scale” and then click “Reliability Analysis.”
- Step 2: Transfer your variables (q1 to q5) into “Items,”. The model default should be set as “Alpha.”
- Step 3: Click “Statistics” in the dialog box.
- Step 4: Select “Item,” “Scale,” and “Scale if item deleted” in the box description. Choose “Correlation” in the inter-item box.
- Step 5: Click “Continue” and then click “OK”. [cronbach alpha spss - Google Search](#)

Reliability test

The screenshot shows the SPSS 'Analyze' menu. The 'Scale' option is highlighted with a red oval. A sub-menu is open for 'Scale', and the 'Reliability Analysis...' option is also highlighted with a red oval. The sub-menu includes 'Reliability Analysis...', 'Weighted Kappa...', 'Multidimensional Unfolding (PREFSCAL)...', 'Multidimensional Scaling (PROXSCAL)...', and 'Multidimensional Scaling (ALSCAL)...'. In the background, a data table is visible with columns EP2, EP3, AC1, EP4, and JS2.

	EP2	EP3	AC1	EP4	JS2
	0	5	1	6	4
	0	10	2	7	4
	0	10	1	7	2
	0	9	2	7	5
	9	10	1	6	4
	0	7	1	7	6
	9	9	2	6	3
	0	10	1	7	2
	3	8	3	3	5
	0	8	2	7	3
	0	9	4	7	7
	0	9	4	7	4
	9	8	1	5	4
	3	8	1	5	4
	9	9	2	6	4
	0	10	4	7	4

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Reliability Test

3 OC4 EP2 EP3 AC1 EP4 JS2 JS3 AC2

Reliability Analysis

Items:

JS2 [JS2]
JS3 [JS3]
AC2 [AC2]
SI1 [SI1]
JS4 [js4]
SI2 [SI2]
JS5 [JS5]
AC3 [AC3]
SI3 [SI3]
AC4 [AC4]
SI4 [SI4]
C1 - Gender Class [C1]
C2 - Employee Type Cl...

JS1 [JS1]
JS2 [JS2]
JS3 [JS3]
JS4 [js4]
JS5 [JS5]

Ratings:

Model: Alpha

Scale label: JS1-5

OK Paste Reset Cancel Help

Statistics...

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
JS1	64.92	518.873	.586	.448	.230
JS2	64.91	517.287	.598	.453	.226
JS3	65.90	523.897	.511	.384	.240
JS4	66.45	522.507	.551	.411	.237
JS5	14.28	17.988	.653	.433	.811

Exercise time

- Please run Reliability Test for the following items
- OC1
- OC2
- OC3
- OC4

Presenting Cronbach's Alpha

- **Definition:** Cronbach's Alpha measures the internal consistency or reliability of a scale or questionnaire.
- **Value:** Report the alpha coefficient (e.g., 0.85).
- **Interpretation:**
 - Values ≥ 0.70 are generally considered acceptable.
 - Higher values indicate better reliability.
- **Example:**
"Cronbach's Alpha = 0.85, indicating good internal consistency of the measurement scale."

Announcement

Please think about your assignment topic. Let me know your topic by 9 July 2025.



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Thanks

Any question