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Authors: HCW de Vet, CB Terwee, LB Mokkink, DL Knol
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Guide for the calculation of ICC in SPSS

Riekie de Vet

This note presents three ways to calculate ICCs in SPSS, using the example in the paper by Shrout and Fleiss, 1979

1. ICC (direct) via Scale – reliability-analysis

Required format of data-set

Persons	obs 1	obs 2	obs 3	obs 4
1,00	9,00	2,00	5,00	8,00
2,00	6,00	1,00	3,00	2,00
3,00	8,00	4,00	6,00	8,00
4,00	7,00	1,00	2,00	6,00
5,00	10,00	5,00	6,00	9,00
6,00	6,00	2,00	4,00	7,00

Commands

- Analyze – choose option 'Scale' and then 'reliability-analysis' – choose in 'statistics' for the option ICC
- For the options one-way (Model 1.1) or two way ANOVA (Model 2 of 3): two way ANOVA is the best choice.
- Then there is the choice between 'agreement' ofr 'consistency'.
- (The program also offers the possibility to choose for 'fixed' or 'random', but this does not change the outcome)
- Tick 'Variances' under the option 'Summaries' in 'Statistics' to obtain a complete ANOVA table in the output.

De output

The output of ICC (agreement) is as follows:
n = 6 patients
k= 4 observers

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

N of Cases = 6,0

Item Variances	Mean	Minimum	Maximum	Range	Max/Min	Variance
	3,5750	2,6667	6,2667	3,6000	2,3500	3,2203

Analysis of Variance

Source of Variation	Sum of Sq.	DF	Mean Square	F	Prob.
Between People	56,2083	5	11,2417 BMS		
Within People	112,7500	18	6,2639		
Between observers	97,4583	3	32,4861 OMS	31,8665	,0000
Residual	15,2917	15	1,0194 EMS		
Total	168,9583	23	7,3460		
Grand Mean	5,2917				

Intraclass Correlation Coefficient
Two-Way Mixed Effect Model (Absolute Agreement Definition):
People Effect Random, Measure Effect Random
Single Measure Intraclass Correlation = ,2898*
95,00% C.I.: Lower = ,0188 Upper = ,7611
F = 11,0272 DF = (5, 15,0) Sig. = ,0001 (Test Value = ,0000)
Average Measure Intraclass Correlation = ,6201**
95,00% C.I.: Lower = ,0394 Upper = ,9286
F = 11,0272 DF = (5, 15,0) Sig. = ,0001 (Test Value = ,0000)
*: Notice that the same estimator is used whether the interaction effect is present or not.
**: This estimate is computed if the interaction effect is absent, otherwise ICC is not estimable.

Reliability Coefficients 4 items

Alpha = ,9093 Standardized item alpha = ,9269

The value for ICC is 0.2898. The average measure ICC, i.e. when the scores of the four observers are averaged, is 0.6201. Cronbach α is 0.9093. The output does not provide variance components. The formulas below can be used to calculate variance components from the mean square values.

2. Calculation of ICCs based on Mean Squares
Data from ANOVA analyses based on the Shrout and Fleiss example (see output above).

2A Indirect calculation of ICCs from mean squares
EMS Mean square (error) =σ^2_{Err} = 1,0194
(BMS) Mean square (patients) = kσ^2_{pat}+σ^2_{Err}
dus σ^2_{pat} = (BMS - EMS) / k =(11,2417 –1.0194)/4 = 2,555

(OMS) Mean square (obs) = n σ^2_{obs} + σ^2_{Err}
dus σ^2_{obs} = (OMS - EMS) / n = (32,4861 – 1,0194)/6 = 5,244

ICC agreement = σ^2_{pat} / (σ^2_{pat}+ σ^2_{Obs} + σ^2_{Err}) = 2,555 / (2,555 + 5,244 + 1.0194) = 0,2897

ICC agreement for mean of four observers
ICC = σ^2_{pat} / [σ^2_{pat}+ (σ^2_{Obs} + σ^2_{Err})/4] =
2,555 / [2,555 + (5,244 + 1.0194)/4] = 0,6200

ICC consistency = σ^2_{pat} / (σ^2_{pat}+ σ^2_{Err}) = 2,555 / (2,555 +1.0194) = 0,7148
Cronbach α is model (2.s.C)
ICC (2.s.C) = σ^2_{pat} / (σ^2_{pat}+ σ^2_{Err} /4) = 2,555 / (2,555 +1.0194/4) = 0,9093

3. Calculation of Variance components and construction of ICC formulas.

Required format of data-set

Personen	Obs	Scores
1,00	1,00	9,00
2,00	1,00	6,00
3,00	1,00	8,00
4,00	1,00	7,00
5,00	1,00	10,00
6,00	1,00	6,00
1,00	2,00	2,00
2,00	2,00	1,00
3,00	2,00	4,00
4,00	2,00	1,00
5,00	2,00	5,00
6,00	2,00	2,00
1,00	3,00	5,00
2,00	3,00	3,00
3,00	3,00	6,00
4,00	3,00	2,00
5,00	3,00	6,00
6,00	3,00	4,00
1,00	4,00	8,00
2,00	4,00	2,00
3,00	4,00	8,00
4,00	4,00	6,00
5,00	4,00	9,00
6,00	4,00	7,00

Commands

Analyze: 'General Linear Model': option 'varcomps'
Dependent variable: Scores
Random factors: Persons
Observers
(If one chooses option 'fixed' for observers, σ^2_{Obs} will not be calculated)

Choose option 'Custom' under 'Specify Model'
Choose option 'main effects' under 'Build terms' (Note that in case there is only one observation per cell, with and without interaction give the same answer).
Includes 'Persons' and 'Observers' in Model.

Under "Options' choose for 'restricted maximum likelihood (REML)' as model for analyses. REML prevents the occurrence of negative variance components.
Choose option 'type III' under 'Sum of Squares'.

Output varcomps

Factor Level Information

		N
PERSONS	1,00	4
	2,00	4
	3,00	4
	4,00	4
	5,00	4
	6,00	4
OBS	1,00	6
	2,00	6
	3,00	6
	4,00	6

Dependent Variable: SCORES

Variance Estimates

Component	Estimate
Var(PERSONEN)	2,556
Var(OBS)	5,244
Var(Error)	1,019

Dependent Variable: SCORES Method: ANOVA (Type III Sum of Squares)

ICC (agreement) = $\sigma^2_{pat} / (\sigma^2_{pat} + \sigma^2_{Obs} + \sigma^2_{Err}) = 2,555 / (2,555 + 5,244 + 1.0194) = 0,2897$

ICC (consistency) = $\sigma^2_{pat} / (\sigma^2_{pat} + \sigma^2_{Err}) = 2,555 / (2,555 + 1.0194) = 0,7148$