(1) Estimate confidence intervals for Krippendorff's alpha coefficient
(2) Check if there are coders whose results are extremely different from others

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The confidence interval of Krippendorff's alpha can be estimated by using K-Alpha in SPSS (see note below). In my research seminar, R has been used to obtain alpha since 2019 instead of SPSS. Therefore, we provide an R script to find confidence intervals of alpha using the Bootstrap method in R as well. This script is easy to use if you have used R before, or if you have someone else who is familiar with R.

Note. SPSS originally incorporates the function to calculate an "alpha coefficient" as a measure of reliability. This is the Cronbach's alpha (at the moment of 2021-06). Cronbach's alpha is a measure of whether subjects answered a group of similar questions consistently in a psychological test, for example, and differs from Krippendorff's alpha (Krippendorff 1970) in both concept and calculation method. To calculate Krippendorff's alpha using SPSS, a script called K-Alpha is required.

1 Files included in this package

Extract the zip file, and the following files will be obtained:

- alpha.R — R script
- alpha_bat.bat — Windows batch file for drug-and-drop use
- data_test1_4coders.csv — Coding data file for test -1
- data_test2_5coders.csv — Coding data file for test -2

※The following site was referred to for how to perform bootstrap in R:
Hiroshi TAROMARU, "Introduction to Bootstrap" (2016-Apr.-03).
http://tarohmaru.web.fc2.com/R/bootstrapping.html

※Kripp.alpha() of “irr” package is used to calculate Krippendorff’s alpha.

2 Preparation 1. Installation

- Prepare a PC.
  - Any PC is fine if R can be installed.

- Install R.
  - RStudio is also fine.
  - I would recommend R over RStudio for R beginners.

- Start R or RStudio
  (Hereafter, "R or Rstudio" will be referred to as "R" simply.)

- Install irr if you have never installed it before.
  - Execute the following on R. This is unnecessary the second and subsequent times.
    `install.packages("irr")`
  - If R runs on Windows but this installation does not, try closing R, right-clicking R again, and "Run with Administrative Privileges". Then try this install.packages again.

3 Preparation 2. Coding Data File

- Edit the data in Excel or other software and save it in csv format.

  The data format of the csv file should be as follows:

  - Coders are lined up vertically, and
  - record units are lined up horizontally.
  - Never the other way around.
  - No header line on the first line or first column.
    The file should contain only data values.
  - The parts that were not coded (missing data) should be left blank.
    Conversely, if a blank space is left as a result of coding, it must be filled in with some value.

As an example, this package includes a data file with 12 documents coded by 4 coders (data_test1_4coders.csv). This is an example provided by Krippendorff with some missing data. Krippendorff's alpha coefficient would be 0.743.

- Check which of the following is the type of your coding variable.
  This should have already been determined by the researcher prior to the coding.
  - nominal / ordinal / interval / ratio
  - See also kripp.alpha in irr package of R for details.

- Edit v_type at the beginning of alpha.R according to the type of the variable.
  - alpha.R can be edited by right-clicking alpha.R on PC, for example.
    It can also be edited in RStudio.
  - If you are not sure of the type of the variable, nominal is recommended.

4 Execution

There are two ways to execute alpha.R. The second is for Windows only.

4.1 The First Method of Execution

- Extract the zip file of the package and enter the resulting folder.
- Place the coding data file there with the name "data_test.csv".
  - If you just want to make a quick try, please rename "data_test1_4coders.csv" to "data_test.csv" in the package.
- Double-click alpha.R to start R.
  - If you are asked which program to use for alpha.R, select R.
  - If R is started without double-clicking alpha.R, close R once and double-click alpha.R again. This is only to set the working directory to the current one.
- Edit v_type in alpha.R according to the type of your coding variable (see above).
  - Even if you open alpha.R and it is garbled, you only need to edit v_type.
- Type the following on R and press Enter:
  source("alpha.R")
- The results are output on R. See 4.3 for the results.

Advantages of this method:

Simple. Probably no errors.

Disadvantages of this method:

The data file name is fixed to data_test.csv.

Requires command line work.

4.2 The Second Method of Execution (Windows Only)

- Extract the zip file of the package and enter the resulting folder.
- Place your coding data file there. The name can be anything.
- Edit v_type in alpha.R according to the type of your coding variable (see above).
  - Even if you open alpha.R and it is garbled, you only need to edit v_type.
- Drag and drop the coding data file to alpha_bat.bat.
- The results are output. See 4.3 for the results.

Advantages of this method:

Can be handled by simply dragging and dropping.

The data file name can be anything.

Disadvantages of this method:

May meet with errors.

4.3 Outputs

- The output results are as follows:

1. Krippendorff's alpha

Value of Krippendorff's alpha.

2. Bootstrap distribution

Represents the alpha values at 2.5, 5, 50, 95 and 97.5%-iles from the bottom by the bootstrap method. Used to estimate confidence intervals.

- For example, if you want to know the 95% confidence interval, take 2.5 to 97.5%-ile.

  Example: The following means 0.4996339--0.8142567 is the 95%

confidence interval.

```
Bootstrap distribution:(0.025 0.050 0.500 0.950 0.975)
0.4996339 0.5205872 0.658312 0.786782 0.8142567
```

✧ The bootstrap method uses random sampling, so the result changes each time it is run. If you want to reduce the variability, set n_boot in alpha.R to a large value.

3. Inter-coder test

Status of inter-coder agreement.

✧ For example, the following shows that the alpha is 0.852 when calculated only between the first and second coder.

```
Coder 001 vs. Coder 002 krip-alpha=0.852
```

✧ For example, the following means that "in the second coder, the average value of alpha when paired with another coder is 0.73, which is the third best value compared to the values for the other coders."

```
Coder 002 rank= 3 average=0.73
```

✧ If there are five Coders in total and a Coder's rank is rank=5, it means that the Coder had the lowest agreement status with others among the five Coders. In general, there is no need to exclude such coders. However, if a particular coder performs significantly lower than all of the other coders, you may want to consider how to treat such a coder.
data_test2_5coders.csv is such an example. This file is data_test1_4coders.csv with a fifth person added. This fifth person had lax coding and the alpha value is significantly lower than anyone else it is paired with.

- When confidence intervals are noted in a paper
  - For example, "The value of Krippendorff's alpha was 0.68 and the 95% confidence interval using the Bootstrap method was $0.52 \leq \alpha \leq 0.84$."

- Distribution of alpha values by the Bootstrap method
  - On the R console, this can be seen by hist(a_boot) after executing source("alpha.R").