# SimplyAgree: An R package and jamovi Module for Simplifying Agreement and Reliability Analyses

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## Summary

Accurate and reliable measurements are critical to quantitative research efforts. Based on citation counts, researchers highly value methods to quantify the accuracy and reliability of the measurement tools (J. Martin Bland & Altman, 1986; Weir, 2005). This article introduces the `SimplyAgree` R package and jamovi module as user-friendly solutions for estimating agreement and reliability (R Core Team, 2020; The jamovi project, 2021).

## Statement of Need

A number of new methods have been developed in the past three decades to improve the calculation of the limits of agreement (Lin, 1989; Shieh, 2019; Zou, 2011) and other measures of measurement reliability (Carrasco, Phillips, Puig-Martinez, King, & Chinchilli, 2013; Weir, 2005). However, to author's best knowledge, statistical software — particularly open source software — to implement these statistical analyses is lacking. While some software may provide the limits of agreement analysis outlined by Bland & Altman (1999; 1986), few, if any, account for multiple observations within the same research subject (Zou, 2011) or include hypothesis tests of agreement (Shieh, 2019). Many researchers may not have the skills necessary to write the code, from scratch, in order to implement many of the newest techniques. The jamovi project (2021) is a open source statistical platform that provides a graphical user interface (GUI), and therefore is an accessible source for researchers without coding experience. Therefore, a jamovi module of `SimplyAgree` was also created in order to reach those researchers who may not have the coding expertise required to effectively use the R package.

## Current R Capabilities

The R package `SimplyAgree`, currently v0.0.2 on the comprehensive R archive network (CRAN), implements a number of useful agreement and reliability analyses.

The current release of the R package can be downloaded directly from CRAN in R:

```
install.packages("SimplyAgree")
```

Or, the developmental version, can be downloaded from GitHub:

```
devtools::install_github("arcaldwell49/SimplyAgree")
```

There are 2 vignettes that document the major functions within the package that can be found on the package's website (https://aaroncaldwell.us/SimplyAgree). Overall, there are 6 fundamental functions, all with generic `plot` and `print` methods, within the R package:

1. `agree_test`: Simple Test of Agreement. This is function performs agreement analyses on two vectors of the same length, and is designed for analyses that were described by Bland & Altman (1999; 1986). In addition to providing the traditional Bland-Altman limits of agreement, the function provides a hypothesis test (Shieh, 2019), and provides the concordance correlation coefficient (Lin, 1989).

2. `agree_reps`: Test of Agreement for Replicate Data. This function provides the limits of agreement described by Zou (2011) for data where the mean, per subject, does not vary. In addition, the concordance correlation coefficient, calculated by U-statistics, is also provided in the output (Carrasco, Phillips, Puig-Martinez, King, & Chinchilli, 2013).

3. `agree_nest`: Test of Agreement for Nested Data. This function provides the limits of agreement described by Zou (2011) for data where the mean, per subject, *does* vary. Similar to the replicate data function, the concordance correlation coefficient, calculated by U-statistics, is provided in the output (Carrasco, Phillips, Puig-Martinez, King, & Chinchilli, 2013).

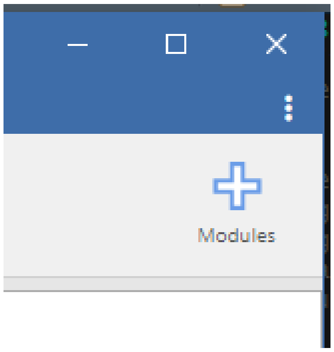
4. `loa_mixed`: Bootstrapped Limits of Agreement for Nested Data. This function calculates limits of agreement using a non-parametric bootstrap method, and can allow the underlying mean to vary (replicate data) or not (nested data).

5. `blandPowerCurve`: Power Analysis for Bland-Altman Limits of Agreement. This function implements the formula outlined by Lu et al. (2016). This allows for power calculations for the J. Martin Bland & Altman (1999) limits of agreement. The function `find_n` can then be used to find the sample size at which adequate power (defined by the user) is achieved.

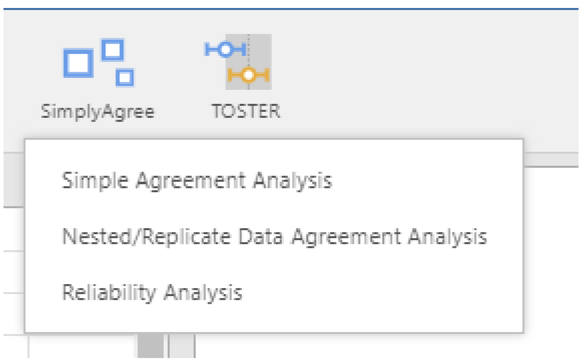
6. `reli_stats`: Reliability Statistics. This function calculates and provides as output the statistics outlined by Weir (2005). This includes an array of intraclass correlation coefficients, the coefficient of variation, and the standard error of measurement.

## Current jamovi Capabilities

The jamovi module can be added to the jamovi directly from the “add module” tab in the GUI.

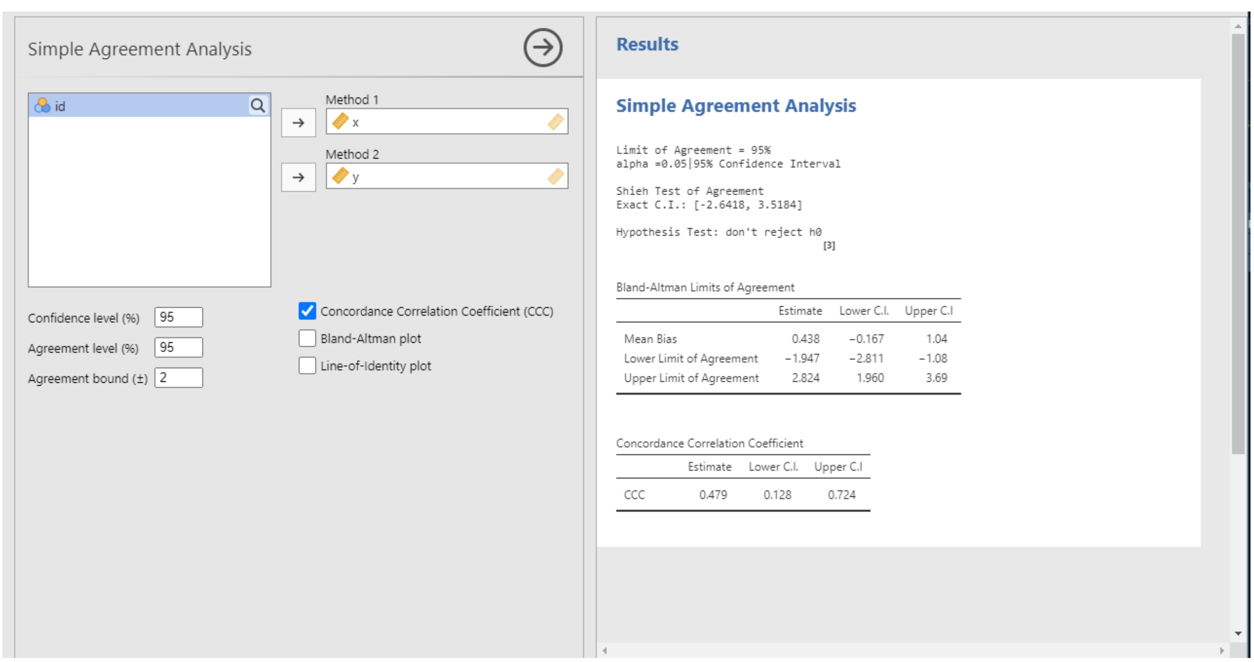



The `SimplyAgree` module is then available on the main menu, and within it there are three analysis options.

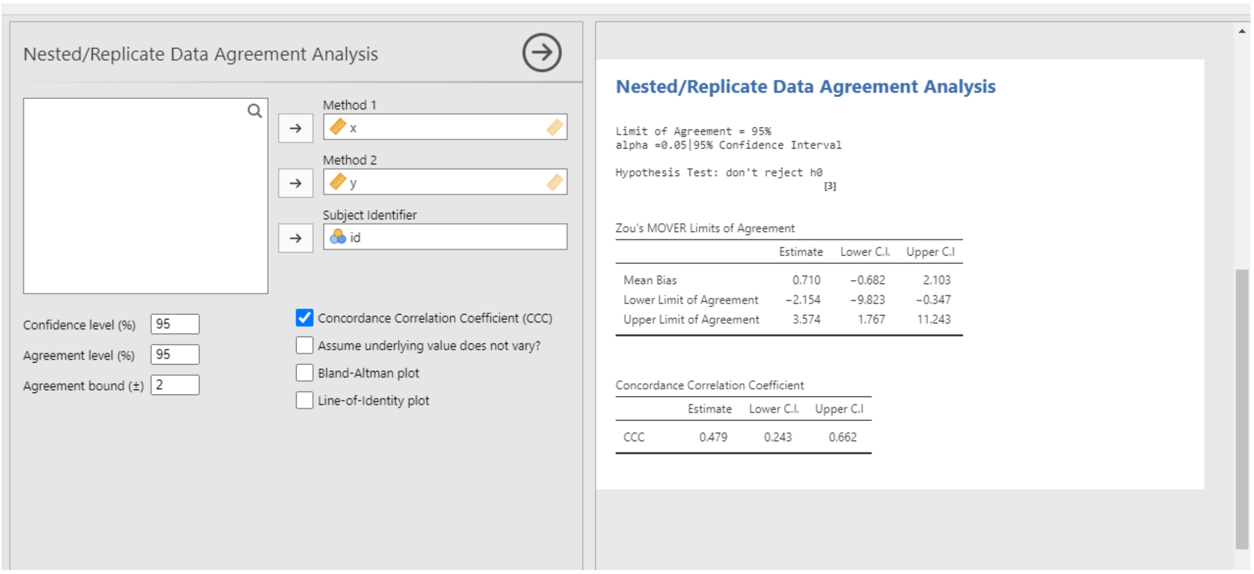



The three analysis options essentially enable jamovi users to complete some of the same analyses available in the R package.

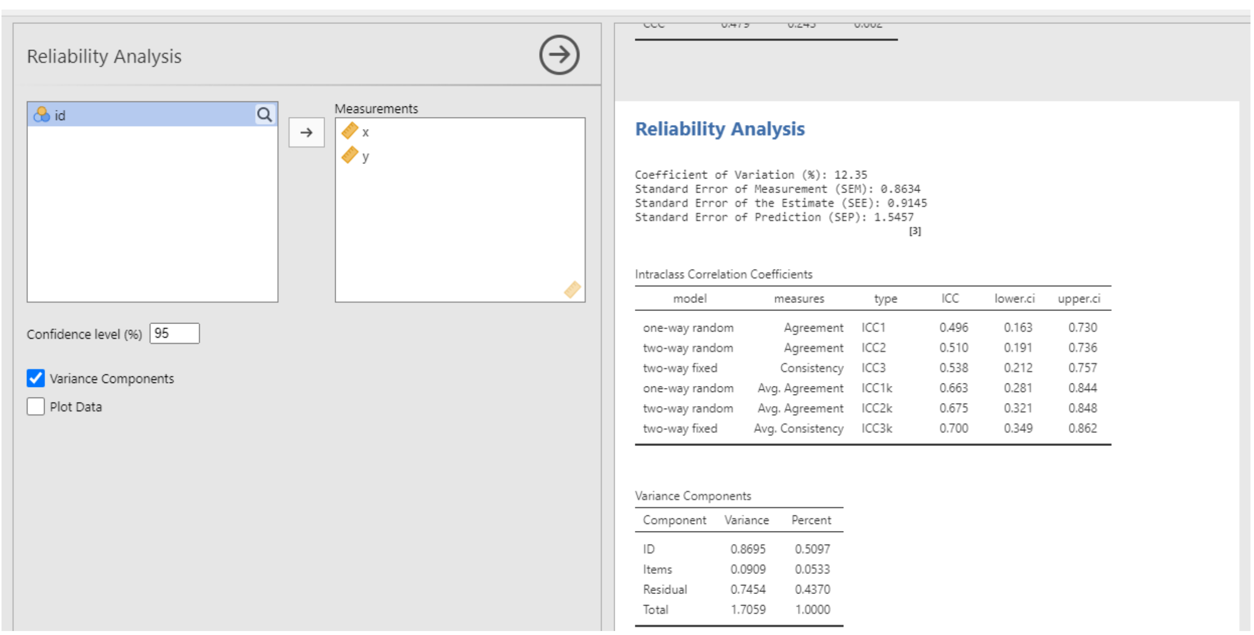
1. The simple agreement analysis incorporates the `agree_test` function. Users have the option of including the concordance correlation coefficient, and plots of the data.



2. The nested/replicate agreement analysis uses the `agree_nest` and `agree_reps` function to perform the analyses. The `agree_reps` function is used if "Assume underlying value does not vary?" is selected; otherwise `agree_nest` is used.




3. The reliability analysis utilizes `reli_stats` to calculate reliability statistics.



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