## Confidence Intervals for Omega Coefficient: Proposal for Calculus

Intervalos de confianza para coeficiente Omega: Propuesta para el cálculo

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easuring instruments are today widely used when conducting scientific research. It is therefore important to verify two properties of such instruments: (a) validity evidence and (b) score reliability. The latter has a direct impact on accuracy and measurement error (Martínez, Hernández & Hernández, 2014), which makes calculating and reporting it in scientific studies advisable.

Reliability is understood to be the ability, based on the instrument scores, to consistently differentiate between that which has a large amount of what is being measured and that which has little of it (Norman, 2014). In its classical form, it is the proportion of true variance explained by the indicators (Morales, 2013), a definition that reveals its connection to measurement instrument scores (Muñiz, 1996), and makes it reporting it on the basis of the sample examined essential for any study (Wilkinson, 1999).

Advances in the measurement of reliability have led to the creation of a variety of coefficients. Among these we find the coefficient  $\beta$ , coefficient H and the Ordinal Alpha coefficient, a suitable estimator for the demands of health scales which frequently use Likert-type response formats (Zumbo et al., 2007). The present letter, however, focuses on the Omega coefficient ( $\omega$ ), which is a relatively new estimator of reliability used in factorial models (Ventura-León & Caycho, 2017).

The Omega coefficient ( $\omega$ ) is an internal consistency estimator based on factorial loads which indicates the proportion of variance attributed to the totality of common variance (McDonald, 1999). Its greater sensitivity compared to other estimators (Zinbarg, Revelle, Yovel & Li, 2005), its robustness when sampling heterogeneous populations, and the reduced risk of overestimating reliability (Waller, 2008) makes  $\omega$  preferable. Furthermore,  $\omega$  does not require tau-equivalence nor the absence of correlated errors, which are limitations of Cronbach's alpha (Dunn et al., 2014). Given these factors, the omega may surpass the alpha coefficient and over time become one of the options of choice for the calculation of reliability (Zinbarg et al., 2005).

The interest in discussing confidence intervals (CI) for  $\omega$  arises from the recent publication of two articles in the journal *Adicciones* in which this coefficient is used (Irles, Morell-Gomis, Laguía, & Moriano, in print; Merino-Soto & Blas, in print), thus making it a necessary complement to be included in future studies in the journal. The CI is understood as a range of values with a normal distribution and a high probability of finding the real value of a given variable (Candia & Caiozzi, 2005). It is nevertheless necessary to clarify that the CI is interpreted as the probability of finding the true value in 95 of 100 intervals produced by taking random samples under the same study conditions (Clark, 2004). Consequently, the resulting CI is highly likely to contain the true value of the variable.

Calculating the CI for a reliability coefficient is not an unknown procedure due to its development in connection with Cronbach's alpha (Domínguez-Lara & Merino, 2015) as well as being recommended by editorial policies (Fan & Thompson, 2001). However, obtaining a CI for  $\omega$  requires the use of computational methods. For this purpose, this letter presents R codes (R Development Core Team, 2007)

Received: April 2017; Accepted: June 2017.

Send correspondence to: José Luis Ventura-León. Av. Tingo María 1122, Breña, Lima. Email: jventuraleon@gmail.com. specifically for the "MBESS" library (Kelley & Lai, 2017), which uses the bootstrap method of estimating the CI for the  $\omega$  coefficient. The following is an example of how this is estimated:

First, the "MBESS" library must be installed and loaded using the following code in the statistical program R:

```
install.packages("MBESS", dependencies = TRUE)
library(MBESS)
```

Second, you must enable the ci.reliability () function, which contains several arguments:

ci.reliability(data=happiness, type="omega", conf.level = 0.95, interval. type="bca", B=1000)

In this example,  $\omega$  is calculated for a scale of happiness. The results of the calculations are shown below (this usually take a few minutes):

\$est [1] 0.9098134 \$se [1] 0.00645999 \$ci.lower [1] 0.8962767 \$ci.upper [1] 0.9221084

As can be seen from the results shown above, the program enables the calculation of the  $\omega$  coefficient, standard error, and the confidence interval's lower and upper limit. It should be noted that in the data argument an array of correlations can be loaded and an omega for each of the models to be tested can be extracted.

Based on these results, the CI for  $\omega$  is reported thus: the happiness scale has an internal consistency of .909 as measured by the omega coefficient. It therefore follows that, according to the level of confidence, there is a 95% probability of the true value of omega being found in the resulting interval [.896, .922].

Finally, it is timely to offer a method for the estimation of a confidence interval for  $\omega$  due to its use in this journal and its potential increase in scientific studies (Zinbarg et al., 2005). Given that many professionals are not experts in statistics, a great advantage of the estimation method outlined in this letter is also the ease and user-friendliness with which the calculation is performed. This makes it a useful tool for researchers writing for *Adicciones*, thus helping to increase measurement accuracy in future studies.

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