Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, *39*, 31–36. (6043 citations as of 4/1/2016).

For all articles that have appeared in *Psychometrika* since its first volume in 1936, this highly cited paper by Henry Kaiser is second only to Cronbach's massively cited 1951 article on coefficient alpha. This Kaiser article suggests a normalized quartimax criterion, bounded between zero and one, to index the simplicity of the factor pattern for a given factor analysis. Based on subjective reflection, Kaiser gave the following verbal evaluation for the levels of his index of factorial simplicity:

in the .90s, marvelous
in the .80s, meritorious
in the .70s, middling
in the .60s, mediocre
in the .50s, miserable
below .50, unacceptable

Unfortunately, almost all but a very small handful of the citations to Kaiser (1974) appear to be in error. Some possible reasons for these misattributions are laid out in what follows.

In his Psychometric Society Presidential Address in 1970 ("A second generation Little Jiffy," *Psychometrika*, 1970, *35* 401–415), Kaiser added a few embellishments to his well-known approach to factor analysis that Chet Harris had disdainfully labeled "Little Jiffy"; this approach could be characterized as "principal components with associated eigenvalues greater than one followed by normal varimax rotation." One such addition in this 1970 paper was a "measure of sampling adequacy" (MSA) that was intended to reflect whether it was reasonable to proceed with a factor analysis in the first place. Kaiser attributed this MSA to work he was doing at the time with Professors Meyer at Loyola (Chicago) and Olkin at Stanford. It is now commonly referred to as the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO-MSA). It is calculated routinely, for example, in the heavily-used SPSS and SAS factor analysis programs; also, functions for KMO-MSA appear in R, such as in the `psych` package developed by Bill Revelle.

The particular KMO-MSA computed by SPSS and various R functions,

is not the exact same measure given in Kaiser (1970); instead, it is a modification meant to improve stability given in a 1974 Kaiser and Rice paper in *Educational and Psychological Measurement* ("Little Jiffy, Mark IV," *34*, 111-117). In this latter article, Kaiser and Rice suggest that the same verbal scale used for the index of factorial simplicity in Kaiser (1974), also be used "as is" for KMO-MSA. So, apparently what has happened over the last four or so decades, is that when the value of the KMO-MSA index is reported (usually taken directly from SPSS output), the reference given for it is most often Kaiser (1974), the factorial simplicity paper, and not the correct citation of Kaiser and Rice (1974), which is the Version IV Little Jiffy article.

The reason for the citation mixup and allowing Kaiser (1974) to become the inappropriately highly-cited paper it has developed into, may be due in part to an article by Charles Dziuban and Edwin Shirkey that appeared in *Psychological Bulletin*, also in 1974: "When is a correlation matrix appropriate for factor analysis" (*81*, 358–361). In discussing KMO-MSA, the following sentence appears (p. 359): "Kaiser's (1974) present calibration of the [KMO-MSA] index is as follows:"; what then follows are the exact same verbal labels given earlier and used by Kaiser (1974) to characterize his index of factorial simplicity. No reference, however, appears for Kaiser (1974) in the bibliography for Dziuban and Shirkey (1974) but one is given for an "in press" piece by Kaiser and Rice. So, what apparently has happened when a KMO-MSA value is reported, the reference for it is incorrectly given as Kaiser (1974) instead of the correct reference of Kaiser and Rice (1974) — an article, by the way, that does *not* appear in *Psychometrika*.[1]

The mixup of using Kaiser (1974) for Kaiser and Rice (1974) may be a miscitation phenomenon that is difficult to correct. Two popular SPSS-related user manuals, for example, make this citation error: the *SPSS Survival Manual* by Julie Pallant, and *Discovering Statistics Using SPSS* by Andy Field; the same citation error is also made in other books by Andy Field, such as in *Discovering Statistics Using SAS*. In hindsight, it is a bit surprising that such a miscitation wasn't caught earlier by one of the au-

[1]According to Google Scholar, Kaiser and Rice (1974) has 1578 citations as of 4/1/2016. This is a substantial number but nowhere near the 6043 citations for Kaiser (1974), almost all of which should be reallocated to Kaiser and Rice (1974).

thors of these secondary SPSS user manuals. Not a single statistical package (SPSS, SAS, SYSTAT, Matlab, or R) computes Kaiser's index of factorial simplicity, irrespective of how good or bad the index might be. Several statistical packages, as noted before however, do compute KMO-MSA (SPSS, SAS, and Bill Revelle's `psych` package for R).

When Bill Revelle was asked why he didn't include a function for Kaiser's index of factorial simplicity in his `psych` R package, he said that he instead included a function for what he thought was a better index (of factorial complexity) due to Richard Hofmann ("Complexity and simplicity as objective indices descriptive of factor solutions," *Multivariate Behavioral Research*, *13*, 1978, 247–250). He also noted that he was never tempted to use Kaiser (1974) in reference to his KMO-MSA function; he gave the three (correct) citations for it of Kaiser (1970), Kaiser and Rice (1974), and Dziuhan and Shirkey (1974).