Skewness and kurtosis: relation between Cain et al. (2017) and the package 'PearsonDS'

Marie Delacre[1]

[1] Service of Analysis of the Data, Université Libre de Bruxelles, Belgium

Author Note

Correspondence concerning this article should be addressed to Marie Delacre, CP191, avenue F.D. Roosevelt 50, 1050 Bruxelles. E-mail: marie.delacre@ulb.ac.be

Abstract

Keywords: keywords

Word count: X

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In 2017, Cain et al. have conducted a review assessing the skewness and kurtosis of articles in recent psychology and education publications. They used the following formulas of Fisher’s skewness (G_1) and kurtosis (G_2):

$$G_1 = \frac{\sqrt{n(n-1)}}{n-2}\frac{m_3}{\sqrt{(m_2)^3}} \tag{1}$$

With n = sample size, m_2 = second centered moment and m_3 = third centered moment.

$$G_2 = \frac{n-1}{(n-2)(n-3)} \times [(n+1)(\frac{m_4}{(m_2)^2} - 3) + 6] \tag{2}$$

with n = sample size and m_2 and m_4 = the second and fourth centered moments. I chose to use this article in order to define which value of skewness and kurtosis I would simulate, in order to test the goodness of different measures of effect sizes under realistic population parameter values. In my simulations, I Chose the function “rPearson” from the package “PearsonDS”, in which skewness and kurtosis are computed as following:

$$skewness = \frac{m_3}{\sqrt{(m_2)^3}} \tag{3}$$

$$kurtosis = \frac{m_4}{(m_2)^2} \tag{4}$$

In order to simulate a sample extracted from a population where $G_1 = X$, using the “rPearson” function, I need to make the following transformation:

$$\frac{\sqrt{n(n-1)}}{n-2}\frac{m_3}{\sqrt{(m_2)^3}} = X <==> \frac{m_3}{\sqrt{(m_2)^3}} = \frac{X(n-2)}{\sqrt{n(n-1)}} \tag{5}$$

In order to simulate a sample extracted from a population where $G_2 = X$, using the "rPearson" function, I need to make the following transformation:

$$\frac{n-1}{(n-2)(n-3)}[(n+1)(\frac{m_4}{(m_2)^2}-3)+6] = X <==> \frac{m_4}{(m_2)^2} = \frac{X(n-2)(n-3)-6(n-1)}{n^2-1}+3 \tag{6}$$