

# Asymptotic biases in factor analysis and structural equation modeling

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## Abstract

Formulas for the asymptotic biases of the parameter estimates in factor analysis and structural equation models are provided in the case of the Wishart maximum likelihood estimation for normally and nonnormally distributed variables. When multivariate normality is satisfied, considerable simplification is obtained for the models of unstandardized variables. Formulas for the models of standardized variables are also provided. Numerical examples with Monte Carlo simulations in factor analysis show the accuracy of the formulas and suggest the asymptotic robustness of the asymptotic biases with normality assumption against nonnormal data. Some relationships between the asymptotic biases and other asymptotic values are discussed.