

# Implications of Dimensionality on Measurement Reliability

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**Abstract** We study some topics of the reliability of measurement, especially certain implications of multidimensionality and unidimensionality. We consider these aspects within a measurement framework focusing on one hand on the dimensionality of the measurement model and on the other hand on the dimensionality of the measurement scale. Working through theorems and examples we compare two reliability estimators, namely Cronbach's alpha and Tarkkonen's rho. It seems that there is not much use for Cronbach's alpha. It is based on unidimensional models and scales, while the models and scales used in practice are multidimensional. Tarkkonen's rho seems to work well in multidimensional studies, giving support to the real purpose of reliability estimation which seems to have been lost for a quite long time.

## 1 Introduction

Measurement brings uncertainty in all statistical research. Assessing its quality requires two concepts: *validity* and *reliability*. The problems of validity can seldom be solved statistically, whereas the reliability is clearly a statistical question, being closely related to the variance of the measurement. Therefore a measurement model is needed to assess the reliability, since the variance of the measurement error must be estimated. The models to be used should be multidimensional with flexible assumptions in order to be applicable in practical applications. In social sciences and behavioral sciences, where the measurements are usually far from stable, the applied research has traditionally concentrated on unidimensional models. Recently, that tradition has been questioned, and the need of multidimensionality recognized (Lucke [11], ten Berge and Sočan [18]).

In this paper we study some topics of reliability, especially certain implications of the multidimensionality and unidimensionality. Section 2 presents a framework for

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