Chapter 13
Comparing PLS-SEM Statistical Technologies for Educating the Importance of Linearity: Attitude Theory Validation in Digital Marketplace

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ABSTRACT

This study aims to reveal how well two PLS-SEM statistical technologies—WarpPLS and SmartPLS—work for testing attitude theory with different types of relationships: linear and nonlinear. Non-probability sampling collects 786 internet customers from the digital marketplace. In the linear relationships between the theory of reasoned action baseline (attitudes and subjective norms) and online buying intention, SmartPLS and WarpPLS deliver similar loadings, reliability, validity, and path coefficients. WarpPLS is more effective in validating the nonlinear relationship of consumer ethnocentrism to attitudes toward imports, but SmartPLS is more comprehensive in providing robustness and advanced features. Teachers should educate students on the importance of testing linearity in the required preliminary checks. This step helps them choose the suitable software algorithm and get more accurate results and reports. This study is limited to the default parameter and standard application; future works can explore more advanced settings and complex path models.

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BACKGROUND

Over the years, statistical technologies have evolved and found their place in the education system, starting from high school where Excel and its statistical add-ins provide basic functions (Claxton, 2009). As the complexity of statistical cases increased in higher education, more advanced tools like SPSS and Eviews were introduced. For a significant period, SPSS reigned supreme in both the statistical technology world and education (Yin et al., 2021). However, as research studies became more intricate, researchers began to explore structural equation modeling (SEM) through various statistical applications: SmartPLS, WarpPLS, and R for partial least squares structural equation modeling (PLS-SEM) or Amos, Lisrel, and Mplus for Covariance Based (CB-SEM). These software, listed in descending order of popularity, have become the go-to tools for researchers (Sakaria et al., 2023).

In the early years, the use of CB-SEM was more prevalent, and PLS-SEM was relatively less familiar (Hsu et al., 2006). However, as students grappled with issues of normality, linearity, homoscedasticity, classical assumptions, and minimum sample size, PLS-SEM emerged as a viable alternative for explanatory and predictive analysis. PLS-SEM quickly gained traction, offering a practical solution to these challenges (Ghasemy et al., 2020). Since 2015, PLS-SEM has taken almost the most dominant role in analyzing complex interrelationships between variables, further solidifying its position (Hair et al., 2018).

Despite being the most popular statistical packages for PLS-SEM, WarpPLS and SmartPLS, there is a noticeable dearth of comparison studies between these two (Sakaria et al., 2023). This gap in research is particularly relevant for students who need guidance in making the optimal choice between these tools. Both WarpPLS and SmartPLS offer unique algorithms and features, and their suitability is contingent upon the users' specific conditions (Memon et al., 2021). This study aims to fill this gap by comparing the effectiveness of these PLS-SEM statistical technologies using a case study that validates attitude theory with different types of relationships, including linear and nonlinear.

This study is vital as it updates the comparison of both software with novel features, such as quadratic effects for SmartPLS and Djikstra for WarpPLS, that were not available in past studies (Memon et al., 2021). It can provide more empirical evidence to support the effectiveness and relevance of appropriate statistical tools, given the nature of nonlinear relationships in an extended context from tourism (Rasoolimanesh et al., 2018) into marketing and attitude theory. It sharpens past comparative studies with gap analysis and datasets representing linear and nonlinear relationships (Kumar & Purani, 2018). Educators of research methods can use this study to underline the importance of linearity checks to justify their students' selection of data analysis strategies.

LITERATURE REVIEW AND HYPOTHESES

PLS-SEM Among Multivariate Data Analysis

Multivariate analysis, a powerful tool, enables researchers to simultaneously use many (more than two) variables (multivariate) for explanation and prediction. This study, for instance, utilizes four variables. Many multivariate methods derived from univariate analysis (which examines the distribution of a single variable) and bivariate analysis (which studies two variables and employs correlation, simple regression, and analysis of variance). In multivariate analysis, researchers can choose to declare no dependent variables (e.g., factor and cluster analysis), relate variables to one dependent variable, also known as single