Hypothesis Testing with Confidence Intervals and P Values in PLS-SEM

Ned Kock, Division of International Business and Technology Studies, Texas A&M International University, Laredo, TX, USA

ABSTRACT

E-collaboration researchers usually employ P values for hypothesis testing, a common practice in a variety of other fields. This is also customary in many methodological contexts, such as analyses of path models with or without latent variables, as well as simpler tests that can be seen as special cases of these (e.g., comparisons of means). The author discusses here how a researcher can use another major approach for hypothesis testing, the one building on confidence intervals, in analyses of path models with latent variables employing partial least squares structural equation modeling (PLS-SEM). The author contrasts this approach with the one employing P values through the analysis of a simulated dataset, created based on a model grounded on past theory and empirical research. The model refers to social networking site use at work and its impact on job performance. The results of the analyses suggest that tests employing confidence intervals and P values are likely to lead to very similar outcomes in terms of acceptance or rejection of hypotheses.

KEYWORDS

Confidence Interval, E-Collaboration, Hypothesis Testing, Monte Carlo Simulation, P Value, Partial Least Squares, Structural Equation Modeling

INTRODUCTION

There has been steady growth in the use of structural equation modeling (SEM) employing the partial least squares (PLS) method (Kock, 2014; Kock & Lynn, 2012), referred to here as PLS-SEM, in the field of e-collaboration (Kock, 2005; Kock & Nosek, 2005) as well as in many other fields where multivariate statistics are employed.

This is in part due to the emergence of powerful yet user-friendly software tools such as WarpPLS (Kock, 2010; 2015c), which implement the PLS-SEM method. Another reason for this growth is that, from a conceptual perspective, many statistical tests can be seen as special cases of PLS-SEM analyses. Examples are robust path analyses (Kock & Gaskins, 2014), nonparametric comparisons of means (Kock & Chatelain-Jardón, 2011), and even nonparametric tests where only one group and one condition are available (Kock, 2013). All of these tests can be easily conducted with WarpPLS. A third reason for the growth in the use of PLS-SEM is the emergence of factor-based algorithms, which bring together the advantages of algorithms employed in traditional PLS-SEM with the precision of covariance-based SEM under common factor model conditions (Kock, 2015a).

Hypothesis testing in the context of PLS-SEM is usually conducted through the calculation of a P value for each path coefficient, where the P value may be one-tailed or two-tailed depending on the researcher’s prior knowledge about the direction of the path and the sign of its associated coefficient (Kock, 2015b). One question that frequently arises in this context is: How can one use
confidence intervals for hypothesis testing, in addition to or instead of P values? This paper is an answer to this question.

ILLUSTRATIVE MODEL AND DATA

Figure 1 shows an illustrative model that is used in our discussion about using confidence intervals and P values in hypothesis testing. This model contains five latent variables: internal social networking tool use (SN), job satisfaction (JS), organizational commitment (OC), job innovativeness (JI), and job performance (JP).

Internal social networking tool use (SN) measures the degree to which an employee uses a social networking tool (e.g., Facebook) made available internally in the employee’s organization to facilitate employee-employee socialization. This is the only exogenous (or independent) latent variable in the model. Job performance (JP), the main endogenous (or dependent) latent variable in the model measures the employee’s overall performance at work.

Three latent variables mediated the indirect relationship between SN and JP. Job satisfaction (JS) measures the degree to which the employee is satisfied with the organization. Organizational commitment (OC) measures the degree to which the employee is personally committed to the organization. Job innovativeness (JI) measures the degree to which the employee engages in innovative or creative behavior at work.

The figure has been created with WarpPLS, and thus employs the software’s notation for summarized latent variable description: the alphanumeric combination under each latent variable’s label (e.g., “JP”) in the model describes the measurement approach used for that latent variable and the number of indicators. For example, “(R)5i” means reflective measurement with 5 indicators.

We employed a Monte Carlo simulation (Robert & Casella, 2005) to create sample data based on this model and on assumptions based on past empirical research. The sample we created had 160 cases, or rows in the data table. The number of columns was 21, the total number of indicators. We assumed that the indirect relationship between SN and JP is fully mediated by the latent variables JS, OC and JI. That is, we assumed a neutral direct effect SN>JP at the population level.

Because of the above, the direct path SN>JP was expected in the subsequent analysis to be associated with a non-significant effect. Nevertheless, this path must be included in the model to avoid bias, as its coefficient is only reduced to zero due to the multivariate analysis performed by

Figure 1. Illustrative model representation in WarpPLS. Notes: SN = internal social networking tool use; JS = job satisfaction; OC = organizational commitment; JI = job innovativeness; JP = job performance; notation under latent variable acronym describes measurement approach and number of indicators, e.g., (R)5i = reflective measurement with 5 indicators.
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