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Regularised SEM-Based Out-of-Sample Predictions

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Regularised SEM-Based Out-of-Sample Predictions

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Abstract

Predictive modelling—which applies model parameters from one data sample to generate predicted values for new observations beyond that sample—can play a critical role in psychological research. Until recently, prediction mechanisms were limited to the traditional linear regression and machine learning frameworks. However, these approaches assume that psychological variables are measured without error, which is often not the case. Structural equation models (SEMs) do consider measurement error, and a prediction rule for SEMs with normally distributed, continuous data was recently proposed. Although the SEM-based prediction rule outperforms predictions based on (regularised) linear regression models in most cases, it is sensitive to model misspecification—specifically when additional direct effects between indicators on the predictor side and the latent response variable are included in the data-generating SEM. Regularising the SEM-based prediction rule—using methods like ridge regression or regularised discriminant analysis—can help address this issue. In this study, we propose using regularisation to achieve a data-driven compromise between a restricted SEM and a linear regression model fit to the same data, thereby producing regularised SEM-based out-of-sample predictions. The combination of regularisation and SEM indirectly accounts for the degree of model misspecification to produce more accurate and precise predictions by weighting the influence of the linear regression and the SEM. We hypothesise that the regularised SEM-based prediction rule will perform at least as well as the SEM-based prediction rule when the model is misspecified.

Keywords

prediction, structural_equation_modelling, cross-validation, machine_learning, regularisation

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