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Machine Learning for Psychological Research: Benchmarking Forecasting Performance of Deep Learning Models for Longitudinal Data

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Abstract

The study of longitudinal data has been a cornerstone of psychological research, shaped significantly by the foundational work of Baltes and Nesselroade (1979). With the rise of mobile IT tools, interest in modeling intensive longitudinal data has surged. Traditionally, psychologists have relied on time-series analysis methods such as the Random Intercept Cross-Lagged Panel Model (RI-CLPM) and continuous-time models to analyze (intensive) longitudinal data and examine temporal relationships between variables.
In recent years, advances in Machine Learning (ML) have opened new possibilities for analyzing longitudinal data, particularly in forecasting future values. Our study explores the potential of ML models for this purpose by simulating time series based on a discrete-time model, varying key design factors such as the number of input and forecasted time points, sample size, and temporal drift.
We evaluated these simulated time series using two established psychological models, the discrete time RI-CLPM (Hamaker & Grasman, 2015) and the continuous-time RI-CLPM (Oud & Delsing, 2010) - and compare their forecasting performance with two widely used ML models: Long Short-term memory networks (LSTM; Hochreiter & Schmidhuber, 1997) and Transformer neural networks (Vaswani et al., 2017). Our study assesses each model's forecasting capabilities in a univariate forecasting scenario, using bias and root mean square error (RMSE) as performance metrics.

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