Advanced Time Series Forecasting with Hierarchical Data and Deep Learning

Abstract

This project investigates hierarchical time series forecasting using deep learning. A synthetic dataset inspired by the M4 competition is generated with 50 bottom-level series across SKU, Store, and Region levels. A multi-horizon LSTM model is compared against an Exponential Smoothing baseline using rolling-origin cross-validation.

Model Architecture

A multi-horizon LSTM jointly predicts seven future steps and captures temporal dependencies using time-varying and static covariates.

Evaluation

Performance is evaluated using the Mean Absolute Scaled Error (MASE). The deep learning model consistently outperforms the ETS baseline across all hierarchy levels.