Yulong Zhao

Statistics PhD Candidate | Statistical Machine Learning & Sequential Modeling

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Education

University of Arizona — PhD, Statistics — Expected May 2028

University of Wisconsin–Madison — MS, Statistics and Data Science — 2023

University of Science and Technology of China — BS, Mathematics and Applied Mathematics — 2022

Research Experience

University of Arizona — PhD Researcher — 2023 – Present

Advisors: Prof. Xueying Tang, Prof. Hao Helen Zhang | NSF #2310664, #1929348

Time-Varying Action Effects in User Behavior Sequences — Interactive demo

- Revealed actions whose effect on task success **reverses over task time**, a pattern masked by aggregate action counts, in 19,089 events from 2,668 users of an educational problem-solving assessment (OECD PISA 2012).
- Developed the **interpretable model** behind it, which estimates how each action's effect changes with *when* it occurs and classifies every action as having no effect, a constant effect, or a time-varying effect.
- Also improved prediction over a count-feature logistic baseline: **50% lower log loss** (0.237 → 0.118) and accuracy from 93.5% to 96.1% in 10-fold cross-validation, winning every fold.

Early Failure Warning with Guaranteed False-Alarm Control — Interactive demo

- **More than doubled** the share of failing users caught at least 2 actions before submission (**14%** → **34%** at a 10% false-alarm budget, vs. a published early-window XGBoost baseline) on OECD PIAAC assessment data, by adding users' behavior on earlier tasks.
- Built the **online early-warning system** behind it: a neural sequence model (GRU) updates each user's risk of failing after every action and raises an alert **before the user submits**, while there is still time to intervene.
- Designed a **model-agnostic alert rule** calibrated on each user's peak risk over the whole sequence, with a provable guarantee that the share of successful users ever falsely alerted stays within a chosen budget.

Learning Latent Skills and Behavioral States

- **Recovered interpretable structure** without labels on 1,129 users of an email-and-spreadsheet task: **3 skills and 2 behavioral states** learned from 48 action types, with distinct skills for search, sort, and email actions, skills with opposing effects on related actions, and state transitions consistent with the task logic; all 14 learned skill-to-action links reappeared in at least 94% of bootstrap resamples.
- Developed the **structured latent-variable model** behind it, which jointly estimates persistent user skills and evolving behavioral states from interaction sequences, learning sparse skill-to-action mappings without prespecified assignments or labeled states.

Time-Series Forecasting & Regime-Shift Detection

- Reduced forecast MSE by **38%** on average versus a historical-mean baseline, beating it in all 18 settings, with a nonlinear regression pipeline (PCA + kernel SVR) forecasting biological change from paleo-environmental records, evaluated strictly out-of-sample (walk-forward).
- Evaluated environmental regime shifts using **recurrence plots**, multiple-testing correction, and preprocessing sensitivity analysis, distinguishing robust findings from preprocessing-dependent results.

Technical Skills

Languages & Tools: Python (PyTorch, scikit-learn, pandas, NumPy, XGBoost, Numba), R, SQL, Git, Slurm/HPC.

Methods: latent-variable models (EM), regularized GLMs, sequence models, time-series forecasting.

Selected Research Outputs

Zhao, Y. & Tang, X. "Scalar-on-Process Model for Educational Assessment: Modeling Time-Varying Action Effects with Group LASSO Regularization." *Manuscript ready for submission.*

Refereed oral presentation of the above, Symposium on Data Science & Statistics (SDSS), Milwaukee, WI, April 2026.