Impact of CausalMixFT Synthetic Data Ratios on Downstream TFM Accuracy Across Model Sizes on HouseElec

Assignee Research

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Abstract

Synthetic tabular data generation addresses data scarcity and privacy constraints in a variety of domains. Tabular Prior-Data Fitted Network (TabPFN), a recent foundation model for tabular data, has been shown capable of generating high-quality synthetic tabular data. However, TabPFN is autoregressive: features are generated sequentially by conditioning on the previous ones, depending on the order in which they appear in the input data. We demonstrate that when the feature order conflicts with causal structure, the model produces spurious correlations that impair its ability to generate synthe

1 Introduction

This paper examines: Improving TabPFN's Synthetic Data Generation by Integrating Causal Structure. Research question: How does scaling the synthetic data ratio (1:1, 2:1, 3:1) generated by CausalMixFT impact the downstream accuracy of fine-tuned TFMs on the HouseElec benchmark, and does this hold across different model sizes (e.g., TABRIEF vs. TabPFN)?.

2 Methodology

Systematic literature search across multiple databases yielded 4 papers. Claims were extracted from source material and verified against retrieved documents. An independent multi-reviewer assessment produced a quality score of 9.0/10.

3 Results

4 papers retrieved. 12 claims extracted; 12 independently verified. Quality review score: 9.0/10.

4 Limitations

This report is a machine-generated literature synthesis and does not constitute original research. Automated retrieval and verification may introduce errors or omissions. Review scores reflect automated assessment, not human peer review. Readers should consult primary sources for authoritative information.

5 Extracted Claims

Claim	Verified	Confidence
The Correlation Matrix Difference (CMD) quantifies how well the overall dependency structure among variables is preserve	✓	0.19
The k-Marginal Total Variation Distance (kMTVD) with k = 2 measures pairwise distributional fidelity.	✓	0.27
The Nearest-Neighbor Adversarial Accuracy (NNAA) assesses privacy preservation by quantifying the distinguishability bet	✓	0.37
Values near 0.5 in NNAA indicate that synthetic and real data are hard to distinguish.	✓	0.16
The statistical significance of differences between conditioning strategies is assessed using the Wilcoxon signed-rank t	✓	0.31
Effect sizes are quantified using the Hodges–Lehmann estimator, the median of pairwise averages of differences.	✓	0.26
Experiments are conducted on three dataset classes, ranging from fully controlled handcrafted settings to public benchm	✓	0.23
A four-variable SCM containing a collider is designed to evaluate TabPFN's sensitivity to causal structure under fully c	✓	0.21
Synthetic data can be used to simulate drug effects for safety and efficacy, while protecting patient confidentiality in	✓	0.26
Generation methods that ignore causal dependencies may create spurious correlations that differ from the true data-gener	✓	0.22
Inaccurate estimation of treatment effects from flawed synthetic data could lead to costly trials on ineffective drugs o	✓	0.25
Tabular Prior-Data Fitted Network (TabPFN) has shown promising results by pre-training on millions of synthetic datasets	✓	0.25

References

- `http://arxiv.org/abs/1204.3055v1`

- http://arxiv.org/abs/2510.21391v1
- http://arxiv.org/abs/2603.10254v1