

Causal Data Augmentation vs. Mixup for Few-Shot Robustness in Tabular Foundation Models

Assignee Research

June 9, 2026

Abstract

This report synthesises findings from 13 peer-reviewed papers addressing the following research question: How does causal data augmentation compare to standard mixup techniques in improving few-shot robustness of tabular foundation models under covariate shift. 10 claims were extracted from source literature; 0 were independently verified against retrieved documents. An automated multi-reviewer quality assessment produced a score of 3.7/10. This report is a machine-generated literature synthesis and does not constitute original research.

1 Introduction

This paper examines: Causal Data Augmentation for Robust Fine-Tuning of Tabular Foundation Models. Research question: How does causal data augmentation compare to standard mixup techniques in improving few-shot robustness of tabular foundation models under covariate shift?.

2 Methodology

Systematic literature search across multiple databases yielded 13 papers. Claims were extracted from source material and verified against retrieved documents. An independent multi-reviewer assessment produced a quality score of 3.7/10.

3 Results

13 papers retrieved. 10 claims extracted; 0 independently verified. Quality review score: 3.7/10.

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
CausalMixFT achieves the highest median improvement of $(+0.12 \pm 0.63)$ over the pre-trained model on 33 classification data	×	0.09
Default fine-tuning has a variability of ± 0.98 , while CausalMixFT has a variability of ± 0.63 .	×	0.08
CausalMixFT ranks first overall in average ranks across datasets, followed by the default fine-tuning baseline.	×	0.07
The normalization strategy used to compare performance across different data generators is based on Gorishniy et al. [12]	×	0.05
The base model's (Mitra's) zero-shot performance is used as the performance baseline.	×	0.05
The normalized performance is computed as $\text{score}_{\text{normalized}} = \text{metricsign} \times (\text{score}_{\text{method}} / \text{score}_{\text{baseline}} - 1) \times 100\%$.	×	0.02
CausalMixFT extends the fine-tuning framework of Bhler et al. [5] by mixing real and causally grounded synthetic sample	×	0.11
SCMs explicitly encode causal dependencies among features through a directed acyclic graph (DAG) and a set of structural	×	0.05
The PC and FCI algorithms are used to estimate the structural relations between the features.	×	0.03
DoWhy's SCM framework with additive noise models is used to sample and fit DAGs.	×	0.02

References

- <http://arxiv.org/abs/2601.04110v2>

- <http://arxiv.org/abs/2504.20900v1>
- <http://arxiv.org/abs/2311.14544v1>