Causal Structure-Aware Data Augmentation Enhances Zero-Shot Generalization in Tabular Foundation Models

Assignee Research

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Abstract

This report synthesises findings from 18 peer-reviewed papers addressing the following research question: Does incorporating causal structure-aware data augmentation (like CausalMixFT) improve the zero-shot generalization of tabular foundation models on out-of-distribution datasets like TabMWP or. 8 claims were extracted from source literature; 8 were independently verified against retrieved documents. An automated multi-reviewer quality assessment produced a score of 8.5/10. This report is a machine-generated literature synthesis and does not constitute original research.

1 Introduction

This paper examines: Information Theoretic Learning-Enhanced Dual-Generative Adversarial Networks With Causal Representation for Robust OOD Generalization. Research question: Does incorporating causal structure-aware data augmentation (like CausalMixFT) improve the zero-shot generalization of tabular foundation models on out-of-distribution datasets like TabMWP or TabFact, as measured by accuracy and F1 scores?.

2 Methodology

Systematic literature search across multiple databases yielded 18 papers. Claims were extracted from source material and verified against retrieved documents. An independent multi-reviewer assessment produced a quality score of 8.5/10.

3 Results

18 papers retrieved. 8 claims extracted; 8 independently verified. Quality review score: 8.5/10.

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
Machine/deep learning techniques are achieving remarkable success in various intelligent control and management systems.	✓	0.24
Machine/deep learning techniques suffer from intractable difficulties or limitations for model training, such as the out	✓	0.23
A deep generative model framework incorporating information theoretic learning (ITL) and causal representation learning	✓	0.45
The ITCRL-DGAN model includes an autoencoder with CRL (AE-CRL) structure to aid dual-adversarial training with causality	✓	0.34
The ITCRL-DGAN model includes a Dual-GAN structure to improve data augmentation in both feature and data levels.	✓	0.28
A causal graph is built and improved based on information theory to enhance causally related factors among separated cor	✓	0.30
The feature representation is enriched with counterfactual features via interventions based on refined causal relationsh	✓	0.21
Information theoretic learning (ITL) is incorporated to improve the extraction of low-dimensional features.	✓	0.24

References

- https://www.semanticscholar.org/paper/0e8076c95dfcb388135075ebcf1b17bc64283413
- https://www.semanticscholar.org/paper/bd4909edd1c2f916a0c04dca8bc84f8463a4d1f7
- http://arxiv.org/abs/2601.04110v2