Bankruptcy Prediction for Micro and Small Enterprises with Heterogeneous Graph Representation Learning and Topology-Aware Domain Adaptation

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Abstract

The bankruptcy prediction of micro and small-sized enterprises (MSEs) is of great significance for financial institutions to identify potential risks in advance. Existing enterprise risk assessment methods mostly rely on structured financial data and explicit relational information, and rarely consider implicit relationships such as litigation associations as well as risk event information, resulting in incomplete semantic representations of enterprise risk. Additionally, distributional shift across different regions also poses significant challenges to improving the prediction performance. To address these issues, we propose a unified framework that integrates graph representation learning and cross-domain adaptation for MSE bankruptcy prediction. First, we propose a Multi-source Heterogeneous Graph Synergistic Contrastive Learning model (MHGSC). The model uses heterogeneous graph neural networks to capture both explicit and implicit relational structures among enterprises, and employs a risk-aware contrastive learning mechanism to learn more discriminative risk representations. Furthermore, to address cross-regional distribution discrepancies, we propose a Topology-Aware Unsupervised Graph Domain Adaptation method (TAGDA). Existing domain adaptation approaches mainly focus on feature alignment while overlooking structural differences in enterprise relational graphs. To overcome this limitation, TAGDA incorporates topology-aware representation learning and a feature disentanglement mechanism to separate domain-invariant and domain-specific features, enabling stable knowledge transfer across regions. In addition, a topology-guided contrastive learning strategy is introduced to enhance cross-domain representation alignment and consistency. Experimental results based on datasets of MSEs from Chengdu and Aba show that the proposed method significantly outperforms multiple baseline models in both enterprise bankruptcy prediction and cross-domain risk prediction tasks. Further ablation experiments, sensitivity analysis, and interpretability analysis verify the effectiveness of each module of the model and its application value in real-world financial risk management.

Keywords

Bankruptcy Prediction, Heterogeneous Graph Neural Networks, Topology-aware Domain Adaptation, Feature Disentanglement, Contrastive Learning