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| Title | QAmplifyNet: pushing the boundaries of supply chain backorder prediction using interpretable hybrid quantum-classical neural network | | |
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| Abstract |  |
| Supply chain management relies on accurate backorder prediction for optimizing inventory control, reducing costs, and enhancing customer satisfaction. Traditional machine-learning models struggle with large-scale datasets and complex relationships. This research introduces a novel methodological framework for supply chain backorder prediction, addressing the challenge of collecting large real-world datasets with 90% accuracy. Our proposed model demonstrates remarkable accuracy in predicting backorders on short and imbalanced datasets. We capture intricate patterns and dependencies by leveraging quantum-inspired techniques within the quantum-classical neural network QAmplifyNet. Experimental evaluations on a benchmark dataset establish QAmplifyNet’s superiority over eight classical models, three classically stacked quantum ensembles, five quantum neural networks, and a deep reinforcement learning model. Its ability to handle short, imbalanced datasets makes it ideal for supply chain management. We evaluate seven preprocessing techniques, selecting the best one based on logistic regression’s performance on each preprocessed dataset. The model’s interpretability is enhanced using Explainable artificial intelligence techniques. Practical implications include improved inventory control, reduced backorders, and enhanced operational efficiency. QAmplifyNet also achieved the highest F1-score of 94% for predicting “Not Backorder” and 75% for predicting “backorder,” outperforming all other models. It also exhibited the highest AUC-ROC score of 79.85%, further validating its superior predictive capabilities. QAmplifyNet seamlessly integrates into real-world supply chain management systems, empowering proactive decision-making and efficient resource allocation. Future work involves exploring additional quantum-inspired techniques, expanding the dataset, and investigating other supply chain applications. This research unlocks the potential of quantum computing in supply chain optimization and paves the way for further exploration of quantum-inspired machine learning models in supply chain management. Our framework and QAmplifyNet model offer a breakthrough approach to supply chain backorder prediction, offering superior performance and opening new avenues for leveraging quantum-inspired techniques in supply chain management. | |