Predicting Violent Crime with Machine Learning: An Holistic Analysis of Algorithms and Approaches

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Abstract:

The prediction of violent crimes is a critical challenge for law enforcement agencies aiming to improve public safety and allocate resources more effectively. Traditional crime prevention methods often rely on reactive strategies that may lack the precision to predict and prevent incidents before they occur. With the advent of advanced machine learning (ML) techniques, there is growing interest in leveraging large datasets and predictive models to forecast violent crimes. This paper explores the use of various machine learning algorithms—such as decision trees, random forests, support vector machines (SVMs), and deep learning methods—to predict violent crime occurrences based on historical crime data, demographic information, and spatio-temporal patterns. By integrating these algorithms with geographical and temporal features, the potential of ML models to identify high-risk areas and times are demonstrated where violent crimes are likely to occur. The effectiveness of the different Machine Learning algorithms are also demonstrated, focusing on accuracy, precision, recall, and interpretability. Additionally, challenges such as data imbalance, model bias, and ethical concerns surrounding the use of predictive policing technologies are equally addressed. The results show that machine learning models can provide valuable insights for crime prevention, but careful consideration must be given to the transparency and fairness of these systems. This study contributes to the growing field of crime prediction by highlighting the strengths and limitations of various machine learning approaches and providing recommendations for future research and practical deployment.