Reinforcement Learning for Targeted Policy Intervention: A Model for Reducing Multidimensional Deprivation

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Abstract

Traditional approaches to district-level policy planning for national development often rely on static analyses that fail to account for the dynamic nature of deprivation and the complex interdependencies between various socio-economic indicators. We propose a novel, data- driven framework that integrates a composite deprivation metric with a reinforcement learning (RL) approach to address this limitation. Our model first uses a pre-trained machine learning model to compute a Multidimensional Deprivation Index (MDI) from twenty-four key indicators for each district using the latest available dataset. A Q-learning algorithm then simulates thousands of policy trials across different governance-sector options to learn the optimal policy for maximizing the reduction in the MDI. The resulting Q-table serves as a clear, actionable recommendation for each district. The explainability of this framework is ensured through SHAP (SHapley Additive exPlanations) analysis, which confirms those specific features which are the root causes of deprivation. The findings of this research demonstrates a significant shift from reactive policy-making to a proactive, intelligent and transparent system for targeted development, optimizing resource allocation and accelerating progress toward well-being.