OPTIMIZING BASEBALL LINEUPS THROUGH DETERMINISTIC TREE-BASED SIMULATION ANALYSIS

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Zoom Link https://binghamton.zoom.us/j/97209672997

Abstract

This research proposes an in-depth analysis of a deterministic, tree-based model designed to simulate baseball game dynamics and optimize batting lineups. The approach is comprised of simulating baseball game scenarios utilizing depth-first and breadth-first tree-based simulations, and exhaustively exploring player outcomes to computer expected runs for various lineup configurations of nine different players. The depth-first tree expansion multiplies the probabilities of concurring nodes until reaching a leaf node, then backtracks and continues the search. This tree-expansion approach to simulation enables utilization of player outcome probabilities to determine the probability of certain branches of outcomes occurring. The breadth-first tree expansion also multiplies the probabilities of branches of nodes but searches all possibilities for a given batter before moving onto the next. Lineups are generated recursively as well, exploring all possible combinations of the nine players studied. The study compares the tree expansion method to a random sampling technique, highlighting accuracy and computational efficiency differences. The tree-expansion method outpaces simulating 10^7 game samples using a random number generator to generate outcomes by a factor of 12, while maintaining a 0% error rate in calculating expected runs. The simulation results demonstrate the model's precision in predicting expected runs, emphasizing its potential impact on strategic decision-making in baseball. Potential enhancements to this model may include adapting to player rotations, addressing dynamic base running scenarios, and implementing a tree-expansion search past a maximum depth of 9 levels to better replicate a true baseball game.