

ABSTRACT

Backward Induction Is Not Robust: The Parity Problem and the Uncertainty Problem

A cornerstone of game theory is backward induction, whereby players reason backward from the end of a game in extensive form to the beginning in order to determine what choices are rational at each stage of play. Truels, or three-person duels, are used to illustrate how the outcome can depend on (1) the evenness/oddness of the number of rounds (*the parity problem*) and (2) uncertainty about the endpoint of the game (*the uncertainty problem*). Since there is no known endpoint in the latter case, an extension of the idea of backward induction is used to determine the possible outcomes.

The parity problem highlights the lack of robustness of backward induction, but it poses no conflict between two foundational principles and, hence, does not seem paradoxical. On the other hand, two conflicting views of the future underlie the uncertainty problem, depending on whether the number of rounds is bounded or unbounded. While in the bounded case the players invariably shoot from the start, in the unbounded case they may all cooperate and never shoot, despite the fact that the truel will end with near certainty—and therefore be *effectively* bounded—by the end of several rounds. Some real-life examples, in which destructive behavior sometimes occurred and sometimes did not, are used to illustrate these differences.

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