

Title:An example of game-theoretic approaches to analyze simple board games and evaluate globally optimal strategies / Revision 3: "Heroes and Fortresses" **Abstract:**In many cases, including some popular board games like the classic RISK, people tend to follow the same basic principles when it comes in formulating a winning strategy. It turns out that these commonly shared principles of play can be predicted and evaluated by using well-defined mathematical approaches that define the core of the so-called Game Theory. This short study presents the basic principles of game-theoretic approaches in game-playing and applies a simple, yet comprehensive, analysis of the dice-battle outcome in RISK.

This report is an extensive version of an earlier packet of notes, produced over a brief discussion over the Usenet during May 2002. A related message, including the Matlab source code for the RISK battle outcome simulation, were first posted at comp.ai.games on May 2002. Since then, I received numerous messages requiring further explanations about the Matlab source code and the results produced. As the program itself is nothing more than a dice-drawing enumerator, I decided it was better to explain the overall simulation methodology instead, presenting a practical example of applied game-theoretic modeling and giving a brief glimpse of the underlying theory behind it. The source code itself is quite generic and can be executed nearly in every version of Matlab, however it has been tested only on versions 4.x and newer.

Revision 3 of this paper contains useful elements on recent variations of the standard RISK game, including the participation of "Hero" and "Fortress" attributes when calculating battle outcome in specific locations and/or special units. It also contains an extension to the initial game-theoretic model of battle analysis, based on a new probabilistic model that is introduced for calculating the probabilities for each outcome in any single battle, using binomial distribution processes. With such a model at hand, it is fairly easy to decide not only "how" but also "when" to go on dice-battle, given the specific forces opposition.

Summary of results - Recommendations:

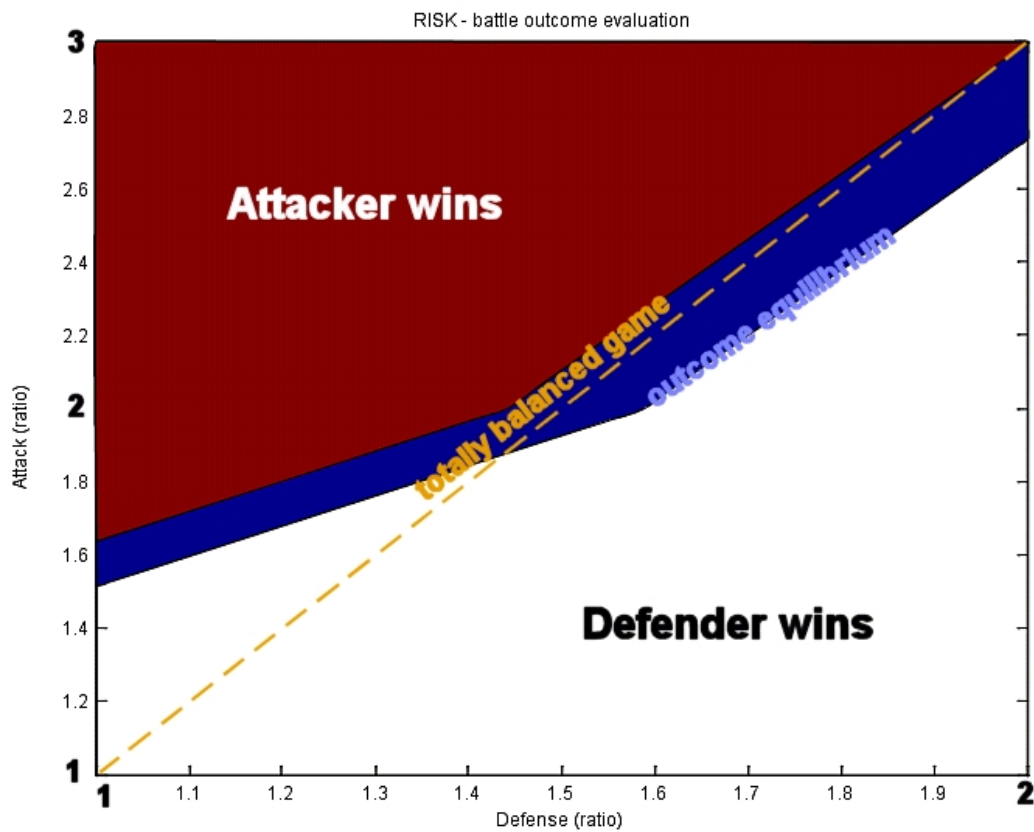
- For standard battle rules (0/0) or when equal "hero" and "fortress" bonuses (+1/+1) apply, the attacker should use at least as much units as the defending force size.
- When a "hero" bonus is available for the attacker and no bonuses are available for the defender (+1/0), the attacker can use 72% or more of the defender's force size.
- When the defender exhibits a +1 difference in bonuses towards the attacker, i.e. when the attacker has no "hero" pawn versus one defender's bonus (0/+1) or has a "hero" pawn versus two defender's bonuses (+1/+2), at least 12% larger force should be used during the attack.

- Finally, when the defender has both a "hero" and a "fortress" in the area, the attacker, in case of an attack, should use at least double the size of the defending force.

RISK: Battle outcome analysis in the popular strategy game

Written by

Saturday, 10 October 2009 19:41 - Last Updated Sunday, 20 December 2009 07:43



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and [Wikipedia](#).
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