

Tipsy Cop and Tipsy Robber: a Variation of Cops and Robbers Game

Viktoriya Bardenova*, Vincent Ciarcia*, Erik Insko, Florida Gulf Coast University

In this project we explore a variation of the cops and robbers game, first introduced independently by Quilliot, and Nowakowski and Winkler. In the original game, a cop and a robber alternate turns moving from vertex to adjacent vertex on a connected graph with the cop trying to catch the robber and the robber trying to evade the cop. In our variant we assume that the cop and robber are tipsy, meaning that a proportion of both their moves are random, and rather than forcing the players to alternate moves, we use a spinner wheel to determine whether the next move will be a sober cop move, a sober robber move, or a tipsy move by either player. We model this scenario on vertex-transitive and non-vertex transitive graphs using the theory of Markov chains. Given a specified set of initial conditions on the players' distance and tipsiness, we consider the following questions: What is the probability that the game, beginning in state i , will be in state j after exactly M rounds? What is the probability that the game lasts at least M rounds if the players start distance d away? What is the expected number of rounds the game should last if the players start distance d away? One inspiration for this game is to model the biological scenario illustrated in the YouTube video https://www.youtube.com/watch?v=Z_mXDvZQ6dU, where a neutrophil chases a bacteria cell moving in random directions. While the bacteria's movement seems mostly random, the neutrophil appears slightly more purposeful.

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