

# Advancing Past the Basics of Forecasting using Artificial Market Models

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Binary and ternary agent resource games, such as the Minority Game, have been studied as a way of understanding complex adaptive systems. These games involve a number of agents who compete for a limited resource based on a set of strategies and a method to score these strategies over past information. An interesting question that arises is: Given the current state of the complex system, and its past states, what will happen in the future? In the context of the artificial market corresponding to such agent resource games, we become interested in estimating the probability distribution of agents over the space of possible strategy sets. We attempt to solve such an estimation problem using a recursive Gauss-Newton numerical optimization technique. The method we will describe is similar to a Kalman Filter, but allows inequality constraints. Using such a scheme, we can find future estimates in real time along with a covariance matrix representing the distribution of our expected errors. This covariance matrix is also useful in determining when we are in a pocket of predictability.

We investigate variations on the game and estimation scheme that might make our framework more robust. We try using a ternary minority game, in which agents can play a linear combination of their strategies or not play at all based on their strategy scores. We also allow the agents to use an exponentially discounted weighting of past information. We believe this may be a better model for certain complex adaptive systems and may also contain information that will be easier to estimate. We look for routines to initialize our recursive scheme and methods to recover from false forecasts. In addition, we discuss a variation of the recursive scheme to provide theoretically better estimates, ways to tighten covariance matrices, and possible downfalls caused by numerical inaccuracy.