

A STUDY ON MODELING AND ANALYSIS OF AGENT-BASED SIMULATIONS WITH Q-LEARNING

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ABSTRACT. *Recently, an agent-based problem has been attracting much attention in various fields, for instance marketing research as well as economic and social sciences. Though many researchers treat this problem, learning effects of agents cannot be disregarded because most agents (persons) often change their action rule according to circumstances. In this paper, we deal with an agent-based problem including Q-learning algorithm, which is one of reinforcement learning methods. In this study, we employ two kinds of agents, followers and pioneers, and design their characters by using Q values. Agents decide their attitudes by ones which neighbor agents show, and then Q values are updated. Simulation studies show that the results of agent-based simulations are affected by action rules of agents and the initial attitudes of agents.*

Keywords: Agent-based simulations, Marketing research, Reinforcement learning, Q-learning, ϵ -greedy method, Categorization of agents

1. **Introduction.** Many researchers study estimation and simulation problems for economic and social activities [1-9]. Recently, agent-based approaches have been attracting much attention as one of simulating method for not only various social and economic phenomena but also marketing researches. Agent-based simulation is the method for analyzing various phenomena in virtual spaces which researchers set up. At first, agents are given some initial conditions and performance rules. Then, these agents are arranged in a virtual space and they perform autonomously according to their performance rules.

Among marketing researchers, analyzing tools for diffusion of rumors and fashions are demanded as they want to analyze selections of goods which consumers purchase. In order to model and analyze social and economic systems, the methods by constructing some differential equations are proposed [8]. But it is sometimes difficult to identify some parameters in these equations [9,10] because it is difficult to perform many experiments or to get enough real data in order to identify parameters in economic and social systems. On the other hand, in the case of agent-based problems researchers only set the characters of agents and virtual spaces according to real social systems. Hence, the author considers that an agent-based approach is suitable for some social and economic problems.

The author researched agent-based approaches for marketing researches and set some kinds of characters of agents [1-3], their characters are simply changed randomly in some fixed patterns. But in real society, many people (agents), especially trendsetters, often change their action rules by attitudes of neighbor agents. Furthermore, they learn and improve their action rules not only in a good sense but also in a bad sense. Hence we cannot disregard the effect of learning for agents when we consider the circulation of rumors and fashions.