International Journal of Innovative Computing, Information and Control
Volume **4**, Number **3**, March **2008**

ICIC International ©2008 ISSN 1349-4198
pp. **651–659**

STATIC, COMPLETELY STATIC, AND RATIONAL GAMES OF COMPLETE INFORMATION AND THEIR DIFFERENT NASH EQUILIBRIA

Dianyu Jiang

Institute of Games Theory with Applications
Huaihai Institute of Technology
No.59 Cangwu Road, Xinpu, Lianyungang-city 222005, P. R. China
jiangdianyu425@126.com

Received December 2006; revised May 2007

Abstract. *In this paper, we define expected equilibria in a finite game where all the players have exactly the same common knowledge: (1) a set of players (at least two players), (2) for each player, a set of actions, (3) payoffs received by each player for the combinations of the actions, and (4) each player hoping to derive maximal utility. Our first conclusion is that in a condition game all players have exactly the same common knowledge: (1), (2), (3) and (4). And the second is that Expected equilibria in a finite game are significant if and only if all the players have exactly the same common knowledge (1), (2), (3), (4) and (5) the principle of maximum entropy. Finally, according to our results, we obtain the new conclusions on the three typical examples, i.e. prisoners' dilemma, battle of the sexes, and hawk- dove game.*
Keywords: Principle of maximum entropy, Greatest utility axiom, Completely static game, Rational game, Condition game, Pure Nash equilibrium, Expected equilibrium

1. **Introduction.** If a player repeatedly plays a zero-sum game, a mixed strategy adds an uncertainty which could confuse his/her enemy [1]. As a result, each player hopes to use his/her mixed strategy with the greatest uncertainty. In 1948, Shannon introduced the concept of information entropy to describe an uncertainty of a random variable taking value [2]. In 1999, R. J. Aumann studied the formalization of knowledge and common knowledge in games theory. Call an event common knowledge (in a population) if all know the event, all know that all know it, all know that all know that all know it, and so on ad infinitum [3, 4].

The Principle of Maximum Entropy states: When one has only partial information about the possible outcome one should choose the probabilities so as to maximize the uncertainty about the missing information. In other words, the basic rule is: Use all the information on the parameter that you have, but avoid including any information that you do not have. Therefore one should be as uncommitted as possible about missing information [5, 6].

A game is said to be a static (or simultaneous move) one of complete information, if all the following are common knowledge among all the players. (1) A set of players (at least two players). (2) For each player, a set of actions. (3) Payoffs received by each player for the combinations of the actions. And (4) each player hopes that his/her own utility is as great as possible. But for an actual game, the players have other common knowledge relating to their action selection. For instance, in Battle of the Sexes, it is possible that it is their common knowledge that the husband is willing to make any sacrifice for his wife.