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論文要旨

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論文題名	Theoretical Approaches to One-Shot Games and Their Applications

Usually, equilibrium is thought as an evolutionary solution concept which is reached after players have corrected their biased beliefs and adjusted their strategies. Basically, equilibrium models require three components: strategic thinking (formation of beliefs about others' behaviors); optimization (choosing a best response to those beliefs); mutual consistency (adjustment of beliefs and best responses until they are mutually consistent). However, it is often the case that solutions of equilibrium models are not supported by data in lab or the phenomena in the real world (McKelvey & Palfrey, 1992; Nagel, 1995; Camerer, 2003). A leading explanation of such failures is that the mutual consistency assumption is too strong. So far several models have been proposed to relax the mutual consistency. For example, the level-k model, initially proposed by Nagel (1995) and Stahl and Wilson (1995), partitions players according to 'levels of reasoning': the action of a level-k player is the best response to that of a level -(k-1) player and actions of the level-

0 player are assumed to be uniformly distributed over the action set. The Cognitive Hierarchy model proposed by Camerer, Ho and Chong (2004) is also based on the 'depth of reasoning' idea. Goeree and Holt (2004) propose the Noisy Introspection model to consider the reasoning process reversely, i.e. from a sufficiently large order of belief. In summary, these approaches share the same idea of weakening the mutual consistency assumption, in other words, an involved player is assumed to play according to some beliefs which are not necessarily consistent with his/her opponents' actions.

The other key common argument of the above three non-equilibrium model is that players are assumed to think 'k' step. However, this raise the question that which step an involved player should stop at. It is rather untraceable and arbitrary. A natural thinking is that a player doesn't take the iterative thinking at all, or once a player started iterative thinking, he/she will continue this process until equilibrium is reached. So we argue the 'k' step thinking way is relatively far from real players' decision making process in a game.

In this research, we propose a new theoretical model – the **One-Shot Game Model** to character real player's decision making process as well as handle deviations in several typical games. Simply speaking, in our model, the decision process of a player consists of two steps. Firstly, a player formulates his/her belief about his/her opponents' actions;

secondly, based on the formulated belief, a player decides his/her optimal choice. Similar with the existing approaches, the proposed approach also relaxes the mutual consistency assumption and can be regarded as a non-equilibrium approach. However, we distinguish our approach in mainly the following two aspects.

Firstly, we enrich the methods of belief formulation. Speaking in detail, we propose several alternatives possibly reflecting real players' thinking process when formulating his/her belief. For example, a player may deduce that his/her opponent should adopt an action which generates a higher average payoff with a higher probability. This kind of deduction is based on his/her opponent's payoffs and reflect the idea that an involved player should put him/her into his/her opponent's shoes in a game.

Secondly, we utilize the **One-Shot Decision Theory** to solve each player's decision problem. The One-Shot Decision Theory is initially proposed by Guo (2011) which argues that a person makes a decision under uncertainty based on his/her imagined scenario which is most consistent with his/her personality. In order to understand this core argument, let us examine several well-known examples. The expected utility theory tells that the reason why a person buys a lottery is because his/her utility function is convex while the reason why a person buys insurance is because his/her utility is concave. The One-Shot Decision Theory manifests that the lottery buyer is a decision maker who takes into account the scenario which has a low probability to happen but can bring about a large benefit and the insurance buyer is a decision maker who takes care of the scenario which can cause a large loss even with a low probability. Clearly, the One-Shot Decision Theory based explanation is close to the way of human beings' thinking and intuitively acceptable.

We apply our framework to analyze some simple games: the stag hunt game, the chicken game and the battle of sexes. Interestingly, in those games, players' choices are rather robust to the formulated beliefs, in other words, players' choices (or focus points) are only determined by his/her character and is independent of the formulated beliefs.

Utilizing the One-Shot Game Approach, we also analyze two relatively difficult games, namely, the **Capacity Allocation Game** and the **First Price Sealed Bid Auction**. Further, we provide explanations for the abnormalities in those games.

1 Capacity Allocation Game

In a supply chain, the capacity shortage refers to the situation that retailers' demand is higher than the supplier's inventory, as modifications are infeasible in a short term, the supplier has to divide the limited inventory to each retailer. The proportional allocation method is the most popular allocation mechanism and says the supplier provides each retailer the quantity proportional to his/her order. However, under such a natural allocation rule, the Nash equilibrium of such a game is that each retailer submits an order of infinity, which is in contrary to people's intuition as well as deviates from experimental findings (Chen et al, 2012). What is worse, such an equilibrium stays the same even if we change the shape of the utility function and the model parameters, which obviously increases the difficulty of solving such an abnormality.

We utilize the proposed One-Shot Game Approach to analyze such a game. Simply speaking, for each order quantity, say x, a retailer evaluates every possible order quantity, say y, which is submitted by his/her rival with considering the probability of his/her rival choosing y and his/her own payoff when his/her rival chooses y. For x, amongst all possible order quantities submitted by his/her rival, the retailer chooses one with the highest evaluation, which is the imagined scenario (the focus point) for x. Then a retailer evaluates his/her each order quantity, x, based on its focus point, and chooses the one as the optimal order quantity which can bring highest payoff when its focus point (imagined scenario) occurs. Analytical results obtained within our framework matches the experimental findings well.

2 First Price Sealed Bid Auction

The classical solution concept in first price sealed bid auctions is the risk-neutral Bayesian Nash Equilibrium (hereafter RNBNE) (Vickrey, 1961). However, experimental evidence shows that real bidders don't follow it at most time. Generally speaking, there exist two major tendencies. One is that bidders with low valuation tend to bid randomly (Cox et al., 1988), and the other one is that bidders with high valuation tend to overbid (Cox et al., 1982). To the best of our knowledge, until now, there exists no theoretical model providing a unified explanation for those phenomena and we utilize the One-Shot Game Approach to achieve this goal.

In our setting, each bidder is thought to face a decision problem under uncertainty which origins from other bidders' bidding prices. The action set is his/her bidding price and the uncertain factor is his/her rivals' bidding prices. Taking into account the one-time feature of auctions, it is intuitive that a bidder only imagines one bidding price presented by his/her opponents amongst all possible prices for determining his/her bidding price rather than take any kind of average of all possible prices. Taking the possible winning and losing regret into account, analytical results obtained within our framework well explain the deviations observed in first price sealed bid auctions: bidders tend to bid randomly upon drawing a low value and overbid when their valuation is relatively high.