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論文要旨

THESIS SUMMARY

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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

We study two-sided matching problems where one side consists of institutions and the other side individuals. These problems have prolonged social and economic influence since they associate with lots of real-world matching practice such as job matching, school admission and so on. Theoretically, such a problem can be formulated as a many-to-one matching model. Previous and current research on this model has been focusing on mainly three aspects: stability concept, equilibrium analysis and algorithmic solution. Our research aims at exploring to which extent Gale and Shapley's classical model can be enhanced to solve complex many-to-one matching problems, and then contributes to fixing market failures by providing solutions in these three aspects. Specifically, we look into a labor market with externalities among firms, a preference revelation game which is defined on a school choice market and a house allocation problem with existing tenants.

We first study a labor market with externalities among firms. In this market, each firm cares about not only which workers it hires but also which workers the other firms hire. Under this assumption, the standard definition of stable matching is not applicable any more since firms have preferences over matchings instead of workers. Moreover, we assume that whenever a firm hires new workers or fires its current workers, the matching of the rest firms and workers is not kept fixed. Then different outcomes will in turn affect this firm's strategic choice. In order to formulate each firm's expectation on such uncertainty, we apply a tool called estimation function which represents all possible matchings it believes will happen. Particularly, we enhance the current notion of estimation function by defining a function which assigns a numeric rank to each matching. Among all these matchings, we assume that there exists a matching which determines a firm will deviate or not according to whether this matching is more preferred to the current one. In this sense, we name such a matching as threshold matching. Based on it, we propose a new stability concept called T-stability. Finally, we provide two restrictions on firms' preferences which are called T-substitutability and induced preferences. When these restrictions are satisfied, we show that T-stable matchings always exist.

Then we analyze a preference revelation game which is defined on a school choice market. In this market, each school's preferences are open to the public due to laws, regulations and so on, but each student is able to report preferences strategically. This fact enables us to formulate this market as a preference revelation game of students and then analyze the equilibrium outcome. Previous research has demonstrated the existence of two Nash equilibria which are called strong Nash equilibrium and strictly strong Nash equilibrium. Moreover, two types of strictly strong Nash equilibria have been characterized according to the way by which they are derived. In our research, we refine the current result by proposing an even stronger equilibrium concept called passively-strictly strong Nash equilibrium. It rules out a deviating coalition which includes students who were threatened to join. Simply speaking, such a student deviates not for achieving a better outcome but for avoiding an even worse one which can be caused by the rest coalition members. Then we show two existence results about this Nash equilibrium. One is that if two types of strictly strong Nash equilibria are not equivalent, then none of them is a passively-strictly strong Nash equilibrium. The other one is that if the strictly strong Nash equilibrium derived by an iterative deferred acceptance algorithm satisfies a condition called irrelevance of low-tier agents, then it is also a passively-strictly strong Nash equilibrium.

Finally, we investigate a house allocation problem with existing tenants. This problem is not a many-to-one matching problem, but is closely related since it adopts a popular mechanism which has been demonstrated to be a special case of the student-optimal stable mechanism which has important application in many-to-one

matching problems. Named as the MIT-NH4 mechanism, this mechanism satisfies several nice properties including individual rationality, fairness and strategy-proofness. But it does not satisfy Pareto efficiency and easily causes large efficiency loss. Witnessing this fact, our research aims at recovering efficiency loss for the MIT-NH4 mechanism. We first partition houses into underdemanded house, quasi-underdemanded house and overdemanded house according to the outcome determined by the standard MIT-NH4 mechanism. Then we show that students who are matched with underdemanded houses and quasi-underdemanded houses are Pareto unimprovable. But nevertheless, if they give consent to certain priority violation, then Pareto efficiency of the other students' assignment can be improved. Based on these results, we propose an efficiency-adjusted MIT-NH4 mechanism which recovers efficiency loss for the standard MIT-NH4 mechanism. Furthermore, we show two properties of the new mechanism. One is that the consent granted by Pareto unimprovable students will not worsen their own assignments. The other one is that the efficiency-adjusted MIT-NH4 mechanism proceeds along a monotonic improving path.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

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