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Announcement

An annotated bibliography of Lloyd Shapley's contributions[☆]

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ABSTRACT

This paper provides an annotated bibliography of Lloyd Shapley's contributions to matching theory, game theory in general, and other areas in mathematics.

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1. Introduction

I thank David K. Levine, guest editor of this special issue, for kindly inviting me to contribute to it. I am delighted to do so. In addition to Serrano (2013), "Lloyd Shapley's Matching and Game Theory," *Scandinavian Journal of Economics* **115**, pp. 599–618, this paper has used Google Scholar and the most updated vitae of Shapley's, posted at the UCLA economics department webpage, in order to provide an annotated bibliography of Shapley's contributions that is as complete as possible. The paper is organized by the major areas to which Shapley contributed. The reader is encouraged to consult further details in Serrano (2013) and the many papers and surveys cited therein. The breadth and depth of the contributions of Lloyd Shapley's and his distinguished coauthors come across quite clearly in all these impressive papers.

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2. Matching theory

2.1. Matching: marriage and roommate problems

- Gale, D. and L. S. Shapley (1962), "College Admissions and the Stability of Marriage," *American Mathematical Monthly* **69**, 9–15.
This joint paper with David Gale initiates matching theory. It proposes marriage, roommates, and college admissions problems, and studies the nonemptiness and other properties of stable matchings. It introduces the deferred-acceptance algorithm as a tool to prove that the set of stable matchings in the marriage problem is nonempty. It also proves that the outcome of the algorithm when one side proposes is the optimal stable matching for that side. See also:
- Shapley, L. S. (1962), "Complements and Substitutes in the Optimal Assignment Problem," *Naval Research Logistics Quarterly* **9**, 1, 45–48.

2.2. Assignment: housing problems

- Shapley, L. S. and H. E. Scarf (1974), "On Cores and Indivisibility," *Journal of Mathematical Economics* **1**, 23–28.
This joint paper with Herbert Scarf studies assignment problems, like housing, in which one of the sides "does not have preferences." It proves that the core of these problems is nonempty, using the top-trading cycles algorithm as well as an argument based on balancedness. It was reprinted as:
- Shapley, L. S. and H. E. Scarf (1974), "On Cores and Indivisibility," in *Studies in Optimization*, George B. Dantzig and B. Curtis Eaves, eds., The Mathematical Association of America.

2.3. Assignment: trading indivisible goods for money

- Shapley, L. S. and M. Shubik (1971), "The Assignment Game I: The Core," *International Journal of Game Theory* **1**, 111–130.
This paper studies a model of exchange of indivisible goods for money. It proves nonemptiness of the core, and that the core coincides with the set of competitive equilibrium allocations. See also:
- Shapley, L. S. and M. Shubik (1975), "Competitive Outcomes in the Cores of Market Games," *International Journal of Game Theory* **4**, 229–237.
It is shown here that every "market game" (i.e., one that arises from an exchange economy with money) can be represented by a "direct market" whose competitive outcomes completely fill up the core.

3. General game theory

3.1. Cooperative games: the Shapley value

- Shapley, L. S. (1953), "A Value for n-Person Games," in *Contributions to the Theory of Games*, volume II, H.W. Kuhn and A.W. Tucker (eds.), 307–317, Princeton University Press.
This paper is the first application of the axiomatic method to general cooperative games. It characterizes a unique function that satisfies the four axioms of efficiency, anonymity, additivity, and dummy player. This function is known today as the Shapley value.
- Shapley, L. S. and M. Shubik (1954), "A Method for Evaluating the Distribution of Power in a Committee System," *American Political Science Review* **48**, 787–792.
- Shapley, L. S. (1962), "Simple Games: An Outline of the Descriptive Theory," *Behavioral Science* **7**, 59–66.
This joint paper with Martin Shubik provides an important early application of the Shapley value. It considers a committee and tries to measure the power of each member of the committee. The result is the Shapley–Shubik power index, and the authors illustrate its use in different applications, including the power of permanent versus nonpermanent members of the United Nations Security Council. The approach is based on simple games, and the second paper is a good outline of the class.
- Dubey, P. and L. S. Shapley (1979), "Mathematical Properties of the Banzhaf Power Index," *Mathematics of Operations Research* **4**, 99–132.
One of the main alternative indices to the Shapley–Shubik power index in political theory is the Banzhaf power index. The Banzhaf index lacked an axiomatic analysis supporting it, and this joint paper with Pradeep Dubey provides it.
- Shapley, L. S. (1977), "A Comparison of Power Indices and a Nonsymmetric Generalization," P-5872, The RAND Corporation, Santa Monica, CA.
- Owen, G. and L. S. Shapley (1989), "Optimal Location of Candidates in Ideological Space," *International Journal of Game Theory* **18**, 339–356.
With the consideration of ideologies, relaxing the assumption of uniform orderings in the Shapley–Shubik power index, in collaboration with Guillermo Owen, these papers lead to the Shapley–Owen asymmetric power index.
- Shapley, L. S. (1994), "A Boolean Model of Organization Authority Based on the Theory of Simple Games," Mimeo.

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