Lectures on the Theory of Random Utility Models

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The study of stochastic choice is appealing in two ways. First, stochastic choice data are exactly the type of data we observe in empirical analysis. Second, the theory of stochastic choice contains interesting mathematical results that are distinct from those in deterministic choice theory.

However, it can be difficult for a student to gain a unified understanding of the literature on stochastic choice. This difficulty arises from the fact that the literature has developed independently across three different disciplines: psychology, decision theory, and mathematics. In fact, the axiomatization of random utility models was first provided by Falmagne (1978) in mathematical psychology. Without knowing the result, Barbera and Pattanaik (1986) obtained the same axiomatization in economics. Later, Mcfadden and Richter (1990) proposed an alternative axiomatization. Since then, economists, especially empirical researchers, have paid more attention to the result by Mcfadden and Richter (1990) than to the result by Falmagne (1978).

Moreover, ever since Gul and Pesendorfer (2006) generalized the random utility model to incorporate stochastic choice over lotteries, the literature in decision theory has become active again and has grown rapidly.

In this course we will review the classical results achieved by Block and Marschak (1960), Falmagne (1978), and Mcfadden and Richter (1990). Although these results have been regarded as independent of each other, I provide a new unified geometric way to understand these classical results. To demonstrate the usefulness of this geometric insight, I will show my recent preliminary result with Prof. Yusuke Narita (of Yale). In this result, we obtain a necessary and sufficient condition under which any random utility model can be represented by a random-coefficient multinomial logit model. (The result can be seen as a discrete version of the main result of Mcfadden and Train (2000).)

I will also provide a detailed explanation of Gul and Pesendorfer (2006). Time permitting, we may also review more recent generalizations, including those in my papers with Prof. Jay Lu (of UCLA), such as Lu (2016), Lu and Saito (2018), and Lu and Saito (2019), as well as those in Frick, Iijima, and Strzalecki (2018). (I will present Lu and Saito (2019) in a separate theory

seminar on July 30.)

The main purpose of this course is to help students get ready to start their own research on the topic. Accordingly, instead of providing rough explanations of many papers, I will focus on just a few important papers, and explain their proofs in detail. After the first four classes, a reading group will be organized to read more papers on stochastic choice across different fields.

This course is designed for students who are interested not only in decision theory but also in empirical analysis (such as empirical IO) or econometrics, both because the topic is directly relevant to empirical analysis and because the course content is not usually taught in the Ph.D. program due to its interdisciplinarity.

The course has no prerequisites beyond knowledge of expected utility theory. Advanced undergraduate students and students from other schools are also welcome.

Main References:

- Barbera, S. and P. K. Pattanaik (1986): "Falmagne and the rationalizability of stochastic choices in terms of random orderings," Econometrica, 707–715.
- Block, H. D. and J. Marschak (1960): "Random orderings and stochastic theories of responses," Contributions to Probability and Statistics, 2, 97–132.
- Falmagne, J.-C. (1978): "A representation theorem for finite random scale systems," Journal of Mathematical Psychology, 18, 52–72.
- Gul, F. and W. Pesendorfer (2006): "Random expected utility," Econometrica, 74, 121–146.
- McFadden, D. and M. Richter (1990): "Stochastic rationality and revealed stochastic reference," in Preferences, Uncertainty, and Optimality, Essays in Honor of Leo Hurwicz, Boulder, CO: Westview Press, 161–186.
- McFadden, D. and K. Train (2000): "Mixed MNL models for discrete response," Journal of Applied Econometrics, 447–470.

Additional References:

- Frick, M., R. Iijima, and T. Strzalecki (2018): "Dynamic random utility," Working paper.
- Lu, J. (2016): "Random choice and private information," Econometrica, 84, 1983–2027.
- Lu, J. and K. Saito (2018): "Random intertemporal choice," Journal of Economic Theory.
- Lu, J. and K. Saito (2019): "Repeated choice: A theory of stochastic intertemporal

preferences," Working paper.