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Afriat in the lab ☆

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Abstract

Varian (1988) showed that the utility maximization hypothesis cannot be falsified when only a subset of goods is observed. We show that this result does not hold under the assumptions that unobserved prices and expenditures remain constant. These assumptions are naturally satisfied in laboratory settings where the world outside the lab remains unchanged during the experiment. Hence for so-called induced budget experiments the Generalized Axiom of Revealed Preference is a necessary and sufficient condition for utility maximization in general, not just over lab goods. Lab experiments are therefore a valid tool to put the utility maximization hypothesis to the test.

JEL classification: C14; C91; D11; D12

Keywords: Afriat's Theorem; Experimental economics; GARP; Revealed preference; Utility maximization

1. Introduction

In the past twenty years, laboratory experiments have become an important tool for economists to test theories and elicit preferences. Induced budget experiments, in which subjects are asked to make choices from budgets provided by the experimenter, make particular use

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of the opportunity to collect data that is otherwise difficult to come by.[1] Such experiments have become increasingly popular.[2]

Choices on such budgets can be tested for consistency with the Generalized Axiom of Revealed Preference (GARP), which is a necessary and sufficient condition for the existence of a utility function that rationalizes the observed choices (Afriat, 1967; Varian, 1982). Choices on budgets with many different prices collected under clean laboratory conditions provide well-suited data for this test. Experiments therefore seem to offer a unique opportunity to put the utility maximization hypothesis to the test as observing a violation of GARP falsifies the hypothesis.

However, testing a data set for consistency with GARP only characterizes utility maximization when the demand for all available goods is observed. Varian (1988) shows that if we only observe demand for a subset of goods, then GARP is no longer necessary. In his conclusion, Varian (1988) calls his finding "a negative result, similar in spirit to the Sonnenschein–Mantel–Debreu results" (p. 184) and laments "[t]he sad fact" that unless the entire demand is observed, the utility maximization hypothesis imposes no restrictions on observable data. Based on the same result, Cox (1997) argues that if only demand data on a subset of goods is available, tests "cannot discriminate between inconsistencies with the utility hypothesis and inconsistencies with weak separability" (p. 1055).

Clearly even the best laboratory experiments can only include a subset of the set of goods available to subjects before, during, and after the experiment. It therefore seems necessary to include the caveat that the analysis of experimental data is only about a sub-utility function for goods in the lab. However, we will show that this is not the case: Our theorem shows that consistency of the observed data with GARP is still a necessary and sufficient condition for utility maximization over all (observed and unobserved) goods if unobserved prices and expenditure remain constant. In particular, these conditions are naturally satisfied in the lab, as the world outside the lab typically remains unchanged during the course of an experiment. Thus, consistency with GARP of the choice set collected in the lab or under similar conditions is still a necessary and sufficient condition for the maximization of a utility function over all goods, and the utility maximization hypothesis can be falsified using laboratory experiments.

2. Testing utility maximization with subsets of goods

Let $\mathbb{R}^k_+$ be the *consumption space*, where $k \geq 2$ is the number of different goods. A decision maker *demands* a bundle of goods $\mathbf{x}^i \in \mathbb{R}^k_+$ when facing the *price vector* $\mathbf{p}^i \in \mathbb{R}^k_{++}$ such that *expenditure* equals $\mathbf{p}^i\mathbf{x}^i$. We then say that $(\mathbf{x}^i, \mathbf{p}^i)$ constitutes one *observation*, although we will later assume that we do not necessarily observe all parts of $\mathbf{x}^i$ and $\mathbf{p}^i$. We assume that we have N observations, and the entire set of observations is denoted by $\Omega = \{(\mathbf{p}^i, \mathbf{x}^i)\}_{i=1}^N$.

An observation $\mathbf{x}^i$ is *directly revealed preferred* to $\mathbf{x}$, written $\mathbf{x}^i \, \mathrm{R}^0 \, \mathbf{x}$, if $\mathbf{p}^i\mathbf{x}^i \geq \mathbf{p}^i\mathbf{x}$. It is *revealed preferred* to $\mathbf{x}$, written $\mathbf{x}^i \, \mathrm{R} \, \mathbf{x}$, if $\mathbf{x}^i \, \mathrm{R}^0 \, \mathbf{x}^a$, $\mathbf{x}^a \, \mathrm{R}^0 \, \mathbf{x}^b, \ldots, \mathbf{x}^c \, \mathrm{R}^0 \, \mathbf{x}$; in that case, R is called the *transitive closure* of R^0. It is *strictly directly revealed preferred* to $\mathbf{x}$, written $\mathbf{x}^i \, \mathrm{P}^0 \, \mathbf{x}$, if $\mathbf{p}^i\mathbf{x}^i > \mathbf{p}^i\mathbf{x}$.

[1] To the best of the authors' knowledge, the term 'induced budget experiment' was introduced by Banerjee and Murphy (2011) "[t]o contrast them from *induced value* experiments, i.e. those in which demand and supply are determined by the experimenter and the object of interest is the performance of an allocation mechanism" (p. 3864).

[2] Examples include Sippel (1997), Harbaugh and Krause (2000), Mattei (2000), Andreoni and Miller (2002), Février and Visser (2004), Fisman et al. (2007), Choi et al. (2007), Banerjee and Murphy (2011), Dawes et al. (2011), Visser and Roelofs (2011), Bruyneel et al. (2012), Becker et al. (2013), Burghart et al. (2013), Ahn et al. (2014), and Choi et al. (2014).