Modelling Search with the LCRC Algorithm

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Abstract

The Labour Conserving Rational Choice Algorithm (LCRCA or LCRC Algorithm) is a new theoretical choice algorithm that builds on both the satisficing model, created by Herbert Simon, and the Choice by Iterative Search model, created by Masatlioglu and Nakajima. Instead of maintaining the contemporary assumption of search being curtailed by a satisfactory level of utility gain, the LCRC Algorithm hypothesizes that search is primarily limited by a decision maker's willingness to invest labour and time. It is also assumed in LCRC that the decision maker has the ability to quit at any point. The algorithm attempts to explain bounded rational iterative search by utilizing graph theory and unifying multiple different choice procedures, primarily rational choice and attention overload choice protocols, under the assumption of decision maker constraints on inputted effort and time. This algorithm presents new trains of thought regarding repeated search, concurrent search, and how the difficulty of the search problem and a decision maker's willingness to explore affects consumer choice.

1 Introduction

The problem of search and modelling decision maker choice when presented with a search situation has been a relatively recent and moderately computationally difficult field of study in behavioral economics. With the advent of widely available search engines, such as Google Search, and other technologies that have made data more widely available to the public, there has been a drastic increase in incentive to understand search behavior and the effects new technology may have on consumer choice.

The scenario defining a search is, itself, relatively simple. There are, of course, many ways to define search. The following is a more mathematically rigorous interpretation. A consumer or decision maker is presented with a set of objects to choose from; let this selection set be denoted as S. The decision maker has a choice function, f, defined as $f : S \to S$. Note that f is simply a mapping (i.e. a morphism) on S. As it is the case that f is a mapping, it follows that $\exists\ F_i$ and $s_0 \in S\ s.t.\ F_i(s_0) = x,\ \forall\ x \in S$ where F_i is defined by repeated (i function calls) application of the action, f, on a starting element $s_0 \in S$. Thus, any final selection of the decision maker can be represented by a repeated function call on s_0 by f. This repeat action is limited if the group is finite and the consumer's search is exhaustive as then DM preference cannot maintain cycles. More formally, given a decision maker's final selection s', $\exists\ s_0 \in S\ s.t.\ (f \circ f \circ ... \circ f)(s_0) = s'$. This method of defining search results in an element for each function invocation which represents the decision maker's choice at time step t (i.e. choice correspondence). The resulting set of these choices can be considered the consideration set for the individual decision maker. The total ordered consideration set indicates the "path" the decision maker takes before reaching a decision. Note that, as stated before, the definition of search is relatively simple, the interest in the subject is generated by the ambiguity present in the consumer choice function, f.

This ambiguity surrounding consumer choice in search has not quite subsided and formal modelling is generally seen as quite a difficult task. Despite this, there are already several

effective models that generalize search under different circumstances quite well (discussed in depth in section 2). However, the models proposed often overlook what defines a DM's intrinsic budget constraint, are too ambiguous in identifying halting points, or do not fully capture logical consumer consideration set alteration. The algorithm proposed in this paper addresses these issues and, utilizing fundamental graph theory, iterative search, and applying simple optimization algorithms, provides a relatively simple method of modelling search via one theoretical unified choice procedure under certain ideal circumstances. This method of modelling builds off of the contemporary notion of satisficing, proposed by Herbert Simon, and constrains the decision maker's choice by the individuals supposed rationality, attention span, and inherent desire to conserve labour. This defines satisficing as a consequence of the search process and not as an arbitrary sufficient level of utility. For the sake of simplicity let this proposed procedure be named the Labour Conserving Rational Choice (LCRC) Algorithm, it is at the heart of this paper and shall be presented in section 3.

LCRC clearly builds on traditional models of iterative search such as satisficing, where decision makers all have a sufficient level of utility that, once reached, causes search curtailment. The core elements of LCRC also complements, with some or no modification, already existing models such as Choice by Iterative Search (Masatlioglu and Nakajima, 2013) and potentially further explain the results of choice theoretic search experiments such as the one proposed by Andrew Caplin, Mark Dean, and Daniel Martin.