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Information and admissible sets

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Abstract

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I consider the inclusion of relevant exogenous variables on the identified set of values for the average treatment effect in a binary model that permits non-random selection by agents into treatment groups. I allow covariates to enter a non-parametric threshold crossing function that determines a scalar outcome, and contrast this with an equivalent formulation that does not explicitly model the contribution of additional relevant exogenous variables beyond the endogenous variable of interest.

The identification of a structural characteristic by a model is dependent upon the restrictions that are embedded in such a model, and upon data. Restrictions are either verifiable, that is consistent with dependence and independence relations that are observed in data, or are non-verifiable. Where the sum of verifiable and non-verifiable restrictions that a model embeds exclude all structures that are consistent with data then such a model is observationally restrictive (Koopmans and Reiersøl, 1950), and falsified. Observational restrictiveness is then a criterion by which to judge competing models; where competing models are not observationally restrictive then a criterion by which to judge competing models is the relative strength of the restrictions that models embed, with less stringent restrictions being preferred to more stringent ones. Accordingly, a model is judged to be more credible relative to another if it is not observationally restrictive, or if it is not observationally restrictive and it embeds less stringent non-verifiable restrictions.[1] That credibility rests upon the stringency of non-verifiable restrictions where a model is not observationally restrictive is precisely because those verifiable restrictions that are embedded must be valid. The notion of credibility is (more eloquently) explicated in Manski (2013).

[1]Some qualification must be made. Although parsimony is a sensible criterion by which to judge competing models it is unsatisfactory in one respect; specifically, a model that nests another is deemed to be less credible even if it differs only in restrictions that are founded in economic theory. Restrictions that are founded in economic theory should be considered credible regardless of their stringency.

Identification of structure versus structural characteristic.

The purpose of a model in economics is to determine the nature of relationships, principally causal relationships, between economic variables using data. If a model is preferred to another then it follows that estimation of structural characteristics using that model will also be preferred. Credibility is one characteristic of a model for which a preference ordering over models might be constructed. The idea that more credible models lead to more credible inference motivates the use of minimally restrictive models that incorporate only assumptions on the latent structure that are founded in economic theory, or that are the least stringent assumptions that might be made before a model becomes uninformative. However, by their very nature, minimally restrictive models incorporate weak restrictions that are not necessarily, and are commonly not, sufficient to ensure point identification. That is, the restrictions that are embedded in a model do not restrict the set of admissible structures sufficiently such that a mapping from any distribution in the image of a model on the space of probability distributions is a singleton set. Recent advances have meant that the identified set of structures can be recovered.

The use of models in economics is to determine the nature of relationships, principally causal, between economic variables. Simple logic dictates that if a model is preferred to another on the basis of credibility then the inferences that can be drawn from data using that model should also be preferred. This drive towards credible modelling has manifested recently with the development of tools

Credibility motivates partial identification.

> *Causas rerum natruralium non plures admitti debere, quàm quæ & vera sint & earum Phænomenis explicandis sufficiunt.*
> – Isaac Newton, *Philosophiæ Naturalis Principia Mathematica.*

Notation

There is a probability space $(\Omega, \Sigma, \mathbb{P})$ on which are defined random variables (Y, D, X, Z, U). Here, (Y, D, X, Z) are observable with supports $(\mathcal{R}_Y, \mathcal{R}_D, \mathcal{R}_X, \mathcal{R}_Z)$, and U is unobservable with as yet unspecified support. I allow (X, Z, U) to be vectors, in which case the support is given by the Cartesian product of the supports of each element in the vector. I refer to Y as the dependent variable, to D as the endogenous variable, to X as the exogenous variable, to Z as the instrumental variable, and to U as unobservable heterogeneity. The logic of this naming convention will be made clear by the restrictions that are imposed upon these random variables in the main text. Lower case letters are used to represent specific values of these random variables.

I denote by $Y(d)$ the counterfactual value of Y when D is externally fixed, and by $D(z)$ the counterfactual value of D when Z is externally fixed. I denote by $\mathbb{E}$ the expectation operator, and by $\mathbb{1}$ the indicator function. Related to these concepts are the average causal effects $ACE(D \to Y)$ and $ACE(Z \to X)$ that are defined as $\mathbb{E}[Y(d_1) - Y(d_0)]$ and $\mathbb{E}[D(z_1) - D(z_0)]$, respectively. To distinguish between population and sample quantities, I subscript sample quantities by n.

1 Introduction

2 A threshold crossing model

I adopt the following notation: Y is a random variable that is observable with support $\mathcal{R}_Y$, and that is to be interpreted as an outcome; D is a random variable that is observable with support $\mathcal{R}_D$, and that is to be interpreted as

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References

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Manski, C. F. (2013). *Public Policy in an Uncertain World: Analysis and Decisions.* Cambridge and London: Harvard University Press.