

A combination of design-based and model-based statistical approaches for effective impact evaluation studies

Topic 2 – Learning more from what we already know

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Introduction

An evidence-based policy making requires effective impact evaluation studies. An effective impact evaluation study is based on a well-developed study design comparing two statistically comparable groups. The methods used, in order to obtain statistically comparable groups, vary based on the used data collection procedures.

When data are collected via a completely randomised experiment, it is investigator's responsibility to develop a study design consisting of statistically comparable groups.

On the other hand, when data collection occurs outside of the completely randomised experiment framework, which is often, the investigator can only re-design a study to mirror a completely randomised study design. The process of re-designing a study should be based on advances of statistical-methodological science in the field of causality, i.e., a combination of design- and model-based statistical approaches.

Such combination of statistical approaches enables one to perform an impact evaluation study in a similar way as if data would be collected via a completely randomised experiment - the gold standard in comparative studies.

Methods / Problem statement

The policy making and program developments are today increasingly based on evidence studies, such as impact evaluations, which can be performed in a qualitative and quantitative way. For both approaches, is fundamental to understand a study design, in the sense of being able to compare statistically comparable groups. Study designs that are not completely randomised experiments mostly result in data where groups in comparison are not statistically comparable.

Using only model-based approaches to estimate differences between groups often result in bias estimates. Hence, it is crucial to use a design-based approach to initiate a process of balancing a study design, in the sense of creating statistically comparable groups, before estimation of desired quantities. Once a balanced design is obtained, different model-based approaches can be used to estimate differences between the groups in comparison.

The aim of this paper is to highlight the importance of a design-based statistical approach and its combination with a model-based approach in order to perform impact evaluation studies effectively. Furthermore, statistical tools required to utilise a design-based approach are presented.

Results / Proposed solution

The propensity score methods are today one of the most scientifically completed methods for causal inference studies and consequently for impact evaluation studies. They are design-based methods and as

such aiming to obtain statistically comparable groups before the estimation of desired quantities. The methods consist of two separate phases.

In the first phase, a study design is balanced based on the observed covariates in order to reflect a completely randomised experiment design of statistically comparable groups. The balancing is done with a propensity score (Rosenbaum and Rubin 1983), a balancing score that takes information of all the observed covariates and summarises it to a single value on the interval between 0 and 1 for each unit. Such a propensity score is defined as a conditional probability of a unit belonging to a group 1 ($I=1$) versus belonging to a group 2 ($I=0$), given the observed covariates, X : $e(x)=Pr(I=1|X)$.

As a result, units from group 1 and group 2 that have the same value of propensity score, have identical covariate distributions in expectations and are said to be statistically comparable. In the second phase, the model-based approach is used to obtain estimates of desired quantities.

Conclusions

Although, impact evaluation studies can be done also in a qualitative way, an empirical evaluation is encouraged. Similarly so, it is encouraged to use the combination of design-based and model-based statistical approaches because each of them used alone will not produce such reliable estimates as their combination. A combination of a design- and model-based approaches is thus essential for effective impact evaluation studies. The design-based approach provides a healthy foundation based on which the model-based approach can derive reliable estimates of desired quantities.

The foundation is a data set consisting of statistically comparable groups. Furthermore, besides combining these approaches, the investigator is required to have a good understanding of the study topic, collected data, used statistical methods and how to deal with shortcomings, e.g., poorly measured covariates, poorly representative samples or not a sufficient amount of disposable data to be able to draw reliable conclusions.