

it as an indispensable approach.

Sustainability, pushed back to a lower priority than green growth, looks like taking back its original position in present administration. Although the fact that sustainable growth was emphasized rather than development is somewhat regretful and worrisome, present government's careful consideration about sustainability is much encouraging. Reviewing Arne Naess' view of deep ecology at this time is considered to be an opportunity to look at policies from new viewpoints. It should be certainly helpful in conceiving policies that would affect longer temporal ranges than policies for 5–10 years. Finally, I would like to finish this book review with part of Arne Naess' writing, which is common but touches my heart.

*“ ... confident that we have a mission, however modest, in shaping a better future that is not remote. Just a couple of hundred years.”*

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**Propensity Score Analysis: Statistical Methods and Applications, Shenyang Guo and Mark W. Fraser, SAGE Publications, Inc.(2009), ISBN: 978-1412953566**

This book, written by Guo and Fraser, deals with the statistical (or econometric) methods used in quantitative evaluation of a treatment. Specifically, this book focuses on explaining the method of propensity score analysis, which has been used in many fields for the last 10 years. The methodology was developed to solve the selection bias problem, a major issue that occurs in performing evaluations. Propensity score analysis was first used to watch the effect of medication or treatment in the health and medical

statistic fields. However, the range of its application has become wider and wider to include areas, such as governmental policy evaluation, etc.

Take the evaluation of the effect of a newly developed medicine for example. First, you will need a medication group and a comparison group. By comparing the two groups with the change in time, you will see the effect of the newly developed medicine. When you experiment with white rats, you can give the test drugs to rats that are randomly selected with no feeling of guilt and leave the other rats as they are to see the effect of the newly developed medicine after a few months. If the number of the rats is sufficiently enough, you can also obtain the statistical significance of the quantitative evaluation effect. This is the randomized experiment, which is a basis of scientific experiments that uses experiment and comparison groups. However, if you try to create an experiment group and comparison group of actual people through random selection, you may be faced with economic and ethical problems. After all, people get medicine because they want to be cured of their diseases or because they show symptoms of a disease. Patients often have physical conditions different from other normal people in many aspects. Accordingly, the method of measuring the effect of a medicine through simple comparison of medication group with normal people group after lapse of a certain period of time can have statistical bias in its results. This bias, which occurs because the characteristics of the experiment group that receives some treatment are different from those of the comparison group, is called selection bias.

The above problem can arise in the evaluation of various fields of different targets and different perspectives. Take the example of a labor policy that carries out job training for the unemployed. The attempt to evaluate the effect of the labor policy through simple comparison of future employment rate of the group of people who received the job training with that of the group of people who did not receive the job training can cause the problem of selection bias. This is because the government, with limited financial resources, would not randomly select people but deliberately select and train people who have high possibility being employed in the future.

Otherwise, the government would be faced with the criticism that it wastes or it does not efficiently use its financial resources. In a wider scope, the problem of this selection bias can occur in the evaluation of an educational policy, a labor policy, and an firm-level policy, such as venture subsidy, microfinance, and R&D support, and even in the analysis of local government policies at the city and provincial levels and in comparative evaluation of trade and regulation policies at the national level as well.

As the controlled randomized experiment cannot be performed in the social science field, the problem of selection bias is likely to occur in the evaluation of the effect of treatment on a certain group of participant. Solving the problem of selection bias has been a great task to statisticians or econometricians. The propensity score analysis introduced in this book was developed in the early part of the 1980s by the contribution of Rosenbaum and Rubin, who were the statisticians, and by Heckman, who was an econometrician. In particular, Heckman won the Nobel Prize in economics in 2000 in recognition of his contribution to the development of various methods to deal with this selection bias. The purpose of propensity score analysis is to create similar conditions as the randomized experiment, if it is impossible to perform the experiment—the index of propensity analysis, which means the probability of participating in certain treatment—plays an important role. In other words, if there is sufficient information on the experiment group that participates in the treatment and on the comparison group, and if the selection process is known, the propensity score can be estimated. The statisticians found out, under several strong assumptions, that the new experiment group and the comparison group with possible randomized experiment can be created in matched pairs of participants and nonparticipants with similar propensity scores. This became the basic idea of various propensity score analyses.

This book is composed of the following chapters. Chapter 1, the introductory part, describes on the advantages of the randomized experiment and problems, such as the selection bias that can occur when the randomized experiment is impossible.

It also introduces the concept of propensity score analysis and its application cases in various fields, such as evaluation of education, labor, medical, and health policies as well. Furthermore, this chapter also introduced the procedures developed by many researchers in order to perform the propensity score analysis in statistical programs, which are frequently used, such as SAS, STATA, and R.

Chapter 2 introduces the four methods that are the major subjects of this book, such as Heckman's Sample Selection Model, the Propensity Score Matching Model, Matching Estimators, and the Propensity Score Analysis with Nonparametric Regression, and the assumptions they share.

Chapter 3 deals with data balancing. Data balancing is an attempt to get similar effects as randomized experiment by adjusting the experiment group and the comparison group in various observation data dealt with in the evaluation of social science field. This chapter introduced the methods of data balancing that are frequently used, such as OLS regression, matching, and stratification, and described on their pros and cons as well.

Chapter 4 mainly describes the sample selection model of Heckman and the characteristics of samples that are applicable (or inapplicable) case of the model. In particular, this chapter introduces the instructions and exercises of STATA program that can implement Heckman model, describing in detail their respective pros and cons as well.

Chapter 5 is considered the most important chapter of this book. This chapter explains why the Propensity Score Model is a useful evaluation tool in comparison with various methods described in previous chapters. In particular, this chapter introduces the methods of various data balancing used in actual analysis, showing on the process flowchart in selecting the method to be used according to the purpose and sample characteristic. Furthermore, this chapter shows the pros and cons of each method by using STATA and R.

Chapter 6, which continues from Chapter 5, introduces various attempts to obtain the significance of quantitative evaluation of a treatment that was analyzed using propensity score analysis. Propensity score analysis has semiparametric or nonparametric

nature that makes it difficult to derive statistical significance using the conventional methods. Statistical research efforts have been concentrated in this area for the last few years, and the authors of this book introduce recent research results of the frontier research groups.

Chapter 7 deals with the nonparametric regression, which is another analysis method using propensity score, and Chapter 8 describes on the method of performing the sensitivity analysis to check the robustness of the analysis results.

Lastly, Chapter 9 explains 18 kinds of mistakes that are frequently committed in using the propensity score analysis, summarizing the criticisms on the effectiveness and reliability of the methodology itself and the future developmental directions as well.

Recently, the government is actively making efforts for efficient policy implementation and accurate quantitative ex-post evaluation of the policy lies at the center of this change. The same is true of the governmental support to R&D. Due to its uncertainty, large variation in the result of each project, and spillover effect, R&D is known to be an area where it is difficult to carry out policy evaluation. Recently, however, European countries are attempting to quantitatively evaluate the effects of governmental supports for various R&D projects using the data accumulated from the surveys (such as the Oslo manual). The methods that are frequently used in this evaluation are Heckman's selection model or various propensity score analysis introduced in this

book. Those interested in policy evaluation will be able to obtain enormous tips from this book about the overall subjects covering the pros and cons of various methods, the selection of proper methods according to the evaluation purpose and samples, and the actual analysis in using the statistical program. However, the most important value of this book may be lying in the final conclusion. The authors of this book are points out the improper use of propensity score analysis in its frequent application recently, where a checklist of 18 patterns of mistakes was shown. Actually, the propensity score analysis requires vast amount of data from the policy (or treatment) participants and nonparticipants. Furthermore, these data should be able to reflect the selection process well. Above all, considerable number of participants is required to observe the significant result because this is a statistical method. Recently, there are many cases where propensity score analysis is applied in actual evaluation of governmental support policy. Close examination of this checklist will be greatly helpful in getting more robust results.

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