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Ecological Fallacy: Concepts, Causes and Solutions

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Abstract

The ecological fallacy refers to the incorrect assumption that the relationships between variables observed at the aggregated, or ecological-level, are the same at the individual-level. The paper first explains the concept and causes of the ecological fallacy. Further, the paper proposes two solutions. This will help researchers in education avoid drawing erroneous conclusions based on aggregated data.

Much of what goes on in education occurs within some group context because schooling activities occur within hierarchical organizations, such that students are nested in classrooms located within schools, within school districts, and so on. Naturally, the sources of educational influence on students occur in the groups to which an individual belongs. Although social scientists are aware that the behavior of individuals and the groups, to which they belong, are inherently intertwined (see Bronfenbrenner, 1976; Burstein, 1980; Cronbach, 1976; Mischel, 1977; Webb, 1977), little is known about how the effects of group contexts can be identified. Therefore, extensive examinations are necessary to explain the complex influences of group settings on the individual behaviors, or the effects of higher-level organizational units (e.g., schools, classrooms, and teachers) on lower-level group members (e.g., students).

Among a number of methodologies applied to evaluate these cross-level effects in education, ecological analysis using aggregated data continues to play an important role in identifying and monitoring patterns and trends in inequalities between groups of students or over time. In this type of research design, data on individuals are aggregated to higher levels. Then, the relations among these aggregated variables, as well as the ecologically measured variables are investigated, for example, the relationship between schools' average achievement scores and their students' average socioeconomic statuses. Furthermore, conclusions based on group-level

analyses are often simply applied to individual behaviors, thus committing the ecological fallacy, a serious violation of the true relationship between investigated variables. Conceptually, the ecological fallacy refers to the incorrect assumption that the relationships between variables observed at the aggregated, or ecological level, are necessarily the same at the individual level. In fact, estimates of coefficients from aggregated data can be wrong both in the magnitude and the effective direction at the individual level. Consequently, problems of aggregation can either confound the effects among the variables of the major interest or produce spurious interpretations. In this respect, the ecological fallacy is also referred as ecological bias, cross-level bias (Greenland and Morgenstern, 1989; Morgenstern and Thomas, 1993; Greenland and Robins, 1994; Greenland, 2001) or aggregation bias, which all refers to the difference between the regression coefficients obtained at the aggregate level and the coefficients of interest at the individual level.

Currently, in educational research, the process of aggregation has been widely used in the study of educational effects for its simplicity to perform; nevertheless, the methodological problems associated with the aggregation are unfortunately less well understood and mostly ignored. As a result, the aggregation problem remains potentially serious in the educational research and merits extensive methodological inquiry. Seeing the significance of this issue, in my paper, I first explain the concept of ecological fallacy and the causing factors using examples and illustrations. Further, I will introduce two solutions to ecological fallacy, multilevel approach and approximation of individual-level coefficients. To better present my study, I will use PowerPoint slides.

References

- Bronfenbrenner, U. (1976). The experimental ecology of education. *Educational Researcher*, 5(9), 5–15.
- Burstein, L. (1980). The analysis of multilevel data in educational research and evaluation. *Review of Research in Education*, 8, 158–233.
- Cronbach, L. J. (1976). *Research on classrooms and schools: Formulation of questions, design and analysis*. Stanford, CA: Stanford Evaluation Consortium
- Greenland, S. (2001). Ecologic versus individual-level sources of bias in ecologic estimates of contextual health effects. *International Journal of Epidemiology*, 30(6), 1343–1350.
- Greenland, S., & Morgenstern, H. (1989). Ecological bias, confounding, and effect modification. *International Journal of Epidemiology*, 18, 269–274.
- Greenland, S., & Robins, J. M. (1994). Ecologic studies—biases, misconceptions, and counterexamples. *American Journal of Epidemiology*, 139, 747–760.
- Mischel, W. (1977). The interaction of person and situation. In D. Magnusson, & N. S. Endler (Eds.), *Personality at the crossroads. Current issues in interactional psychology* (pp. 333–352). Hillsdale, NJ: Erlbaum.
- Morgenstern, H., & Thomas, D. (1993). Principles of study design in environmental epidemiology. *Environmental Health Perspectives*, 101(4), 23–38.
- Webb, N. M. (1977). *Learning in individual and small group settings*. Stanford, CA: Stanford University School of Education.