

Book Review

M. Smithson and J. Verkuilen (2006). *Fuzzy Set Theory: Applications in the Social Sciences*. Thousand Oaks, CA: Sage.

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Sociologists are increasingly interested in combinatorial and fuzzy set methods as reflected, for example, by several studies that have recently appeared in leading journals. Michael Smithson (e.g., 1982) is an important pioneer in this area, although he is perhaps less heralded than the widely cited Charles Ragin. Along with coauthor Jay Verkuilen, Smithson brings a high level of expertise to the subject at hand. *Fuzzy Set Theory: Applications in the Social Sciences*, the authors' recent contribution to Sage's Little Green Book series, seeks to combine the intuitive appeal of fuzzy sets with the rigor of standard quantitative analysis and does so with sophistication. For readers not already versed in fuzzy sets and highly motivated to learn more, however, this strength may turn out to be a challenge. Because of its mathematical comprehensiveness and detail, such readers may lose the proverbial forest for the trees.

The book is organized into six substantive chapters. After making the case for the overall utility of fuzzy sets for social science research in chapter 1, the authors launch into a discussion of fuzzy set mathematics in chapter 2. They cover the basics of set theory, make a case for the utility of fuzzy sets over crisp sets, and go over basic set operations such as intersection and union. Chapter 3 is comparatively more technical and considers a number of strategies by which fuzzy sets can be measured and transformed. The authors cover the implications of ordinal, interval, and ratio measurement assumptions in detail and look at a wide variety of procedures for transforming "ordinary" variables into fuzzy sets. They also consider how the use of multiple judges (simulated or real) can facilitate sensitivity analyses and bolster confidence in one's substantive conclusions. In chapter 4, the authors look at the internal properties of sets, including cardinality (analogous to summation) and fuzziness (a measure of overall ambiguity). They also briefly consider how fuzzy sets can be connected to a number of existing probability distributions in ways that allow fuzzy sets to be analyzed using general linear models. An example of how this could be done would have been helpful.

Chapter 5 returns to the basic operations of bivariate intersection and union and introduces a new and generative concept: inclusion. Inclusion refers to the degree to which one set may be thought of as a subset of another. The authors rightly point out that although subset and superset relationships are vital to our theories and concepts in social science, correlational methods are unable to model them. After all, correlational methods assume symmetry between variables—the correlation of X with Y is the same as the correlation of Y with X . This is not the case with inclusion coefficients. Although the authors mention necessity and sufficiency in passing, inclusion coefficients are necessary for modeling logical relations. Knowing the

extent to which X is a subset of Y is the same as asking, “How confident are we that Y is the case if we know that X is the case?” Conversely, knowing the extent to which Y is a subset of X helps establish how necessary X is for the existence of Y . While such considerations are straightforward in crisp set mathematics (i.e., they are equivalent to conditional probabilities), they are more complex in the fuzzy set case. The authors present several strategies for measuring inclusion, but the compelling substantive payoff is partially overshadowed by discussions of alternative strategies and extensive attention to detail.

In chapter 6, the authors begin an examination of multiset relations, presented mainly through an extended example that looks at comorbidity among a group of psychological syndromes. Classical comorbidity is essentially a relationship between dichotomous categories, but using fuzzy sets allows extending the concept to more finely graded measures. The example shows that using correlational measures of comorbidity between nondichotomous measures (as some researchers have) can lead to erroneous conclusions, while the fuzzy analysis provides a more realistic picture of the co-occurrence of various symptoms.

Reading *Fuzzy Set Theory*, I couldn't help but think of Barry Schwartz's *Paradox of Choice* (2004). Citing a host of psychological studies, Schwartz convincingly argues that too many choices can be demotivating. Rather than choose between a large number of options, most people will decline to choose at all. Similarly, I worry that the level of detail in *Fuzzy Set Theory* may daunt the novice interested in applying this invaluable family of techniques. Herein lies a tension found in the Little Green Book series: It is extremely difficult both to provide a firm foundation for a method and to facilitate its application in a straightforward manner. The choices here are manifold: How should one transform specific variables into fuzzy sets? Should one think of them in formalist, probabilist, decision-theoretic, or axiomatic terms? Should one assume that their measurement properties are ordinal, interval, or ratio? Which formulas best model intersection and inclusion in the data? And so on. The authors, with admirable caution, are reluctant to provide much guidance. Yet I fear that few readers of the book will be prepared to make such decisions without extensive additional reading, and this might be a disincentive for some researchers who want to incorporate fuzzy methods into their current research.

Smithson and Verkuilen have provided a firm mathematical foundation and illustrated it with interesting psychometric case studies. Yet one might have hoped for examples with more of a connection to mainstream social research. This would have facilitated practical application among the likely readership. With this admirable volume now in our libraries, we can hope for another slim volume on practical applications of fuzzy set methods to common sociological research questions. Together, the two volumes would contribute enormously to the dissemination of a technique that has the capacity to transform many subfields of sociology.

Bottom line: This book is compelling, challenging, and fascinating for sociologists who already possess an interest and some expertise in using fuzzy sets. There

is a wealth of ideas and techniques presented that complement and extend Ragin's (2000) *Fuzzy-Set Social Science*. To those belonging to this set of potential readers, I highly recommend the book. For potential readers in the "set of sociologists with little background in fuzzy sets and wanting to use this method rather immediately," it seems you'll have to wait a bit longer.

References

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Stephen Vaisey
University of California, Berkeley