

Fundamentals of Demographic Analysis: Concepts, Measures, and Methods

by Gordon A. Carmichael
New York: Springer, 2016
ISBN 978-3-319-23254-6
Hardcover \$179, 394 pp.

Reviewed by Thomas K. Burch
University of Victoria

Not long ago there was a dearth of textbooks on techniques of demographic analysis. This is no longer the case, thanks to the publication of several new texts in recent years. Nonetheless, Carmichael's *Fundamentals of Demographic Analysis* is a welcome addition. A wide variety of texts on technical demography is useful because the subject is taught in so many different contexts—different departments, different programs, different levels. It's not likely that one size will fit all. But most of all this work is welcome because of its quality. Like most good texts, it has evolved, with early versions in course-note form used in different courses by different instructors. The book is comprehensive (with some exceptions noted below), thorough in its exposition, and extremely clearly written.

By the author's own account, the book is designed for an introductory course at the graduate level. In my view, it also could be used in an upper-division course for undergraduates, assuming some solid previous coursework on population studies. It makes use of no mathematics beyond secondary-school algebra (no calculus or linear algebra). This was based on the author's experience with students with a wide range of mathematical and statistical background, some with very little, something familiar to anyone who has taught demography in a sociology department. Carmichael speaks of "...my efforts to make demographic analysis more accessible to students with limited quantitative backgrounds, without being too pedestrian for those with greater mathematical aptitude" (p. vi). In my view, he has succeeded, although I have come to believe that the compromises come at a cost (see below).

In nine chapters, the book deals with: demographic data, standardization and decomposition, cohort/period, mortality, marriage, marital status and relationships, fertility, distribution, urbanization and migration, stable population theory, and population projections. There is an index of topics and names, and references at the end of each chapter.

An important omission: there is virtually no material on the demography of household, family, and kinship. Admittedly, the technical side of these topics is not highly developed, but there are several important measures and models. The Goodman/Kefitz/Pullum equations of kin numbers by type of kin come to mind as one of the most original contributions to formal demography in the last decades. (Absent a separate chapter, this model could easily have been included in a section on applications of stable population theory in chapter 8.) There is also a small body of material on the measurement of household/family size and composition, important for research on housing, consumer economics, old-age dependency, and many other topics.

Similarly, in the chapter on fertility, Carmichael devotes two and a half pages to the Coale-Trussell model. In the chapter on marriage, by contrast, there is no mention of the Coale-McNeil or Hernes models of first marriage, despite five or so pages on first marriage, and detailed presentations of nuptiality tables and Hajnal's singulate mean age at marriage (SMAM).

In his treatment of SMAM, Carmichael shows the common tendency in demographic texts to provide too many refinements and complications at the expense of a simple introduction of the basic concept. Using Bangladesh as the detailed example, he modifies the standard procedure to deal with marriages before age 10. Detailed data are given for ages up to 65+, although, as is correct, these are not used in the calculations, which deal with first marriages before age 50. The avoidance of mathematics comes into play here, since the relatively simple formulas for SMAM (using finite summation or the definite integral of proportion single by age) are not given, somewhat obscuring the basic idea of SMAM as an average measure of total person-years lived single by persons entering first marriages before a given age, divided by the proportion that eventually marries. His earlier treatments of real/ synthetic cohorts and of the concept of person-years had already laid the foundation for a ready understanding of the formula. The presentation of SMAM also omits any graph of the process/procedure. Along with the formula, such a diagram could give Carmichael's verbal explanation and computational recipe more clarity and force. But the focus is on an eight-step "recipe," that is, on a computational procedure (algorithm) rather than the basic idea underlying the algorithm.

In general, however, Carmichael makes effective use of graphs—for example, comprehensive graphs of all the main life-table functions (p. 174), or a somewhat novel age pyramid (pp. 8 ff), which uses shading to show excess males or females in each age interval, something not easily read from the garden-variety age pyramid.

The proper mathematical level for a demographic methods text is a difficult issue, on which there is considerable disagreement and variation in practice. Carmichael has chosen to make no reference to calculus or matrix algebra. As a result, a student of this work would not learn that population projections can be done using the Leslie matrix, or that the stable population theorem in demography is but a special case of some general theorems in linear algebra. The avoidance of calculus means the student never sees the basic equations underlying such concepts as exponential or logistic growth (discussed in the chapter on population projection). In each case, it is the differential equation that makes transparent the basic growth pattern: (a) growth as proportional to current population (exponential); and (b) proportional growth modified by a term showing the difference between current population and an assumed maximum population for a given environment (logistic). This text gives only the integral formulas, which do not directly reveal the underlying concepts.

More, and more up-to-date, information on computer resources for demographic calculations would also have been welcome, probably by many instructors as well as students. The author recommends the NCSS statistical package (over US\$350 for the academic license), but not R, for example, which is free. Nor does he mention that Excel or other readily available spreadsheets are well-suited to demographic analysis (the Excel Solver and Goal Seek add-ins can now do non-linear fits, such as the exponential or the logistic). To transform a five-year age distribution to single years, reference is to a mid-1940s set of actuarial tables. But modern software has given us better and more flexible ways to do this, using full-featured spreadsheets, or mainstream mathematics packages (R, Mathcad, Mathematica, Matlab, Maple, Derive, etc.), which provide a variety of built-in interpolation functions.

However, it's not entirely fair to compare Carmichael's text with an ideal or near-perfect introduction to demography, one that among other things would integrate technique and substantive theory, rather than treating them in separate courses and textbooks, as is the standard approach. But such a text exists only in my fantasies, and not in English so far as I am aware. His is a sturdy and readable work, to be recommended as a text or supplementary text in courses emphasizing demographic techniques, and as a handy reference for the working demographer or any serious analyst of human population.