APPLIED DEMOGRAPHY: ITS BUSINESS AND PUBLIC SECTOR COMPONENTS

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Summary

The development of data through estimation and projection (particularly for small areas) has and will continue to be affected by continued improvements in methods and technology. Although focus here is on applied demography in the United States, the developments described in methodology and technology transcend national boundaries and, as such, serve to globalize its key features and practice. These developments will, in turn, influence business demography not only in the United States, but elsewhere. They suggest that even more skills and an expanded demographic perspective will be needed by those with a desire to be successful applied demographers.

1. Introduction

Business demography is considered to be relatively new, as is its closely related counterpart, “public sector demography.” Together, these two areas can be considered as comprising applied demography. As such, we refer to them collectively as “applied demography” throughout our discussion. What is applied demography? It is primarily concerned with solving exogenously-defined problems by producing the information necessary to effect practical decision-making while minimizing the time and resources needed to produce this information. Basic demography, in comparison, is primarily
concerned with solving endogenously-defined problems by offering convincing explanations of demographic phenomena while viewing time and resources as barriers to surmount in order to maximize precision and explanatory power. Demographers view basic demography as comprised of two distinct subsets, formal demography and population studies.

It also is useful to distinguish business demography from public sector applications. Even though the methods and materials utilized in both types of studies are the same, the unique, profit-oriented and oftentimes proprietary nature of the work justifies separate consideration for business demography. It also is worthwhile to note that much of the public sector applied work seen today has a longer history and might have been classified as part of the more general rubric of “social demography” at an earlier time. As can be seen in Figure 1, the refinement and extension of census and survey data as well as administrative records data (the foundation upon which estimates and projections are based) are accomplished by the processes of estimation and projection, which overlap both sectors. Estimation and projection are viewed as the heart and soul of applied demography.

![Figure 1 Major Components of Applied Demography & Their Relationships.](image)

Before turning to a discussion of business demography, it is useful to define not only the terms “estimate” and “projection,” but also the term “forecast.” Because it is more inclusive, we generally use the term “projection” rather than “forecast” in our discussion.

**Estimate** – A calculation of a current or past population, typically based on symptomatic indicators of population change.

**Projection** -- The numerical outcome of a particular set of assumptions regarding future
population trends.

**Forecast** – The projection deemed most accurate for the purpose of predicting future population.

It also is useful to note here that there are two distinct traditions in regard to population estimates (1) demographic; and (2) statistical – that is, the methods used by those who do sample surveys. Demographic methods are used to develop estimates of a total population as well as the ascribed characteristics – age, race, and sex - of a given population. Statistical methods are largely used to estimate the achieved characteristics of a population – educational attainment, employment status, income, and marital status, for example. Among survey statisticians, the demographer’s definition of an estimate is generally termed an “indirect estimate” because unlike a sample survey, the data used to construct a demographic estimate are symptomatic indicators of population change (e.g., K-12 enrollment data, births, deaths,) and do not directly represent the phenomenon of interest. Among demographers, the term “indirect estimate” has a different meaning (See “Direct Estimate” and “Indirect Estimate” in the Glossary). As is suggested in Figure 1, most national statistical agencies produce estimates using both of these traditions, demographic and statistical. We return to this issue later when we discuss small area demography. In regard to population projections, the distinction between the demographic tradition and the statistical tradition is less pronounced, however.

It also is important to note that there are two different definitions of “population” used by national statistical agencies. In the United States, for example, the Census Bureau uses a definition based on place of “usual residence.” This also is known as the “De Jure” population. The other definition is based on the concept of a “De Facto” population. Examples of de facto populations are many. They include vacationers (of interest, for example, to the hotel owners in Phuket, Thailand, the casino industry in Macao or Las Vegas, and the Hawaii Visitors Bureau), migratory workers (of interest, for example, to health care, school, and other social service providers), and the people who work in the central business district of a large city each day, but leave it largely vacant in the evenings (of interest to the San Francisco City Planning Office, for example). While estimates of De Facto populations are of great interest, they are difficult to make in countries that use the De Jure concept of residency for their census counts. In addition, they are also difficult to evaluate in these countries because there is no “gold standard” against which to measure them in terms of validity and reliability.

**2. Business and Public Sector Demography**

The development of an applied demographic focus has been driven by the interaction of several elements that have shaped the nature of certain streams of research in demography. The first is the rise in the use of the demographic perspective, data and methods in addressing business opportunities and problems. In the late 1950s, Donald Bogue introduced the concept of “micro-demography,” along with a model of applied demography for small areas. The model presented applications in general planning and was comprised of three components: transportation and facilities, urban renewal, and the market analysis. Included within market analysis was the evaluation of new and
existing sites with respect to shopping centers and individual retail establishments. However, business demography as it is known today is a phenomenon that only emerged in the late 1970s. Closely related is the rise in interest regarding demographic applications in micro decision making (e.g., the decision of an individual business in a specific location to expand its market reach). However, without improvements in methods to produce good quality small area demographic estimates, some of the information needed to drive micro decision-making would not be available. Encouraged in part by the need for small area data, many demographers more recently have focused their efforts on the improvement of techniques and technology needed to generate, display, and analyze small area data, both for the private and the public sectors. Finally, while the vast majority of demographic research focuses on the demography of geographic units, it is worthwhile to note that an interest in organizational demography and other non-geography-based applications has emerged in the last decade or so.

Both Business and Public Sector Demography focus on the use of demographic data, methods and perspectives in decision-making. That is, managers, chief executive officers (CEOs), chief financial officers (CFOs), elected officials and public planners are responsible for strategy development and implementation. Demographic input is but one of several considerations as new possibilities in the global marketplace are being evaluated and public works projects are being designed. Demographic data and techniques have been used by businesses for over 100 years. However, the recognition of business demography as a distinct field has only come about in the past 30 or so years. It now is common for many businesses to make decisions on the basis of demographic criteria. To effect these decisions, businesses rely upon the advice of experts who can assemble, analyze, and interpret demographic data.

2.1 Basic Data Sources

In countries that have good census counts, supplemented by reasonable surveys, and maintain some level of administrative records, such as vital events registration (e.g., Australia, Canada, France, India, Japan, New Zealand, the United Kingdom, and the United States), most estimates rely on one or more censuses and use administrative record systems on which different estimation methods for census-defined populations rely (Of course, in countries that have accurate and comprehensive population registers, estimates of this nature are not needed, as is the case in Finland, for example). In the United States, these records include vital events, tax returns, housing permits, assessor parcel files, utility hookups, licensed drivers, covered employment, K-12 enrollment, Medicare counts, and child support payments, among others. It is important to note that there is some variation in availability and quality of administrative records systems by state and by local jurisdictions in the U.S., as well as considerable variation among countries. For example, Alaska makes annual payments to its residents, a unique feature in the United States; while in Canada, these records include family allowance payments, as would be the case in other countries with similar pro-natal policies. It also is important to note that the U.S. Census Bureau maintains as much consistency in data sources and methods as it can because among other desirable features it wants to have a consistent set of estimates for a given “vintage” year. We also note here the emergence of an important resource directly collected by the U.S. Census Bureau – a Master
Address File (MAF) constructed for the 2000 census that is updated and maintained until the next census. This is a new resource for the Census Bureau’s estimates program because in the previous “mail-out/mail-back censuses, the MAF was constructed from scratch before each census. This housing unit inventory potentially serves as a key resource in the Census Bureau’s ability to construct current population estimates. Similar data sets can be found in other countries that conduct regular census counts. It also is useful to note that in these same countries, “record matching” techniques (also known as dual system estimation) can be used to develop estimates. Similar techniques, called “capture-recapture” methods, are used by biologists to estimate the sizes and compositions of wildlife populations such as deer, eagles, and salmon.

In countries that have neither an accurate and comprehensive national population register nor good census counts, surveys, and administrative record systems, the development of population information for business demography is severely limited. In such cases, techniques that emerged from formal demography are needed, such those described in The Demography of Tropical Africa by William Brass et al. Another possible approach that could be used is the use of remote sensing (satellite imagery), such as described by Qui, Woller, and Briggs and by Wicks, Vincent, de Almeida, and Swanson, among others.

Demographic and related data of interest to the business demographer are also found in the private sector. CLARITAS, for example, is a global vendor of demographic and related information in the form of estimates and projections, as is PITNEY BOWES MAPINFO (formerly known as MAPINFO). The large U.S.-based credit bureaus, Equifax, Experian (TRW) and TransUnion, for example, have vast amounts of demographic and related data for households and individuals, as does R. L. Polk, a company that sells city directories. At least some of these companies will sell data to other companies and individuals for analytic and other uses related to business demography. While there are a few other companies in the credit bureau business, there are many small companies in the business of selling customized estimates, projections, and other types of analyses. These companies usually rely on a singular feature that distinguishes business demography from public sector demography, namely the interest in information for postal delivery areas (known as zip codes in the United States). Many companies define their market areas by postal delivery areas and while some national statistical agencies provide census data for these pieces of geography, they do not routinely produce estimates and projections for them. Among other sources (e.g., raffle and lottery tickets), customer loyalty cards and credit cards can be used by the companies that offer them to build purchasing records on the people that hold these cards. That is, these records can provide information on the demand for goods and services. When these records can be statistically matched with demographic, income and other information held on these same individuals from the large credit bureaus, the supply side of the picture emerges. These data become a very important source for analyzing patterns and trends when they are aggregated by characteristics on the demand and supply side, as well as by geography and time.

2.2 Tools

The tools of the trade break down generally into those used for estimation and those
used to make projections, although there are important tools that do not neatly fall into either category, such as data mining and GIS (Geographic Information Systems). Neither data mining nor GIS fall neatly into the preceding discussion because they serve largely as precursors to developing either estimates or projections.

The methods generally used to make estimates are generally found under the headings of component methods, ratio methods, regression-based methods, housing unit methods, and combinations of one or more of these methods, including ratio-correlation and synthetic estimation. These terms are defined in the Glossary and described in “Population Estimates,” by Tom Bryan, a chapter found in The Methods and Materials of Demography, 2nd Edition that provides references to more detailed discussions. Some or all of these methods are not only used by national statistical bureaus in such countries as Australia, Canada, the United Kingdom, and the United States, but also by sub-national entities in these countries such as states, provinces, counties, cities, and councils of government. Some of these same methods can be combined with current sample survey data, to include the ratio methods and regression.

The basic projection methods found in business demography include simple and complex trend extrapolation methods, simple and complex ratio methods, the cohort-component method and its variants (e.g., the Hamilton/Perry Method), and structural models, which include economic/demographic models and integrated land use and transportation models.

2.3 Training

Like many other scientific disciplines, training in applied demography has a formal education component and a practical or on-the-job component. Applied demographers must be able to synthesize data, methods and perspectives from a range of disciplines in order to explore the best opportunities and to produce optimal solutions to problems. Critical to the mastery of these skills is the ability to use the tools discussed in the preceding section. For example, a business demographer working on small area real estate development such as a shopping mall would need to have knowledge of: (1) methods to produce population estimates and projections for sub-county geographic units; (2) zoning regulations for the area(s) of interest; (3) the location and characteristics of current and potential competitors; (4) traffic flows; (5) local and regional government development plans and possible tax incentive programs; (6) land costs; (7) construction costs; (8) an understanding of the markets from which customers will be drawn; and (9) financing in order to be a full partner in the project. He or she would have to determine if an adequate return on investment could be realized before the project was advanced.

There are no programs of training that offer the broad-based education needed for a person to participate at the level described in the scenario outlined above. For the most part, demographers receive reasonably good methods training, but only a few programs offer several courses designed to give students exposure to public and private sector applications. Programs and courses are offered at the undergraduate and graduate levels of instruction and most are housed in departments of sociology. Neither the close affiliation of demography with sociology nor its lack of interdisciplinary connections
serves the training needs of applied demography very well. In only a few instances are programs and courses found within sociology that are well-designed for applied demography, much less business demography. It also is the case that applied demography is neither often found in applied fields (e.g., urban planning departments) nor as part of interdisciplinary efforts (e.g., public policy departments).

Many colleges and universities offer individual courses in applied demography. These courses cover a broad range of applied demography topics of study and several are taught in the context of a particular line in inquiry. “Applied Demography” is a course in the undergraduate sociology curriculum at the University of Mississippi designed both for majors in sociology and others. “Business Demography” is taught to undergraduate business and MBA students at the University of Nebraska at Omaha. The Helsinki School of Economics offers a course that is specific to business demography: “Demographic Analysis and International Business,” while the Department of Business at Macquarie University offers several undergraduate courses in demography, including “Business Demographics.” Moreover, the program at Macquarie University is housed in the business department, thus providing some advantages over programs that call Social Science or Arts and Science colleges their home. An undergraduate course titled “The Demography of Business/Policy” is offered at Duke University and “Market Research in Public and Private Sector Organizations” is taught at Brown University. A graduate course titled “Demographics for Planning and Policy” is taught at the University of California, Irvine, which offers an entire Master’s Degree program in applied demography. “Applied demography” is taught at the University of Calabria in Italy. Graduate level courses in applied demography also are offered at: University of California at Berkeley, Marshall University, the University of Wisconsin at Madison, the University of Connecticut, Lehman College, Concordia University, and the University of Massachusetts at Amherst among others. In terms of pedagogy, the teaching of these courses varies, but some version of the case study method is often found in them. This list of institutions offering courses and programs is meant to be illustrative, not exhaustive, and, as such, we note that new training and education efforts are developing all over the world.

3. Examples.

3.1. The Need for a New Medical Facility

With the advent in the 1980s of intense competition among medical care providers in the U.S., organizations proposing medical facilities such as hospitals were required by local and state health planning board to demonstrate a need for the proposed services by applying for a “certificate of need.” In 2006, David Swanson was engaged by a client to evaluate population projections done using geometric extrapolation to support the need for a medical facility in the urban fringe of a large city in the southern U.S. As a basis for his evaluation, Swanson needed to develop three sets of cohort-component population projections comprised of high, medium, and low scenarios, for the set of zip codes comprising the study area. Swanson found that the population forecasted for the study area on behalf of the organization seeking to build the facility lacked face validity, was implausible, and failed to give any indication of the uncertainty inherent in it. As Swanson discussed in his report, compound growth, linear, and other mathematical
extrapolation formulas have their place in the demographer’s tool kit and are particularly useful when data series are incomplete and budgets are highly constrained. However, in the case of the population of the study area, the data series were, in fact, quite complete, and Swanson observed that the organization should not have been so constrained by costs as to require such a simplistic and inexpensive forecasting method, one that resulted in unrealistic results by being carried too far into the future. A less damaging, but important defect in the organization’s projection was that it provided no indication of the uncertainty inherent in it. A judge agreed with these findings and found in favor of Swanson’s client.

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Brass, W., A. J. Coale, P. Demeny, D. Heisel, F. Lorimer, A. Romaniuk, and E. Van de Walle. 1968. *The Demography of Tropical Africa.* Princeton, NJ: Princeton University Press. A classic in which techniques are described that can be used estimating the size and composition of a population along with its components of change in the absence of good census and administrative records data. The techniques are largely based on formal demography and require a good understanding of the assumptions underlying them to successfully implement.


Burch, T. 1970. “Some Demographic Determinants of Average Household Size: An Analytic Approach.” *Demography* 7: 61-69. The author extends a model developed by Ansley Coale for use with a stationary population to the case of a stable population and finds under all family systems, average household size is positively correlated with fertility, life expectancy, and average age at marriage. The author suggests that a number of modifications in the model would make for greater fit between model and real family systems.


Casparis, J. 1969. “Shopping Center Location and Retail Store Mix in Metropolitan Areas,” *Demography* 6:125-131. The author finds that as metropolitan areas grow, the proportion of retail sales in major retail centers grows while those in the Central Business District decrease, but that the ratio remains constant.

Office. The author describes the results of comparative tests done by the Census Bureau on the population estimation methods it used in the 1970s.

Clemen, R. 1989. “Combining Forecasts: A Review and Annotated Bibliography.” International Journal of Forecasting 5:559-583. The author provides a review and annotated bibliography of the literature on combining forecasts as a way to improve accuracy. He offers suggestions for how to combine forecasts and recommends that this technique become part of the mainstream of forecasting practice.

Congdon, P. 1989. “An Analysis of Population and Social Change in London Wards in the 1980s.” Transactions of the Institute of British Geographers N.S. 14: 478-491. The author discusses the estimation and projection of small area populations in London and considers trends and indices that can be calculated from these estimates. He also provides a typology that can be used to indicate population distribution and processes such as gentrification and ethnic concentration.


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Devine, J. and C. Coleman. 2003. “People Might Move but Housing Units Don’t: An Evaluation of the State and County Housing Unit Estimates.” Population Division Working Paper Series No. 71. Washington, DC: U.S. Census Bureau. The authors find that the 2000 state and county level housing unit estimates developed from building permits, mobile home shipments, and demolitions not only performed with a degree of accuracy similar to the state and county April 1, 2000 population estimates produced by the Population Division of the Census Bureau, but that they follow a pattern similar to other estimates produced by Population Division in that they tended to be more accurate for larger states and counties.

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categories. They find that the technique produces good results for Florida when tested against 1970 census results, but suggest that more extensive testing is required before a definitive evaluation can be rendered.


Griffin, D. and J. Waite. 2006. “American Community Survey overview and the role of external evaluations.” Population Research and Policy Review 25 (3): 201-223. The authors provide an overview of the reasons that led the U. S. Census Bureau to implement the American Community Survey and the evolution of this survey. They describe the importance of external reviews in the ongoing refinement of this survey.

Hamilton, C. and J. Perry. 1962. “A Short Method for Projecting Population by Age from One Decennial Census to Another.” Social Forces 41 (December): 163-170. The authors introduce the “Cohort Change Ratio” approach to population projections, one that has become known as the Hamilton-Perry method. The method refers to a type of survival rate calculated for a cohort from two censuses. It includes not only the effects of mortality, but also the effects of net migration and relative census enumeration error.

Happel, S., and T. Hogan. 1987. "Estimating the Winter Resident Population of the Phoenix Area" Applied Demography 3: 7-8. The authors report on annual survey of mobile home/RV/travel trailer parks that is used to estimate the number of “snowbirds” who temporarily reside in the area of Phoenix, Arizona over the winter months.

Heer, D. M., and P. Herman. 1990. “Estimating the population of Los Angeles County census tracts by ethnicity. pp. 83-88 in 1990 Proceedings of the Social Statistics Section. Alexandria, VA: American Statistical Association. The authors derive postcensal estimates of the population of Los Angeles County, California by census tract and within each census tract by detailed ethnicity.” A variation of the censal ratio method is used, which "consists in using as symptomatic indicators the expected values from a linear regression equation relating the number of births (or deaths) in each year from 1980 through 1986 to time as the independent variable." Results are compared with U.S. Bureau of the Census figures.


Howe, A. 1999. “Assessing the Accuracy of Australia's Small-Area Population Estimates.” Journal of the Australian Population Association 16(1-2): 47-63. The author finds that it is difficult to evaluate the accuracy of annual estimates released by the Australian Bureau of Statistics. Both broad and specific actors affect the quality of these estimates including inherent characteristics of the region, such as population size and growth rate; changes in the geographic boundaries; quality of input data; estimation method; and adjustments to control totals.

Keilman, N. 1988. "Dynamic household models" pp. 123-138 in: N. Keilman, A. Kuijsten, and A. Vossen. (eds.) Modelling Household Formation and Dissolution Oxford, England: Clarendon Press. The author compares five different macro demographic models and finds that the modeling of individual behavior rather than household behavior is a good strategy. He states that the multidimensional approach holds considerable promise for modeling household behavior and observes that there are three difficulties common to most models (1) the availability of data necessary to run the models; (2) inconsistencies that arise when individuals of different sex are modeled separately; and (3) the exponential increase in the number of states when a detailed household breakdown is considered.

Kintner, H. and L. Pol. 1996. “Demography and Decision Making.” Population Research and Policy Review 15 (5/6): 579-584. The authors describe how demographic input is but one of several components needed to make decisions by businesses and argue that to some extent the future of applied demography will be determined by non-demographers.


Kintner, H. and D. Swanson. 1996. “Ties that Bind: A Case Study of the Link Between Employers, Families, and Health Benefits.” Population Research and Policy Review 15 (5-6): 509-526. The authors examine the linkages among employer policies, employee turnover, and family dynamics. They find that employers face limits to the control that they can exert over the size of the health benefits group associated with their active workforce. Demographic processes unrelated to employee turnover or transfers to layoff or retirement accounted for a large portion of the population change in the case study.


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Marks, A. G. Thrall, and M. Arno. 1992. “Siting Hospitals to Provide Cost-Effective Health Care. *Geo Info Systems* 2:58-66. The authors describe how a Geographic Information System (GIS) can be used both to create a spatial data base and to perform a market analysis of the need for additional hospitals. The robustness of a GIS in market analysis is shown by including satellite data for land use-land cover and slope, incorporating data about distance to population decay factors, creating buffers around existing hospitals, and identifying a unique service area for each hospital by applying a weighted Voronoi polygon technique.

McKibben, J. and D. Swanson, 1997. “Linking Substance and Practice: A Case Study of the Relationship Between Socio-Economic Structure and Population Estimation.” *Journal of Economic & Social Measurement* 24: 135-147. The authors argue that some of the shortcomings in small area population estimation methods would be better understood by linking these methods with the substantive socio-economic and demographic dynamics that underlie them. Using a case study of Indiana over two periods, 1970-1980 and 1980-1990, the authors find that changes in the coefficients of a regression-based estimation model are linked to Indiana's transition to a post-industrial economy. They then describe how this transition operated through demographic dynamics that ultimately affected the estimation model.

Morrison, P. and A. Abrahamse. 1996. “Applying Demographic Analysis to Store Site Selection.” *Population Research and Policy Review* 15: 479-489. This case study illustrates how applied demographic analysis can help structure business decision making. The authors screened every one of several thousand square miles within metropolitan Southern California to identify the 10 best locations for a large supermarket catering to one-stop shoppers. The analytic framework for comparing high-potential locations played a central role in structuring the client's thinking.


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estimate temporary residents.

Smith, S. and S. Cody. 1994. “Evaluating the Housing Unit Method: A Case Study of 1990 Population Estimates in Florida.” *Journal of the American Planning Association*, 60: 209-221. The authors evaluate the accuracy and bias of HU population estimates produced for counties and subcounty areas in Florida for April 1, 1990 and find, among other things, that population size has a negative effect on estimation errors (disregarding sign) but no effect on bias. The authors argue that the HU method offers a number of advantages over other population estimation methods and provides planners and demographers with a powerful tool for small-area analysis.


Smith, S. and T. Sincich. 1988. “Stability over Time in the Distribution of Population Projection Errors.” *Demography* 25:461-474. The authors evaluate the assumption that forecast errors remain stable over time by making population projections for [U.S.] states for a number of time periods during the 20th century, comparing these projections with census enumerations to determine forecast errors, and analyzing the stability of the resulting error distributions over time. They find that in the distribution of absolute percentage errors remained relatively stable over time and data on past forecast errors provided very useful predictions of future forecast errors.

Smith, S. K., J. Nogle and S. Cody. 2002. “A Regression Approach to Estimating the Average Number of Persons per Household.” *Demography* 39(4): 697-712. The authors develop regression-based estimates of the average number of persons per household and compare the accuracy of these estimates to those generated by other methods. They find that the regressions-based estimates are more precise and less biased than those produced by the other methods.


Statistics Canada. 1987. *Population Estimation Methods, Canada*. Ottawa, ON: Statistics Canada. This monograph describes the methods used to produce official population estimates for Canada are discussed and evaluated. Individual chapters are organized around three recurring themes: (1) method; (2) data sources, and; (3) quality evaluation.

Statistics Finland. 2004. *Use of Register and Administrative Data Sources for Statistical Purposes: Best Practices of Statistics Finland*. Handbook Series, No. 45. Helsinki, Finland: Statistics Finland. This monograph provides a comprehensive look at Finland’s population register system and its related components. It includes a history of the development of the population register and gives examples of how it is used.

Swanson, D. 2004. “Advancing Methodological Knowledge within State and Local Demography: A Case Study.” *Population Research and Policy Review* 23 (4): 379-398. The author critically evaluates a “fugitive” method used to generate population estimates in the state of Nevada. The evaluation reveals statistical and methodological shortcomings in this model that lead to an alternative model not subject to these shortcomings. The author suggests that states in which estimates are used to allocate resources would be well-served by subjecting new methods being considered for use to academic peer review before they are adopted.


Swanson, D. 1980. “Improving Accuracy in Multiple Regression Estimates of Population using Principles from Causal Modeling.” Demography 17: 413-428. The author shows how relationships based on matrix algebra can be used to assess coefficient stability and to modify coefficients in the ration-correlation regression model to be consistent with post-censal population changes, thereby providing more accurate estimates.


Swanson, D., and J. Tayman. 1995. “Between a Rock and a Hard Place: The Evaluation of Demographic Forecasts.” Population Research and Policy Review 14 (2): 233-249. The authors argue that there is a high level of cognitive dissonance found the process of forecasting, which can be reduced by refocusing forecast evaluations to include utility. They propose for this purpose the Proportionate Reduction in Error (PRE) measure and conclude that including PRE as an evaluation criterion can reduce stress by reducing cognitive dissonance without, at the same time, either trivializing the evaluation process or substantively altering how forecasts are done and presented.

Swanson, D., and L. Tedrow. 1984. “Improving the Measurement of Temporal Change in Regression Models used for County Population Estimates.” Demography 21: 361-372. The authors introduce the rate-correlation method and provide a test of its accuracy. They conclude that it can provide better accuracy in situations where spatial auto-correlation may be present.

Swanson, D., G. Hough, J. Rodriguez, and C. Clemens. 1998. “K-12 Enrollment Forecasting: Merging Methods and Judgment.” ERS Spectrum 16:24-31. The authors describe how the cohort-component method can informed by the use of GIS and informed judgment to develop K-12 enrollment forecasts. They provide a test of accuracy and conclude that the method shows promise.


Swanson, D., T. Burch, and L. Tedrow. 1996. “What is Applied Demography?” Population Research and Policy Review 15 (5/6): 403-418. The authors argue that applied demography is intrinsically distinct from basic demography because it exhibits the value-orientation and empirical characteristics of a decision-making science while the latter exhibits the value-orientation and empirical hallmarks of a basic science. They examine this conceptualization of applied demography in terms of the methods and materials that fall within its purview and discuss some important consequences, including research agendas and training programs.

Swanson, D., J. Tayman, and C. Barr. 2000. “A Note on the Measurement of Accuracy for Subnational Demographic Estimates.” Demography 37: 193-201. The authors argue that the mean absolute percent error (MAPE), a standard measure of accuracy for population estimates overstates error because it is right-skewed. They introduce a revised MAPE called MAPE-R and show how it can be used. The authors argues that MAPE-R should be part of the standard set of evaluation measures.


Tayman, J., S. Smith, and L. Lin. 2007. “Precision, Bias, and Uncertainty for State Population Forecasts: An Exploratory Analysis of Time Series Models.” *Population Research and Policy Review* 26 (6): 347-369. The authors develop and evaluate six ARIMA time series models for states in the United States. Using annual population estimates from 1900 to 2000 and a variety of launch years, base periods, and forecast horizons, they construct population forecasts for four states chosen to reflect a range of population size and growth rate characteristics. They find that prediction intervals based on some ARIMA models provide relatively accurate forecasts of the distribution of future population counts but prediction intervals based on other models do not.


Verma, R., K. Basavarajappa, and R. Bender. 1983. “The Regression Estimates of Population for sub-provincial Areas in Canada.” pp. 512-517 in *1983 Proceedings of the Social Statistics Section*, Alexandria, VA: American Statistical Association. The authors describe two sets of post-censal population estimates that are published yearly by the government of Canada. The two sets were found to be statistically similar, though the first set is more timely, and the second providing more details on the components of population change.

Walashek, P. and D. Swanson. 2006. “The Roots of Conflict over U.S. Census Counts in the Late 20th Century and Prospects for the 21st Century.” *Journal of Economic and Social Measurement* 31 (3-4): 185-205. The authors described the modern U.S. Census as a “commons,” in which private benefits are gained at public expense. They identify the role that historical actions played in making the census into a Commons, thereby setting the stage for modern day census litigation and other forms of conflict. The authors observe that as a Commons, the census is facing a potential collapse that cannot be prevented by methodological developments and conclude by noting that a course of political action may be the best course for preventing such a collapse.

Webster, C. J. 1996. “Population and Dwelling Unit Estimates from Space.” *Third World Planning Review* 18(2):155-76. The author reports on attempts to measure the morphological patterns in an urban satellite scene and to use these for image interpretation. The interpretation task addressed is the estimation of residential dwelling units from the patterns discernible in high resolution satellite images of cities. The practical results include dwelling estimates that can be aggregated to any geographical unit of analysis, population estimates for cities and a dwelling density surface that can be categorized into any number of residential land-use classes.”

Conference. PSRC Press: Bowling Green, Ohio. The focus of the conference was on ways in which demographic data and concepts can be used to produce better and more informed business and public policy decisions. Subject headings include applied demography and government policy; technical issues in business demography; relations between public sector and academic demographers; demography and management issues in business; and linking the demographic information needs of business, state and local governments, and universities.

Wicks, J., R. Vincent, L. P. De Almeida, and D. Swanson. 1999. "Population Estimates from Remotely Sensed Data: A Discussion of Recent Technological Developments and Future Research Plans." Paper presented at the Annual Meeting of the Canadian Population Society, Lennoxville, Quebec, Canada. The authors discuss developments that have created opportunities for the advancement of using remotely sensed data to produce accurate and timely population and housing estimates. They outline plans for the design and testing of procedures capable of producing current population estimates from remotely sensed data.


Biographical Sketches

David A. Swanson is Professor of Sociology, University of California Riverside and a Research Associate with the Blakely Center for Sustainable Suburban Development. His Ph.D. is from the University of Hawaii. Dr. Swanson’s teaching interests include demographic methods, population forecasting, and business demographics. He regularly returns each summer to the Helsinki School of Economics, where he served as Dean of the English-language bachelor’s program from 1999 to 2003, to teach Demographic Analysis and International Business. Dr. Swanson’s research focuses on applied demography, especially small area population estimation and population forecasting. He has published more than 65 sole- and co-authored refereed journal articles and hundreds of reports. With Stan Smith and Jeff Tayman, he wrote *State and Local Population Projections: Methodology and Analysis* (2001) and with Jay Siegel, edited *The Methods and Materials of Demography 2nd Edition* (2004). He serves as a member of the U.S. Census Bureau’s Advisory Committee for Professional Associations and is a past editor of the journal, *Population Research & Policy Review*.

Louis G. Pol is John Becker Dean of the College of Business Administration, University of Nebraska, Omaha. His Ph.D. is from Florida State University. Dr. Pol’s teaching interests include business and health demography, marketing research, and statistics. His research interests include demographic applications, research methodology and statistics, and health care policy. Dr. Pol is the author of six books, including *Demography for Business Decision Making* (1997), with Richard Thomas, and *The Demography of Health and Healthcare, 2nd Edition* (2001), also with Richard Thomas. In addition, he has published over 70 articles, book chapters, and research notes. His most recent work focuses on the determinants and consequences of being without health insurance, and developing a methodology for identifying rural areas at risk to not providing adequate health services to their populations. He serves or has served on the editorial boards of *Journal of Hospital Marketing, Journal of Professional Service Marketing, Journal of Marketing Theory and Practice, Health Marketing Quarterly, and Population Research and Policy Review*. He is past president of Southern Demographic Association.