

Chapter 2

The Methods and Materials of Demography

Abstract This chapter reviews the basic materials and methods of demography and their relevance for applied demography as a sub-discipline. Definitions and concepts utilized are described, and basic demographic techniques that have relevance and types of data important for real-world applications are introduced.

2.1 The Demographic Perspective

The demographic perspective provides a unique way of seeing the world. When we view the world through “a demographic lens” we see things that others do not. The “world” of course could mean literally *the world* or any population of interest. When demographers observe a classroom of students, the residents of a small town, or the citizens of the United States, for example, they do not see an amorphous mass of individuals. They see a well-ordered population with more or less sharply delineated boundaries between various subgroups.

It is a challenge for anyone to understand what has become an increasingly complex world. Demography provides us a tool for making sense of this complexity. With our demographic eyes we can segment the population we are observing into meaningful subgroups. By segmenting the population into such groups, we gain understanding into the nature of that population. This understanding allows the observer to gain insights into the behaviors observed within that population and ultimately apply demographic concepts, techniques and data to real-world problems.

Much of this text is devoted to a discussion of what demographers see when they look at a population from a demographic perspective.¹ Some of the more obvious things that demographers observe are distinctions based on age, sex and race. All of us, of course, intuitively notice basic characteristics of a group that is being observed. We note whether it is a young crowd or an old crowd, the ratio of men to women, and the extent to which the population being observed is racially mixed.

¹Much of the material in this chapter owes a debt to the groundbreaking synthesis published by Shyrock and Siegel (1976) and subsequently revised by Swanson and Siegel (2004).

Demographers notice these same attributes either directly through observation or indirectly through the compilation of statistics.

Looking at the world through “a demographic lens” allows the observer to identify patterns, trends and relationships that otherwise might go unnoticed.

Demographers take these observations a step further in that they can attribute a wide range of other characteristics to the population under study. If one knows the age composition of the population in question, for example, one knows a lot of other things about that population. Although there will be exceptions, we can make assumptions about that population’s family status, their attitudes, their lifestyles and even their health status. As a specific example, health demographers could develop a profile of the health problems of that population with startling accuracy. Further, demographers can deduce other demographic characteristics from knowing the age structure of the population. They know that a young population is typically going to have an “excess” of males and that an old population is going to have an “excess” of females. By knowing the age and sex distribution of the population demographers can draw conclusions concerning marital status and household structure. By examining combinations of demographic characteristics it becomes possible to draw conclusions concerning occupational status, educational attainment, income levels and so forth.

It is possible for demographers to make these assumptions concerning the population under study because the various demographic attributes are highly interrelated. People of a certain age, for example, are likely to have attributes that set them apart from people in other age cohorts. For a variety of reasons, people who are members of a certain racial or ethnic group are likely to have characteristics that set them apart from members of other racial and ethnic groups. This is not to stereotype members of various groups, of course, and there are always going to be individual exceptions, but to underscore the fact that demographic attributes are interrelated and tend to be distributed in clusters throughout a population.

Demographic characteristics are often interrelated so, if a demographer knows one thing about a population, this opens the door to knowledge of other characteristics of that population.

Hopefully, this text will allow students to begin to view the world through demographic eyes. This is not something that always comes intuitively but hopefully enough tools will be provided in the following sections to allow the reader to begin seeing the world around him in a different light.

2.1.1 *The Demographics of Birth and Death*

Demography also provides observers a means of interpreting the world, of understanding social phenomena. One of the obvious insights can be gained with regard to demographic trends. As noted previously, demographics is a two-way street, with the demographic characteristics of a population determining its behavior while, at the same time, the behavior of the population ultimately determining its demographic characteristics. These relationships become clear when one examines basic demographic processes. Of particular significance is the impact of demographic characteristics on fertility or the reproductive behavior of the population. From a “free will” perspective, it could be argued that individuals in society make conscious choices with regard to reproduction. This doesn’t mean that there are not unplanned pregnancies—since there clearly are—but it does suggest that the level of fertility is a function of choices made by millions of Americans on a daily basis.

From a strict demographic perspective it could be contended that the notion of individual volition when it comes to reproduction is overstated. Indeed, it could be argued that one’s social circumstances (manifested in demographic attributes) are a greater predictor of fertility patterns than the vagaries of personal choice. While there are clearly childbearing-aged members of low-income minority groups in the United States who do now want to have children (and most of these avoid having children), the fact of the matter is that the likelihood of pregnancy for this segment of the population is much higher than that for virtually any other segment of the population.

While reproduction is a complicated process and a lot of factors come into play, it is clear that low-income populations have higher fertility rates than high-income populations, that certain racial and ethnic groups have higher fertility levels than other racial and ethnic groups, that immigrant groups have higher fertility rates than native-born populations, that the poorly educated have higher fertility rates than the well educated, and so forth. One would not want to assert that “demographics is destiny” but it is clear that one’s demographic traits exert a considerable influence on reproductive behavior. Because of these clear-cut patterns, demographers are able to predict future fertility patterns and, perhaps more important, predict the future characteristics of the population. They know, for example, that the native-born white population is going to continue to shrink as a proportion of the population for the foreseeable future while minority populations continue to increase their share of the population.

Patterns of fertility and mortality do not exist in a vacuum but are a reflection of the demographic attributes of the population under study.

At the other end of the lifespan, mortality rates are influenced by demographics. Except in rare circumstances, individuals do not choose the time or cause of their deaths. If anything, it would be assumed that death is a somewhat unpredictable

event and that mortality patterns are more a function of biological threats, environmental toxins and accidents among other causes that have little to do with either individual choice or demographic attributes. While the relationship between demographic attributes and mortality is not as clear cut as that for fertility patterns, the demographic characteristics of any population serve as reasonable predictors of both the level of mortality and the most common causes of death. In fact, the correlation between certain demographic attributes and the risk of death is so high that it is possible to calculate the odds of dying for any age group in U.S. society. Further, the cause of death for members of the particular age group can also be anticipated. As with fertility, membership in various demographic categories is associated with risk of death. We find, for example, that males are at much greater risk of death than females (and in every age cohort), that African-Americans are at much greater risk of death than whites, that members of poverty populations are at much greater risk of death than those in affluent groups and so forth. Because of these patterns, demographers are able to predict future mortality levels and the leading causes of death years in advance.

2.1.2 Demographics and Social Change

While the relationship between demographic attributes and demographic processes is fairly direct, there are also more indirect impacts of the population's demographic traits that may be less obvious. Being less obvious does not make them less significant, and it is probably safe to say that virtually every issue faced today by American society and even the world's population ultimately has demographic phenomena at its heart. The fact that the U.S. is facing challenges in funding the Social Security and Medicare programs in the future reflects the demographic fact that more people are living to a ripe old age than in the past. The impetus for the enactment of the Patient Protection and Affordable Care Act in 2010 was the growing population of uninsured citizens and the fact that thousands of Americans were dying every year due to a lack of health insurance. The fact that 2012 college graduates faced the worst job prospects of any recent cohort reflects a number of demographic trends: high rates of educational attainment, a changing job market (both in terms of total jobs and types of jobs), and immigration trends among others.

Beyond our borders international events are also driven by demographic phenomena. The high rate of immigration (especially illegal immigration) into the United States during the first decade of this century was driven by poor job prospects in sending countries and better job prospects in the U.S. At the same time, the significant drop in immigration during the first years of the second decade reflects the decline in available jobs in the U.S. These same factors are influencing worldwide immigration patterns. The transfer of jobs from developed countries to less-developed countries has significant implications for the populations on both ends of this process.

A couple of other examples should suffice to underscore the need to understand demographics if one is to interpret national and international events. Climate change has been increasingly in the news, and there is now conclusive evidence that human behavior is playing a major role in this phenomenon. A large part of the blame is placed on the economic activity of more industrialized nations. These activities are driven by demographically generated demand for energy and the goods that energy produces. In less developed parts of the world, a lot of the pressure on the environment is driven by a growing population which, based on numbers alone, requires ever increasing resources. Add to this the fact that the middle classes in many less-developed countries are growing at an unprecedented rate and this results in a perfect storm for exploiting the environment and inducing climate change. If human behavior is driving climate change, demographic change is driving that behavior.

A knowledge of demographics is important for an understanding of national and international developments, since most of these phenomena are driven by demographic trends.

One final international example involves the so-called “Arab Spring” that occurred late in the first decade of this century. During this period, “revolutions” took place in certain Middle Eastern countries, most notably in Egypt, Tunisia, Libya and Yemen and major disruptions occurred in others. Analysts have attributed the Arab Spring to clearly demographic roots. Demographers point out that the origins of this movement date back two decades when public health measures became widespread in Middle Eastern countries. These countries had historically suffered from high infant mortality rates, assuring that many infants would not survive into adulthood with a subsequent ceiling on population growth. With the introduction of public health measures, the infant mortality rate dropped precipitously. This resulted in a demographic “bulge” beginning 20 or 30 years ago. By the 21st century there was an “excess” of young adults in most Middle Eastern countries. Because there were limited jobs, the respective governments offered educational opportunities to youthful citizens. This resulted in a unprecedented young adult age cohort that was well educated and, further, had access to the Internet. Despite the resistance of various rulers, this demographic wave was able to swamp these recalcitrant politicians. Interestingly, as a footnote to the Arab Spring we now see significant societal disorganization in some of these countries that appeared to be moving toward democracy as various religious and ethnic factions (also demographic categories) vie for control of the respective governments.

The demographic perspective also provides a means for linking social groups to their environments. Virtually all demographic data are linked to some geographic unit thereby linking the population with the particular characteristics of that geography. Knowing that a population resides in the inner-city or the suburbs or a rural area has important implications for our understanding of that population and

its attributes. Similarly, knowing that a population lives in an impoverished urban community rather than an affluent suburb, in single-family detached housing rather than high-density apartments, or in an isolated ethnic enclave rather than a diverse community also has implications for that population's characteristics. Segmenting a population on the basis of its geographic distribution, its type of community or its salient demographic features provides context for the future analysis of that population. This approach to understanding the population provides the basis for various types of spatial analyses.

The demographic perspective further emphasizes the importance of relationships between various demographic variables as well as other, non-demographic variables. As noted previously, many demographic variables are interrelated, and an understanding of these relationships allows for a deeper understanding of the nature of these populations. If one knows the income level for a particular population, it is possible to deduce a number of other attributes of that population, for example. Or, if one knows the age distribution of the population, an analyst can predict the types of health problems that members of that population will exhibit.

One final aspect of the demographic perspective is the emphasis placed on the ability to predict demographic characteristics and demographic trends. Demographers have advantages over those in many other disciplines for a couple of reasons. First, as indicated above, the interrelationships between demographic variables are such that it is no great leap to be able to project the future characteristics of a population based on known current characteristics. If one knows, for example, the current age and sex distribution for a population, it is possible to project the fertility and mortality patterns for that population ten or twenty years into the future. Of course, the analyst is making certain assumptions about fertility rates and mortality rates and, even more risky, about the behavior of individuals. Even so, such projections are often made and usually with surprising accuracy. If we add other variables, e.g., marital status, to the mix, the ability to predict future fertility levels is enhanced. The predictions could be further refined by profiling the population under study in terms of its racial makeup or socioeconomic status.

Demographers have an advantage when it comes to predicting the future in that they can anticipate future social change by observing current demographic trends.

One other way in which demographers have an edge over other researchers is by taking advantage of the natural aging process exhibited by a population. In the absence of high levels of in-migration or out-migration and with some knowledge of reproduction rates, it is possible to project the characteristics of a population into the future based on age distribution alone. For example, demographers can project the number of children entering kindergarten in five years because those children are already in the population (i.e., members of the population one year old or less). Similarly, demographers can project the number of youth entering college ten years

from now because they know the number of eight-year-olds currently in the population. Or, demographers can project the number of new “senior citizens” that will be added to the population thirty years from now because they know how many 35-year-olds are currently in the population (as well as the number of those who are likely to die over the next 30 years). Although in each case the demographer has to make certain assumptions (e.g., college admission rates, mortality rates), the natural aging of the population allows the analyst to use “cohort analysis” to project the future characteristics of that population.

Fertility, mortality and migration are considered the primary demographic processes because of the role they play in shaping a population’s attributes and driving population change.

2.2 Demographic Methods

2.2.1 Demographic Analysis

Demographic analysis is a technique used to develop an understanding of the age, sex, and racial composition of a population and how it has changed over time through the basic demographic processes of birth, death, and migration. Demographic analysis (usually abbreviated as DA) also refers to a specific set of techniques for developing national population estimates by age, sex, and race from administrative records to be used to assess the quality of the decennial census. Demographic analysis allows us to measure the dimensions and dynamics of populations.

2.2.2 Estimation and Projection

Demographers have long used population estimates and projections in the absence of actual data and a variety of techniques are utilized to generate estimates and projections. Population estimates for states, MSAs, and counties are prepared each year as a joint effort of the Census Bureau and the state agency designated by each state governor under the Federal-State Program for Local Population Estimates (FSCPE). The purpose of the program is to standardize data, and procedures so that the best quality estimates can be derived. Most states also generate population estimates and projections that are available through state agencies. However, these figures are often produced at irregular intervals, and thus may be quite dated. The reader is also encouraged to evaluate the quality of these data to the best of his or

her ability. For additional information on population projections and estimates see Smith, Tayman, and Swanson (2000).

Population estimates and projections generated by government agencies have historically been the only ones available. Today, however, a number of data vendors provide these figures. These vendor-generated data are often made available down to small units of geography (e.g., the census tract) and in greater detail (e.g., sex and age breakdowns) than government-produced figures. They offer the flexibility to generate estimates and projections for “custom” geographies (e.g., a market area) not available for government-generated statistics. The drawback, of course, is that some precision is lost as one develops calculations for lower levels of geography and for population components. However, the ease of accessibility and timeliness of these vendor-generated figures have made them a mainstay for applied demography.

2.2.3 Standardization

Standardization is a method for adjusting mortality rates or other measures of vital processes for compositional factors that have an effect on those rates. For example, the number of deaths occurring in any year is a function of three components: health status, population size and demographic attributes (e.g., age). Since mortality rates are frequently used as indicators of health conditions, it is important to hold population size and age structure (and perhaps other attributes) constant when mortality rates are being constructed.

The calculation of rates addresses concerns over differences in population size and allows the analyst to compare the health status of two populations that are different demographically. The crude death rate (CDR), for example, may be used for this purpose. However, the CDR may be misleading since it is influenced by differences in the age structures of the populations in question. That is, areas with relatively young populations (and hence less risk of dying) are likely to report low death rates, while areas with relatively old populations (and greater risk of dying) are likely to report high death rates independent of the size of the respective populations. Thus, while age-specific death rates (ASDRs) are higher for all age cohorts in Mexico than in the United States, the CDR is lower in Mexico due to its very young age structure. For this reason, the unadjusted CDR is not a good measure for comparative purposes. It is possible to adjust or standardize rates in order to control for age structure and, often, other factors (e.g., race).

2.2.4 Cohort Analysis

Cohort analysis is a method used by demographers to describe an aggregate of individuals having in common a significant event in their life histories, such as year

of birth (birth cohort) or year of marriage (marriage cohort). The concept of cohort is useful because occurrence rates of various forms of behavior are often influenced by the length of time elapsed since the event defining the cohort—*e.g.*, the rate of fertility is influenced by the event of marriage. The idea of cohorts is similar to that of generations, although some writers avoid the latter term because it also has other connotations.

Cohort analysis has been used most extensively in demography, especially in studies of fertility. When statistics show a rise in the total fertility rate over a given period, for example, cohort analysis may reveal that this results from a lowering of the cohort mean age of fertility rather than simply a rise in the cohort total fertility rate.

2.2.5 *Spatial Analysis*

Spatial analysis is a set of techniques for analyzing spatial data—that is data linked to particular geographic points. Since most demographic data are linked to a specific geography, this technique is frequently used by population scientists. Spatial statistics extends traditional statistics to support the analysis of geographic data. It includes techniques that describe the distribution of data in the geographic space (descriptive spatial statistics), analyze the spatial patterns of the data (spatial pattern analysis), identify and measure spatial relationships (spatial regression), and create a surface from sampled data (spatial interpolation, usually categorized as geostatistics). Software applications (geographic information systems) that implements spatial analysis techniques require access to both the locations of objects and their attributes.

2.2.6 *Epidemiologic Analysis*

Epidemiology is the study of patterns of disease occurrence and other health-related conditions in human populations and of the factors that influence these occurrences and conditions. Epidemiological studies are used to determine patterns of disease or disability across different populations, geographical areas and over time. Epidemiological studies relate observed differences in the morbidity or mortality to the spatial and temporal distribution of risk factors, lifestyles, genetic composition of groups, or occupational or environmental exposures. Analytic studies are used to test hypotheses related to epidemiological relationships.

Case Study 2.1: A Census of the Jewish Community

Representatives of the Jewish community in a medium-sized city felt that it was important that a census be conducted of their population in that community. On the one hand, there was some evidence that the size of the Jewish population was decreasing although there was little factual data to support this belief. On the other, the community was making plans for some capital investments and, at that point, was considering a facility to support the activities of the Jewish youth in the city. The organization sponsoring the project contracted with a political scientist and a demographer at a local college to conduct the census. Since it was intended to be a census rather than a sample survey, the researchers were asked to identify and profile to the extent possible all Jewish residents whether active in religious life or not.

The project represented a challenge for the researchers engaged for this project. While the sponsoring organization had the names and certain data on the families that were active in the Jewish community, they had virtually no information on those who were not. Thus, the major challenge for the census-takers was to identify and contact those residents with Jewish backgrounds that were not known to the sponsors of the survey. The researchers began by using city directories to identify any listed individuals who had the same name as those on the synagogue roles but were not on the active list. This generated an additional set of names for follow up. The most challenging part was identifying any other residents of Jewish derivation whose names were not included in the initial list. With the guidance of the sponsoring organization, the researchers developed a list of names that had a high probability of Jewish ethnicity. This list of names was used to scour city directories to identify other potential residents of Jewish ancestry.

The lists that were compiled through this process were used as the basis for the administration of a mail-out survey. Every household or unattached individual that was identified was sent a survey form that solicited basic information. The screening question related to whether or not the respondent was of Jewish ancestry and, once this was established, a series of additional questions elicited information on age, sex, family size and other information thought important by the sponsoring organization (including the types of social services desired). This approach turned out to be reasonably successful in that a number of individuals and families were identified that were not known to the mainstream Jewish community and few potential respondents were identified that were not Jewish. Obviously, an unknown number of people with Jewish backgrounds were not included but the sponsors were satisfied that virtually all of the population of interest was identified.

The researchers counted and profiled the Jewish population and developed what they felt was a reasonable approximation of the total population. The sponsoring organization did not anticipate what the census would reveal, and

two major conclusions are discussed here. First, the Jewish population was much smaller than what conventional wisdom had suggested. The researchers calculated that the total population of those of Jewish heritage was 10,000. It is fair to say that many in the community were shocked by this figure. Second, the census revealed that there were very few children within this population, certainly many fewer than anyone had thought. The median age of the Jewish population was much higher than that of the total population, the proportion of senior citizens much higher, and the proportion of children much lower. The visibility of a number of large families that were active in the life of the community had apparently fostered the notion that the population was child heavy.

To the credit of the sponsoring organization, its leaders acknowledged the integrity of the census and accepted the findings. Further, they significantly revised their thinking with regard to the future emphasis of the community's social service programs. At the time of the survey, the organization had a major youth-oriented facility on the drawing board. Based on the results of the census, the organization's decision makers reversed direction and shifted to focus on newly identified needs of the Jewish population. Rather than building a center for youth recreation on the grounds of the Jewish Community Center, they instead build a high-rise facility for senior citizens.

Exercise 2.1: Identifying a Site for a Children's Toy Store

You have been engaged by the Toys-For-U chain to identify the best site for their next store in a particular state. The chain offers relatively high-end toys but not at the same level as the upscale stores found in major cities (e.g., FAO Schwarz, Build-a-Bear). Based on the information provided below, you must analyze the situation and rank the five potential sites in terms of their suitability for a new children's toy store. Be prepared to explain and justify your ranking.

	Population	Annual growth rate (%)	HH income	Children	(%) Children
Site 1	50,000	+5	\$50,000	8000	16
Site 2	100,000	+5	\$40,000	20,000	20
Site 3	100,000	+2	\$20,000	25,000	25
Site 4	150,000	+2	\$35,000	30,000	20
Site 5	200,000	-5	\$30,000	40,000	20

Please rank these sites in terms of their potential for a Toys-For-U store:

Site 1: ____

Site 2: ____

Site 3: ____

Site 4: ____

Site 5: ____

Which factors did you think were most important in making your decision?

What criteria did you use in reaching your conclusions?

What relative importance did you place on growth rate, income and children (especially numbers vs. percentage)?

Given the upscale nature of the toys being offered, in what way did the median household income affect your decision?

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Additional Resources

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