Chapter 5
Population Composition

Abstract This chapter reviews the various components of population composition and the ways these data are used to describe populations. The various measures used for profiling a population in terms of its attributes are discussed and relevant techniques used in demographic analysis (e.g., cohort analysis, standardization) are described.

5.1 Introduction

Population composition refers to the combined demographic characteristics of persons within a geographic area. These characteristics create a profile of the population and are the attributes that give a population its particular character. The population composition of New York City sets it apart from Memphis, Tennessee, and Omaha, Nebraska, more so than its size. Compositional variables are primarily descriptive in nature. Their usefulness is derived from their ability to profile a population in terms of its relevant attributes. An area's age distribution, racial makeup, income level, and dominant religion are the types of characteristics that give a population its "personality." Because of the breadth of information related to population composition the first part of the chapter will present an overview followed by a section on applied examples.

5.2 Compositional Variables

Compositional variables can be divided into two categories: biosocial characteristics and sociocultural characteristics. *Biosocial characteristics* are those that have an underlying biological or physical component. As such, they tend to be "ascribed" characteristics present at birth and not amenable to change. Biosocial factors include age, sex, race and ethnicity, and with the exception of ethnicity all are rooted squarely in biology. Ethnicity has its basis in a common cultural heritage, but

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endogenous marriage within ethnic groups often results in the development of a gene pool that fosters common physical characteristics.

Biosocial attributes are characterized by an underlying biological or physical component accompanied by significant social connotations.

Biosocial characteristics have significant social connotations in that society ascribes certain attributes to people based on their biosocial classification. For example, while being male or female is a biological state, society attaches certain attributes to men (i.e., masculine traits) and to women (i.e., feminine traits). In fact, demographers use the term "sex" to refer to biological differences and "gender" to refer to socially ascribed differences. Similarly, we speak in terms of age-appropriate behavior to indicate that age is not just a matter of years lived but that there are certain social attributes associated with different ages.

Sociocultural factors reflect the positions society members occupy within the social structure. Sociocultural factors, in U.S. society at least, are primarily "acquired" rather than ascribed. These are not traits one is born with in a biological sense but those that are acquired (voluntarily or involuntarily) through participation in the social system. These factors are "cultural" in that those affected take on characteristics assigned by society. Sociocultural factors include marital status, income, education, occupation, and religion among others. Each variable is discussed in turn in the sections that follow.

Sociocultural attributes reflect the position of society members occupy within the social structure and, as such, represent acquired rather than ascribed characteristics.

5.2.1 Biosocial Characteristics

Age. For many purposes, the age distributions of a population represents the most significant compositional variable. After population size, the age distribution is the most important factor in determining a society's character and for calculating many of the rates used by demographers. Age is measured in chronological terms beginning at a person's date of birth. Age data in the United States are generally thought to be of high quality, though some age "heaping" is seen in self-reported data for milestone years such as 21, 62, 65, 100, and years that end in zero.

Although age data may sometimes be presented in single years (e.g., 1, 2, 3, etc.), ages for a population are typically grouped into intervals to simplify data presentation. Five-year and 10-year intervals are generally used by demographers, with exceptions sometimes made for the youngest intervals (under 1, 1–4), and the oldest intervals (age 85 and above). However, there is no substantive reason for utilizing these intervals, and others that are more relevant to the issue at hand may be more useful. It may even be appropriate to create "functional" intervals, such as 0–14, 15–24, 25–44, 45–64 and 65 and older. In addition, age-based cohorts may be carved out in order to focus on specific sub-populations such as teenagers (i.e., 13–19), child-bearing age women (i.e., 15–44), and the young-old (i.e., 65–74). It is important to examine the age distribution of a population to develop an understanding of the importance of various age groups.

Means and medians are often used as summary indicators of the overall age distribution. The median age is most commonly used since it provides the best indicator of the mid-point of the age distribution. The current median age of the U.S. population is around 37 years. This contrasts with a population like that of Uganda with a median age of 15 years. Obviously, the difference in median age between the U.S. and Uganda has all manner of implications for the respective societies. For example, younger populations have proportionally more women in their childbearing years, and therefore produce more births. It is common to separately calculate the median age for males and females as well as for other demographically meaningful subgroups.

The mean age (or arithmetic average) of the population is sometimes used as an indicator of "average" age, although the mean is much more sensitive to extreme values than the median and, thus, considered less meaningful. By comparison the mean age for the U.S. population is 38.5 years, somewhat higher than the median due to "outliers" on the high end of the distribution. Measures of statistical dispersion (e.g., standard deviation) may also be used to describe a population's age distribution. Exhibit 5.1 contains detailed age data for the US population in 2010. This would be considered a "mature" population distribution because of the relatively high median age and due to the fact that there are similar proportions within all age groups except for the very oldest.

Exhibit 5.1: Age Distribution of US Population: 2010 (In Thousands)

Age Category	Population	Percent
Under 5 years	20,201	6.5
5–9 years	20,349	6.6
10–14 years	20,677	6.7
15–19 years	22,042	7.1
20–24 years	21,586	7.0
25–29 years	21,102	6.8
30–34 years	19,962	6.5
35–39 years	20,180	6.5
40–44 years	20,891	6.8
45–49 years	22,709	7.4
50–54 years	22,298	7.2
55–59 years	19,665	6.4
60–64 years	16,818	5.4
65–69 years	12,435	4.0
70–74 years	9278	3.0
75–79 years	7318	2.4
80–84 years	5743	1.9
85 years and over	5493	1.8
Total	308,745	
Median age	37.2	

Source U.S. Census Bureau, American FactFinder. Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1. October 1, 2012

Sex. The *sex* or *gender* of an individual is perhaps the most straightforward attribute to determine, given that there are only two possible categories, male and female. The sex distribution is typically presented in terms of raw numbers (e.g., 5200 females and 4800 males), percentages (e.g., 52% female and 48% male), or converted into a "sex ratio". The sex ratio indicates the number of males per 100 females. Based on these raw numbers, a sex ratio of 92.3 would be generated, meaning that for this population there are only around 92 males for every 100 females. In most developed countries the sex ratio is less than 100, indicating fewer males than females. Interestingly, in the U.S. today the sex ratio varies over the lifecycle reflecting a biological weakness in males. The sex ratio at conception is 108 (i.e., 108 males for every 100 females) and drops to 103 at birth. Parity (sex ratio = 100) is reached around age 20 with the sex ratio remaining under 100 for subsequent age cohorts and rapidly declining. At the oldest ages the sex ratio drops to 40 reflecting the higher attrition rate for males. For the age range 85 and over there are essentially two women for every man.

The sex ratio is reflective of a number of factors including the age distribution, economic conditions, migration patterns and, in some populations, preferences for one sex over the other.

Race and Ethnicity. Race and ethnicity are at the same time biologically determined and socially constructed. Racial identity is based on physical characteristics such as skin color. Ethnic identity, on the other hand, is based on a common cultural heritage. Both "race" and "ethnicity" are social constructs with race, in particular, having no scientific basis. Thus, the number of racial groups and the basis for racial categorization vary from society to society. In the US racial groups include whites, African-Americans, Asian-Americans, American Indians (including Alaska natives), and Hawaiians and Pacific Islanders. The decennial census is the major source of data on the racial composition of the U.S. population and in recent censuses it has been possible to claim two or more races.

Ethnic identification may be determined by members of a subgroup or ascribed by the larger society. Members of many ethnic groups view themselves as distinct from the larger society; others many not see themselves as different at all. Thus, while the Census Bureau may categorize all residents of Hispanic background as "Hispanic", few Mexicans, Cubans or Puerto Ricans would apply that label to themselves. When the US population's racial/ethnic composition is examined, Hispanics are classified as ethnic group members as well as in terms of their race.

Over the past 25 years trends in the racial and ethnic makeup of the U.S. population have created a much more diverse population than previously existed.

The only ethnic group officially recognized by the Census Bureau is Hispanics, although there are other ethnic groups within U.S. society that could be identified. Jews and Arabs could both be considered ethnic groups as could subgroups identified based on their national heritage (e.g., Southeast Asians, east Indians, Ukrainians). Of course, to be considered as an ethnic group, the subpopulation must retain significant aspects of its traditional culture.

Exhibit 5.2 presents a breakdown of the current racial and ethnic distribution for the US population. Note that the total exceeds 100% since Hispanic-origin persons are double counted—i.e., as members of an ethnic group also assigned to various racial groups. The data show that more than one-third, 35.6%, of the U.S. population is made up of persons classified as a racial or ethnic minority. This figure has been rising and will continue to grow given the differences in age structure and fertility behaviors across all groups.

Exhibit 5.2: Racial and Ethnic Composition of the US Population: 2010 (In Thousands)

Race/ethnicity category	Number	Percent
Total population	304,060	
White alone	223,553	72.4
Black or African American alone	38,929	12.6
American Indian, Alaska native alone	2932	0.9
Asian alone	14,674	4.8
Native Hawaiian/Pacific Islander alone	543	0.2
Two or more races	9009	2.9
Hispanic origin	50,478	16.3

Source U.S. Census Bureau, American FactFinder. Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1. October 1, 2012

5.2.2 *Sociocultural Characteristics*

Marital Status/Living Arrangements/Family Structure. Marital status, living arrangements, and family structure are all ways of looking at household characteristics. In the past, marital status was thought by demographers to be the best indicator of household relationships. However, as the traditional family has given way to new and different types of households, other measures of household characteristics have become more salient.

Over the past 50 years the United States population has experienced a shift from one of the developed world's highest marriage rates to one of its lowest.

Individuals are typically grouped into four marital status categories: never married, married, widowed, and divorced. "Never married" refers to individuals who are single and, as the term implies, have not been married. (Widowed and divorced individuals are also technically single.) The Census Bureau also recognizes a "married but separated category", although this does not constitute a formal marital status in all states. Demographers are interested in a range of characteristics related to marital status (e.g., age at marriage, race/ethnicity of bride and groom) Historically, most Americans married when they entered adulthood and virtually everyone married. However, beginning in the 1960s the rate of marriage began to drop and this decline has continued to the point that barely one-half of American adults are married today. While the slim majority of adults are married, the proportions never married, widowed and divorced have all increased. Exhibit 5.3 shows the current marital status of the U.S. population.

Exhibit 5.3: Marital Status of the US Population 15 Years and Over United States: 2010 (In Thousands)

	Number	Percent (%)
Never married	79,640	32.1
Married	126,446	51.0
Widowed	14,944	6.0
Divorced	27,026	10.9

Source Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YRDP02&prodType=table. October 1, 2012

In addition to marital status it is important to determine the living arrangements and family status for members of a population. A *household* is made up of one or more persons living in a housing unit. A *housing unit* is defined as one or more rooms that comprise separate living quarters with access from the outside or through a common hall along with a kitchen or cooking equipment for exclusive use. Thus, individual apartments and duplex units are considered separate housing units, while dormitories and military barracks are not; the latter are referred to as *group quarters*.

Determining whether or not persons in a housing unit or elsewhere constitute a family is also important. A *family* is defined as two or more persons related by blood, marriage, or adoption who live together. Two persons living in the same housing unit are considered to be a household regardless of the relationship; if they are related to each other they are classified as both a household and a family. Because of this distinction, households are assigned to either the family or non-family category.

The distinctions between different types of household structures are important for a number of reasons. Family households, for example, have legal standing, while nonfamily households typically do not. Further, family households are likely to differ from nonfamily households in a number of ways unrelated to the size or nature of the relationship. In healthcare, the health service needs of nonfamily households are likely to differ from those of families.

One additional residential category to be considered is group quarters. Group quarters are defined by the U.S. Census Bureau as living arrangements for groups not living in conventional housing units or groups living in housing units containing ten or more unrelated people or nine or more people unrelated to the person in charge. Group quarters are owned or managed by an entity or organization providing housing and/or services for the residents. These services may include custodial or medical care as well as other types of assistance, and residency is commonly restricted to those receiving these services. People living in group quarters are usually not related to each other. Group quarters include such places as college residence halls, residential treatment centers, skilled nursing facilities, assisted living facilities, group homes, military barracks, correctional facilities, and

workers' dormitories. As the US population continues to age, the number and percentage of Americans living in group facilities is expected to increase.

Over the past 25 years the changes in household structure have been so dramatic that some demographers have referred to it as a second demographic transition.

The proportion of households considered family households (two or more persons who are related) has declined while female- and male-headed families have increased proportionately. Moreover, there has been a rise in the proportion of single-person households over the past quarter century. Exhibit 5.4 provides data on household composition of the U.S. for 2010.

Exhibit 5.4: Household Composition of the United States: 2010 (In Thousands)

Number of households	114,567	
Persons per household	2.63	
Persons per family household	3.23	
Family households	76,089	66.4%
Married couple households	34,031	48.6%
Male-headed households (no spouse)	5386	4.7%
Female-headed households (no spouse)	14,998	13.1%
Nonfamily households	38,478	33.6%
One-person households	31,403	27.4%

Source Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YRDP02&prodType=table. October 1, 2012

Income. *Income* refers to the amount of money taken in by individuals and households during a specified time period (usually a year). Income statistics generally refer to income in the previous year with income reported in absolute dollars (i.e., $23,550) or grouped into intervals (e.g., $20,000–$24,999, $25,000–$29,999). In most cases, income data are collected for the household whether it is a family household or a group of unrelated individuals (i.e., family income vs. household income). In addition to the amount of income, data may be collected on the source of income (e.g., wages and salaries, interest, and royalties).

While income data presented in intervals provide a useful perspective on the distribution of income for a population, summary indicators are typically used. Thus, for all households it is common to report the median household income with the mean household income sometimes also being reported. Similarly, demographers may present the median (or mean) family income in which case only family

households are counted. Median household and median family incomes represent the mid-point of household income and are calculated by determining the point at which half of the households or families are above and half are below the mid-point.

The mean income represents the arithmetic average for all households or families. This indicator is used less frequently than the median since it is more sensitive to extremes in reported income. For example, for a small population, one household with a million dollars in income could badly skew the mean toward the high end.

One other indicator of income level that is frequently used is per capita income. This indicator is calculated differently in that total income for a population is established and then divided by the number of individuals in that population regardless of their contribution to income generation. Per capita income is not considered as useful as household-based indicators because the per capita income can be influenced by a number of factors that might make such an average misleading. (Exhibit 5.5 presents a sample income distribution with associated measures of concentration.)

One other indicator of a population's income is its *poverty* level, or the extent to which individuals, families or populations are economically deprived. Poverty can be measured in absolute or relative terms, depending on the intent. In the U.S. the federal government establishes the criteria for the "official" poverty threshold. The poverty threshold is based on the amount of money required to cover basic living expenses (e.g., housing, food, clothing). The Census Bureau generates a set of money income thresholds that vary by family size and composition to determine who is in poverty. If a family's total income is less than the family's threshold, then that family and every individual in it is considered in poverty. The official poverty definition uses money income before taxes and does not include capital gains or noncash benefits (such as public housing, Medicaid, and food stamps) in its calculations.

Over the past 20 years the gap between the richest and poorest in the U.S. population has expanded resulting in an increased number of Americans living in poverty.

In 2010, the poverty threshold for an urban family of four was around $23,000 and an estimated 13% of Americans currently live at or below the poverty level. Relative poverty is measured in terms of the household or population's relationship to the median household income. Thus, if the nation's median household income is $50,000, a household with an income of $25,000 would be considered to be 50% below the median.

Exhibit 5.5: Household Income Distribution in the US: 2010 (In Thousands)

	Number	Percent
Total households	114,567	
Less than $10,000	8757	7.8
$10,000–$14,999	6668	5.8
$15,000–$24,999	13,165	11.5
$25,000–$34,999	12,323	10.8
$35,000–$49,999	16,312	14.2
$50,000–$74,999	20,941	18.3
$75,000–$99,999	13,526	11.8
$100,000–$149,999	13,545	11.8
$150,000–$199,999	4810	4.2
$200,000 or more	4518	3.9
Median household income	$50,046	
Total family households	75,089	
Less than $10,000	3824	5.0
$10,000–$14,999	2661	3.5
$15,000–$24,999	6771	8.9
$25,000–$34,999	7332	9.6
$35,000–$49,999	10,578	13.9
$50,000–$74,999	14,991	19.7
$75,000–$99,999	10,638	14.0
$100,000–$149,999	11,262	14.8
$150,000–$199,999	4131	5.4
$200,000 or more	3901	5.1
Median household income	$60,609	

Source Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YR_DP03&prodType=table. October 1, 2012

Education. *Education* refers to the average amount of schooling a population has attained. The educational status of a population is typically stated in terms of the number of school years completed and/or the types of degrees earned. Thus, as part of the American Community Survey respondents are asked to report the highest diploma or degree they have earned (e.g., high school diploma, master's degree). Educational attainment is sometimes expressed in mean or median years completed. Exhibit 5.6 presents the current educational breakdown for the United States population.

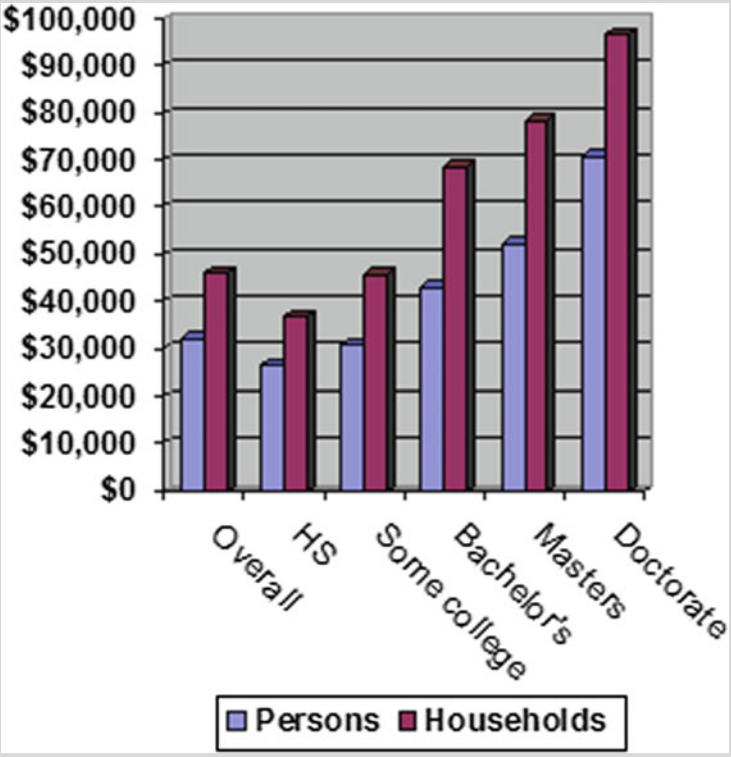
Exhibit 5.6: Educational Attainment for the US Population 25 and Over: 2010 (In Thousands)

	Number	Percent
Less than high school	29,463	14.4
High school graduate only	58,226	28.5
Some college, no degree	43,469	21.3
Bachelor's degree or more	26,244	17.7
Graduate or professional degree	21,334	10.4

Source Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YRDP02&prodType=table. October 1, 2012

The impact of education on income in the U.S. is noteworthy and historically there has been a direct relationship between educational attainment and income. As can be seen in Exhibit 5.7 a college education is associated with higher than average income and as the amount of education increases so does the average income. (Since these figures were published by the Census Bureau there is evidence that the relationship between education and income has weakened somewhat.)

Exhibit 5.7: Education and Income: United States: 2006



Source U.S. Census Bureau

Work Status/Occupation/Industry. *Work status*, *occupation*, and *industry* data all relate to one's position in the labor force. Work status includes information on labor force participation and employment status. For individuals who are employed, additional information on the number of hours worked may be collected. Part-time and full-time classifications may be used based upon the number of hours per week and weeks per year worked. The unemployment rate is indicative of the economic "health" of the population. While the term underemployment is frequently used today, there is no commonly agreed upon definition. Exhibit 5.8 presents recent data on labor force participation.

Exhibit 5.8: Labor Force Statistics: United States: 2014

	Percent
Population in labor force	64
Male population labor force	69
Female population in labor force	57
Women in labor force with children	67
Unemployment rate	6.5

Source Bureau of Labor Statistics, US Department of Commerce

Occupation refers to the kind of work a person normally does (that is, the "job"). Examples of specific occupations include registered nurse, gasoline engine assembler, and teacher's aide. Each occupation is assigned a code from the dictionary of occupational titles (DOC), and individual workers are assigned to an occupation by the Census Bureau. The hundreds of occupations are aggregated into 9 or 10 major groupings, such as professional and technical, sales, and management.

The distribution of workers among various industries changed dramatically as a manufacturing economy was displaced by a service economy.

Industry refers to the business or industry where the occupation resides. For the examples above, the registered nurse would be assigned to health and social services, the gasoline engine assembler to manufacturing, and the teacher's aide to educational services. On the other hand a secretary could be assigned to virtually any industry. Industries are classified based on the North American Industrial Code (NAIC) system. The distribution of workers by industry provides a profile of the population's economic structure with changes in the size of the respective industries reflecting changes in the economy. Exhibit 5.9 presents the current distribution of jobs among different occupational categories, and Exhibit 5.10 presents the current distribution of jobs among different industries.

Exhibit 5.9: Employment by Major Occupational Category in the US: 2010 (In Thousands)

	Number	Percent
Management/business/sciences/arts	49,976	35.9
Service occupations	25,059	18.2
Sales and office occupations	34,711	25.0
Natural resources/construction/maintenance	12,697	9.1
Production/transportation/material moving	16,560	11.9

Source Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YR_DP03&prodType=table. October 1, 2012

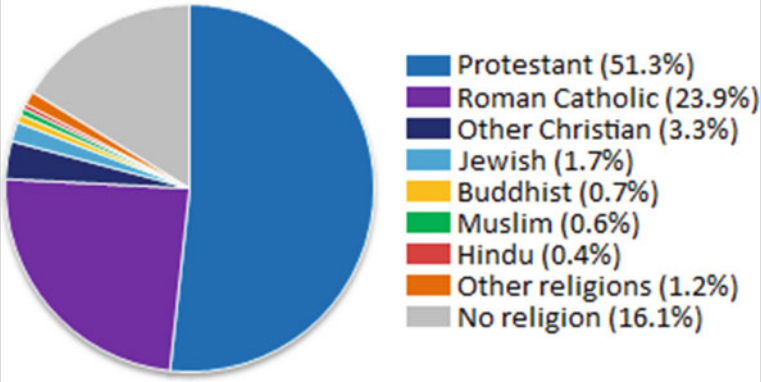
Exhibit 5.10: Employment by Industry in the US: 2010 (In Thousands)

	Number	Percent
Agriculture/forestry/fishing	2647	1.9
Construction	8687	6.2
Manufacturing	14,440	10.4
Wholesale trade	3941	2.8
Retail trade	16,203	11.7
Transportation/warehousing/utilities	6844	4.9
Information	3016	2.3
Finance/insurance/real estate	9275	6.7
Professional/scientific/management	14,710	10.6
Educational services/healthcare/social assistance	32,311	23.2
Arts/entertainment/recreation	12,860	9.2
Other services	6913	5.0
Public administration	7187	5.2

Source Downloaded from URL: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YR_DP03&prodType=table. October 1, 2012

Religion. Despite the importance of religion in American society, religion is one of the least reported compositional variables. Questions regarding religious affiliation or the levels of religiosity are not included in censuses or government-sponsored surveys. However, sample surveys, church registries, and qualitative data can provide partial information on religious affiliation. The types of questions usually asked concern religious affiliation (e.g., Roman Catholic), attendance (e.g., number of times attending per month), and religiosity (e.g., depth of religious commitment). Exhibit 5.11 presents the distribution of members of the US population based on religious affiliation.

Exhibit 5.11: Distribution of Religion in U.S. Population: 2009



Source Haire Dunya.

5.3 Displaying and Analyzing Compositional Variables

5.3.1 Descriptive Statistics

Data on compositional variables will be typically generated as raw data, and it is up to the analyst to convert these data into meaningful information. This section describes some of the ways in which demographic data might be displayed and classified and the types of analysis used to compare different geographies in terms of their compositional attributes. Since various geographies will record populations of differing sizes, it is difficult to compare one geography or population to another using raw data. Therefore, it is necessary to convert raw data into a form that allows for meaningful comparison. For example, knowing that 10,000 deaths occurred in Florida and 2000 deaths occurred in North Dakota in 2005 does not really allow us to compare the health status of the respective states. But, if we convert these into

death rates and generate a crude death rate of 8.5 per 1000 population for Florida and a rate of 9.5 per 1000 for North Dakota, we have a basis for comparison.

Compositional traits are often expressed in proportional terms (e.g., 25% of the population in Orange County, Florida, has a college education or above) along with summary measures such as means and medians. The use of any of these summary measures can result in useful insights, though sometimes the statistics presented are misleading. When using percentage distribution information, it is generally better to include data for several categories (perhaps the entire distribution), even though the focus may be on only one level of aggregation. This will give the user/reader a more complete picture of the conditions being addressed.

Since the mean refers to the arithmetic average and the median to the midpoint of a distribution, these two measures of central tendency are likely to be used for different purposes. It is generally better to rely on the latter, though the use of both of these statistics, along with an examination of the entire distribution, is the best approach. A given mean or median may be the result of an infinite number of combinations of distributional data. Therefore, utilizing the mean or median without analyzing the distribution from which those figures are derived may result in an incomplete understanding of the data.

5.3.2 Population Pyramids

Population distributions are sometimes presented visually in the form of *population pyramids*. The age/sex distribution of a population is presented in a series of stacked bars, though other combinations of characteristics can be used. Each bar represents the percentage or number of the total population in that age cohort. The left side displays the percentage of males in each age cohort and the right side the percentage of females in each age cohort. Pyramids that are "bottom heavy" reveal younger age structures, while old age structures demonstrate more constant age-to-age percentages and appear bullet shaped. Exhibits 5.12 and 5.13 present the population pyramids for Garfield and Sarpy Counties in Nebraska for 2010.

Exhibit 5.12

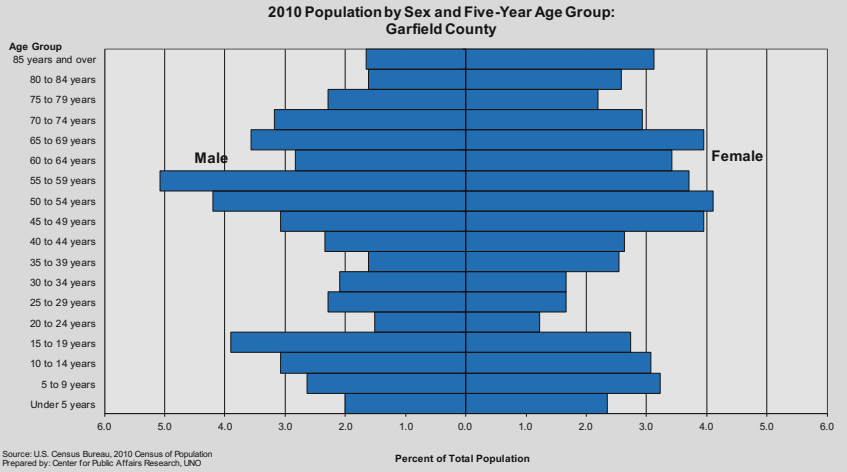
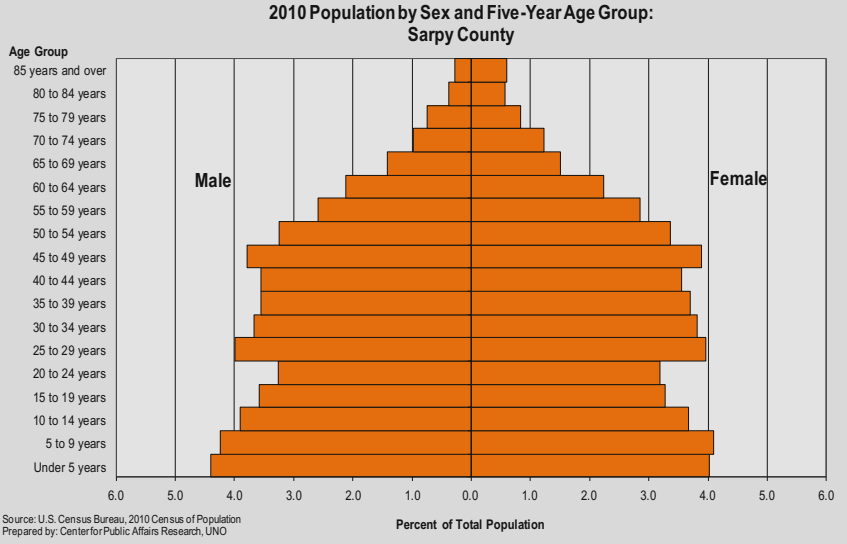


Exhibit 5.13



5.3.3 Dependency Ratios

Age data can be used to calculate *dependency ratios*, or the quotient of an area's dependent population divided by its "supporting" population. Dependent and supporting populations are defined in terms of economic dependence and independence. The supporting population in the United States is usually considered those individuals between the ages of 18 (or 20) and 64, while dependent populations are those under age 18 (or 20) and over age 64. Dependency and support are general notions regarding economic activity, and the population aged 18 (or 20) to 64 is considered to be economically active (income earning).

The *youth dependency ratio* for the United States in 2008 can be calculated as follows:

$$\frac{\text{number of persons under age 18}}{\text{number of persons 18}-64} = \frac{73{,}942{,}000}{191{,}248{,}000} = 0.39$$

This ratio of 0.39 converts to 2.56 persons of approximate working age for every person under age 18. Since 1950 this ratio has declined from 0.58 (1.72 persons of approximate working age for each person under age 18) reflecting the decline in the proportion of children within the U.S. population.

The *age dependency ratio* for 2008 can be calculated as follows:

$$\frac{\text{number of persons aged 65 and over}}{\text{number of persons 18}-64} = \frac{38{,}870{,}000}{191{,}248{,}000} = 0.20$$

This ratio of 0.20 converts to 5.00 persons of approximate working age for each person age 65 and over. Since 1950 this ratio has increased from 0.14 (7.14 persons of approximately working age for each person 65 and older). The age dependency ratio is used to illustrate the ability of a population to support its "non-productive" seniors as well as the growing impact of persons aged 65 and over on the U.S. Social Security system.

The *total dependency ratio* takes the sum of both dependent populations (under age 18 and over age 65) and divides by the number of persons aged 18 to 64. In 2008, the total dependency ratio was 0.59, or 1.69 persons of approximate working age for every person under age 18 or over age 64. Interestingly, the total dependency ratio has not changed much in 50 years; the tremendous growth in the elderly population has been offset by a significant decline in the youth population.

These ratios exhibit a great deal of variability across geographic areas, and this variation has important implications for the demand for services of various types. In 2010, for example, the youth dependency ratios for Garfield and Sarpy Counties, Nebraska, were 0.48 and 0.46, respectively. In contrast, the age dependency ratios were 0.52 and 0.12, respectively. In other words, Garfield County had approximately two workers for every person age 65 and over, while Sarpy County had eight.

5.3.4 Cohort Analysis

Another way of examining compositional data is through *cohort analysis*. A cohort is a group of persons with a common characteristic or characteristics. Age is the most frequent basis for cohort identification used by demographers, with cohorts established by grouping together persons of similar age. It is assumed, although not always correctly, that persons within a cohort share experiences and behavior because of this common characteristic. Cohort analysis typically involves following a cohort over time to measure the effects of exposure to various events, conditions, etc., such as American soldiers exposed to Agent Orange during the Vietnam War or patients undergoing a particular medical procedure.

One benefit of cohort analysis is the insights that can be provided into the future. If one knows the age distribution for a particular point in time, it becomes possible to make predictions concerning the future. For example, if one wants to know how many children will enter the first grade five years from now, we already know how many one-year-olds there are in the population. Of if we want to know how much the Medicare roll will swell in ten years, we already know how many 55-year-olds there are in the population. Of course, assumptions have to be made concerning death rates, birth rates and migration patterns depending on the circumstances. But within limits, cohort analysis provides demographers a tool for predicting future characteristics of the population.

Cohort analysis is sometimes used as a basis for ascribing experiences and behavior patterns to a cohort when individual data are not available. Cohort analysis can range from measuring the change in number and proportion of persons in various age groupings over time to ascertaining how cohort experiences affect different types of behavior (Swanson & Siegal, 2004). Cohort-to-cohort comparisons allow an assessment of change in cohort behavior over time.

Cohort analysis can be particularly useful in a healthcare setting. Since health problems are frequently age specific, cohort analysis can determine future patterns of morbidity and mortality. Age cohorts also exhibit varying types of health-related behavior or levels of exposure to a particular type of carcinogen that is unique to the population in question. Such a cohort could be tracked over time to provide insights, for example, into disease prevalence. Studying the transition or aging of a cohort from one period to the next may involve the use of mortality data and survival analysis. For example, the cohort aged 65–69 in 2010 is made up of those persons aged 60–64 in 2005 minus those who died during the interval (not accounting for immigration). Tracking change in cohort size tells the analyst a great deal about health service demands that are likely to characterize this cohort in the future.

5.4 Data Standardization

Population sizes vary among different geographic areas and, without some way of standardizing the phenomena being evaluated, comparisons between two or more populations can be misleading. Rates can be used to control for differences in size, allowing for the comparison of data for two or more regions, states, metropolitan areas, or market areas. However, even a simple comparison of rates can lead to incorrect conclusions.

For example, if two communities of 10,000 people were being compared and analysts found that one had twice the breast cancer prevalence rate as the other, it would be logical to assume that morbidity levels are higher for one population than the other. While variations in morbidity levels may be able to provide some explanation for the observed differential, demographic explanations must be considered as well. The simplest demographic analysis would determine if there were marked sex differences between the two communities. In other words, a heavily female community would clearly be expected to have more cases of breast cancer and, hence, a higher prevalence rate. Or suppose that one community has a much older age structure than the other. Since breast cancer is more common among older women, the older community would be expected to report more cases of breast cancer.

Up until this point, it has been argued that the age/sex structure differences in the two communities must be studied before cancer prevalence is evaluated. Are there any other demographic variables that might help explain why there is a breast cancer rate difference between the two communities? The researcher may want to consider racial-ethnic compositional differences and/or any other demographic factors known to be associated with breast cancer (e.g., childbearing history). The ultimate goal is to hold constant or control for as many of these factors as possible in order to eliminate competing explanations.

Exhibit 5.14 illustrates the advantages of accounting for age differences through age standardization. For the community under study age-specific prevalence rates were calculated in order to generate the number of breast cancer cases for the year in question. The observed prevalence was 1.72 cases per 1000 women, generating 86 cases of breast cancer within this population. This rate is higher than the 1.20 for the nation. Since this rate is higher than the national average its validity can be assessed by adjusting the population cohorts to resemble a standard population. If the 50,000 residents of this community exhibited the same age distribution as the nation, the incidence rate would be adjusted to 1.40 cases per 1000 and generate 70 cases. By using age standardization it becomes possible to determine whether the community truly has a higher than average prevalence rate. The adjusted rate of 1.40 is substantial lower than the observed rate (although still higher than the national average). This process allows for the generation of a more accurate indication of breast cancer incidence.

Exhibit 5.14: Age Composition and Incidence of Breast Cancer for Fictitious Community

Age group	Observed prevalence			Adjusted prevalence		
	Actual population			Standard population		
	Females	Rate[a]	Cases[b]	Females	Rate[a]	Cases[b]
0–24	13,000	0.02	0.26	16,500	0.02	0.33
25–44	12,000	0.50	2.00	13,000	0.50	6.50
45–64	13,000	2.50	32.50	12,500	2.50	31.25
65+	12,000	4.25	51.00	7500	4.25	31.88
Total	50,000	1.72	85.75	50,000	1.40	69.96

[a]Rate per 1000 female population
[b]Diagnosed cases of breast cancer

Exercise 5.1: Population Composition

For this exercise, students will access the Census Bureau site in order to locate data on population composition with which they should be familiar. Follow the steps below and obtain the data relevant to a city or county of your choice.

(1) Access the Census Bureau website at www.census.gov/quickfacts.
(2) Select a county from the menu box.
(3) Using the pulldown menu (All Topics) find the following information for the selected county.

- Total population (2016 estimate): _____
- Population change (from 2010 to 2016): _____%
- Percent male: ____%
- Percent of the population that is under 5 years: _____%
- Number of people under 5 years (calculate): _____
- Percent of population that is 65 years or older: _____%
- Percent of the population that is white: _____%
- Percent of the population that is Hispanic: _____%
- Percent of the population that is foreign born: _____%
- Percent of the population (1 year and older) living in the same house last year: _____%
- Percent of the population (25 and older) with less than a high school education: _____%
- Percent of the population (25 and older) with a bachelor's degree: _____%
- Percent of homes owned by their occupants: _____%
- Average number of persons per household: _____

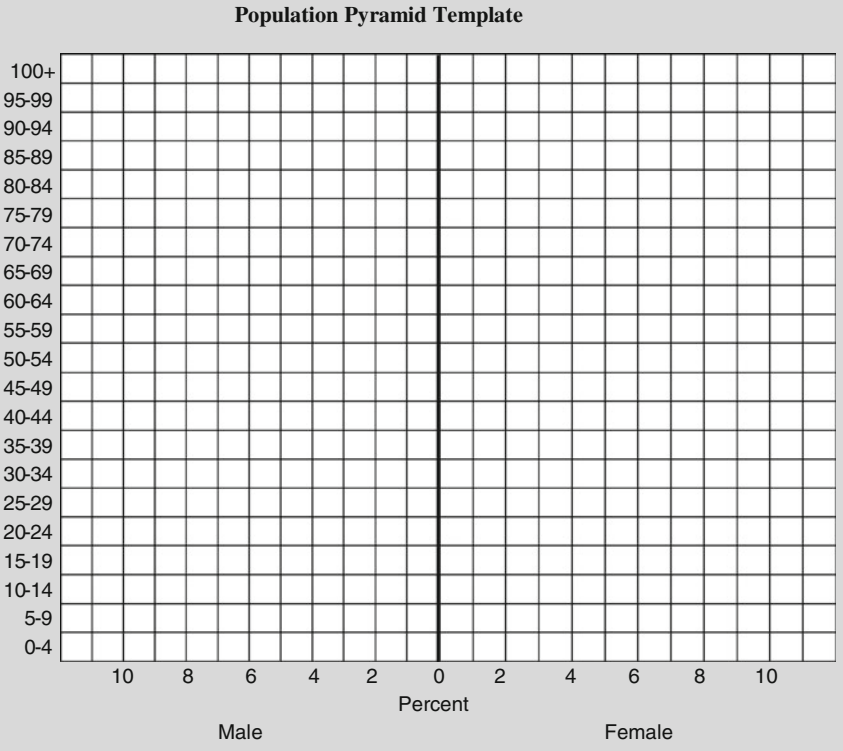
- Median household income: $_____
- Percent of persons below poverty level: _____%
- Percent of businesses owned by women: _____ %
- Persons per square mile: _____

Exercise 5.2: Population Pyramid Exercise

The table below presents the age and sex distribution for the populations of five different countries. For this exercise students will produce two population pyramids—one for one of the first four countries (i.e., Afghanistan, Denmark, Russian Federation, Mexico) and one for the United States. Students will use the template provided below. The two population pyramids should be superimposed on one another in order to make comparisons possible.

Age	Country									
	Afghanistan		Denmark		Russian Federation		Mexico		United States	
	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)
100+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
95–99	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
90–95	0.0	0.0	0.3	0.1	0.0	0.2	0.0	0.1	1.0	0.2
85–89	0.0	0.0	0.4	0.8	0.1	0.6	0.1	0.2	0.3	0.6
80–84	0.1	0.1	1.3	2.5	0.4	1.6	0.4	0.6	1.0	2.1
75–79	0.2	0.2	1.2	1.8	0.5	1.6	0.4	0.6	1.0	1.5
70–74	0.3	0.3	1.6	1.9	1.4	2.7	0.6	0.8	1.3	1.7
65–69	0.5	0.5	1.9	2.1	1.5	2.5	0.9	1.0	1.5	1.8
60–64	0.8	0.7	2.3	2.4	2.4	3.4	1.1	1.1	1.8	2.0
55–59	1.0	1.0	3.1	3.1	1.6	2.1	1.4	1.4	2.3	2.4
50–54	1.4	1.3	3.6	3.5	2.7	3.2	1.6	1.7	3.0	3.1
45–49	1.6	1.5	3.3	3.3	3.6	4.0	2.2	2.3	3.4	3.5
40–44	2.0	1.8	3.4	3.3	4.1	4.3	2.7	2.8	3.8	3.9
35–39	2.5	2.2	3.8	3.6	3.8	3.9	3.2	3.3	3.9	3.9
30–34	3.0	2.8	3.8	3.6	3.2	3.2	3.7	3.9	3.6	3.5
25–29	3.7	3.4	3.5	3.4	3.5	3.4	4.4	4.6	3.3	3.3
20–24	4.4	4.1	3.0	3.0	3.7	3.6	4.8	4.9	3.4	3.2
15–19	5.4	5.0	2.6	2.5	4.1	4.0	5.0	5.1	3.6	3.4
10–14	6.6	6.1	2.8	2.7	4.1	3.9	5.4	5.3	3.6	3.4
5–9	8.0	7.5	3.2	3.0	2.8	2.7	5.7	5.5	3.6	3.4
0–4	10.2	9.6	3.1	3.0	2.2	2.1	5.5	5.3	3.4	3.2

Population Pyramid Template



Exercise 5.3: Age Standardization Exercise

Using the data supplied below, calculate the crude death rate and the age-adjusted death rate for this community in Florida:

	Crude death	Original		Adjusted	
Age Category	Rate	Population (%)	Deaths	Population (%)	Deaths
0–15	2/100	1000 (12.5%)	____	1500 (18.8%)	____
15–29	1/100	1000 (12.5%)	____	1500 (18.8%)	____
30–44	3/100	1000 (12.5%)	____	1500 (18.8%)	____
45–59	5/100	2000 (25.0%)	____	1500 (18.8%)	____
60–74	15/100	2000 (25.0%)	____	1000 (12.5%)	____
75+	30/100	1000 (12.5%)	____	500 (6%)	____
Total		8000	____	8000	____

(continued)

(continued)

	Crude death	Original		Adjusted	
Age Category	Rate	Population (%)	Deaths	Population (%)	Deaths
Crude death rate:		Deaths per 100 persons =			____
Age-adjusted death rate:		Deaths per 100 persons =			_____

Additional Resources

American Community Survey. http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.
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