Part I
Urbanization, GIS, and data visualization
“Neither the historian nor the cartographer can ever reproduce the reality they are trying to communicate to the reader of books or maps; they can but give a plan, a series of indications, of this reality. There are contrasting schemes for choosing from enormous numbers of geographic details. You may have a map in which every feature that can be named . . . is crowded in . . . or you may have a map in which many details are omitted in the effort to show the reader the lay of the land. . . . Both kinds are useful, depending on the needs of the viewer.”

Crane Brinton (1963)
Introduction

“Cities are inherently messy places,” concluded the great British urbanist Sir Peter Hall in his magisterial history of great world cities, *Cities and Civilization* (Hall 2002). Cities are filled with both problems and opportunities.

One purpose of this book is to help social science and public policy students—in geography, sociology, political science, history, anthropology, environmental studies, urban studies, urban planning, public administration, and related disciplines and fields—identify and think clearly about urban problems in order to devise solutions. Another purpose of this book is to help students see the opportunities that urban areas present and to use spatial analysis and data visualization to better understand how to capitalize on the opportunities. Throughout the book there is an emphasis on analysis: using human intelligence (aided by information technology) to analyze conditions and then formulate policy to address problems and take advantage of opportunities, rather than to act based on imprecise and often erroneous impressions of the conditions.

Each section of this book focuses on one topic and primarily uses examples from one region. This section focuses on urbanization and the problems and opportunities urbanization presents. Many of the examples in this chapter are from the San Francisco Bay Area. You will not work with data from the Bay Area in exercise 1, but in exercise 2 you will learn GIS operations using Bay Area data on traffic congestion, the location of low-rent housing, and where foreign-born residents in the Bay Area live. Exercises 3 and 4 focus on impacts of urbanization on the environment in Contra Costa County—a county across San Francisco Bay from San Francisco.

Before proceeding with a discussion of urbanization and the problems and opportunities it creates, it is helpful to introduce this interesting and unique region.

Welcome to the San Francisco Bay Area

The San Francisco Bay Area is a beautiful and prosperous region. It is physically lovely, with beaches and mountains, ranches and agricultural land, forests and wetlands, mountains, lakes, and rivers. It has a dynamic, mixed economy driven by high-tech information and biotech firms. Incomes and home prices are among the highest in the world. Despite its advantages, the Bay Area has its share of problems, including urban poverty, congestion, pollution, and conflicts between the built and natural environments.

The Bay Area is usually defined as all of the land within nine counties that are members of the Association of Bay Area Governments (ABAG)—the regional council of governments (COG). There are 101 cities within the ABAG region. One of the cities—San Francisco—is a combined city and county, so there are a total of 109 separate local governments in the Bay Area.

The entire Bay Area covers about nine thousand square miles. Approximately 17 percent of the land is developed. Much of the remaining 83 percent is undevelopable because it is within a federal, state, or regional park, or is watershed land, land set aside for military use, or land whose topography makes it impossible to develop. Other land in the region might be developed in the future, but it is not presently serviced by roads and other infrastructure.

Most people read maps without much thought as to how they were constructed and exactly what they are really saying. Since this is a book about spatial analysis and data visualization, every map in this book requires a careful look. Map 1.1 is a map layout with one main and two smaller maps. The main map shows the nine Bay Area counties symbolized in a light green color and the 101 cities in orange outlined in gray. The Pacific Ocean is on the left (west) of the map. San Francisco is on the peninsula near the center of the map and is outlined in red and labeled for clarity. Contra Costa County is across the bay from San Francisco and is outlined in amethyst and also labeled. San Francisco Bay is the large bay between San Francisco and East Bay cities such as Oakland.
and Berkeley. One small map shows San Francisco in greater detail—including the outline of census tracts, geographic areas the U.S. Census Bureau uses for reporting demographic, housing, and other census information. The other small map shows unincorporated county land in Contra Costa County in light green and land within the nineteen cities in the county in orange outlined in gray. You will explore San Francisco census tract data in exercise 2 and learn more about conflicts between the built and natural environments in Contra Costa County in exercises 3 and 4.

The scale bar in the large map is included to help map readers understand distances in the map. A cartographic decision was made not to include scale bars in the two small maps because the scale is sufficiently clear from the scale bar in the large map. None of the maps include a north arrow or other map elements because these are not really necessary given the map context. You will learn how to create scale bars and other map elements in exercise 6.
The San Francisco Bay Area’s population has grown steadily since the mid-1800s Gold Rush era (Scott 1985) and continues to grow (ABAG 2003). The U.S. Census reported 6,783,760 people living in the Bay Area in 2000 (U.S. Census 2000a).

Bay Area residents are a very diverse group. A little more than half the Bay Area population is white, followed by large numbers of Asians, Hispanics, African-Americans, and members of other racial and ethnic groups (U.S. Census 2000a). Hispanic and Asian immigration fuels much of the current Bay Area population growth.

Historically, San Francisco was the dominant city in the region. When the United States acquired California from Mexico in 1848 at the conclusion of the Mexican-American War, there were only a few hundred people in San Francisco. Just a year later, the Gold Rush changed all that. “The world rushed in” (Holliday 1981), and San Francisco became an instant city of several hundred thousand people (Barth 1988). The census reported San Francisco’s population to be 776,773 in 2000.

San Francisco is the historical, financial, and cultural center of the Bay Area.

San Francisco has only fifty square miles of area. It is surrounded on the north, west, and east by water. All of the land south of San Francisco lies in incorporated cities, so San Francisco cannot physically expand its land area by annexing unincorporated county land. Almost all of the land in San Francisco is developed. San Francisco’s population is still increasing as infill lots are developed and parts of the city are redeveloped—usually at much higher densities.

Over the last thirty years, the Bay Area has grown by about one hundred thousand people a year (ABAG 2003). San Francisco can’t accommodate more than a small fraction of this continuing population growth. Accordingly, development in the Bay Area has proceeded north and south along the Pacific Coast, across San Francisco Bay, inland along Highway 80 that goes to California’s capital city of Sacramento, and in urban fringe areas like eastern Contra Costa County. You can see in map 1.1 that there now is a nearly continuous band of urbanization around San Francisco Bay.

The small map of Contra Costa County shows a pattern common to many suburban areas. There are nineteen cities in Contra Costa County covering about 27 percent of the county’s land area. The rest of the land—73 percent—is unincorporated county land. Each of the nineteen cities governs itself and makes decisions about the land within its borders. The county government governs the remaining unincorporated areas.

Even though this is a book about urban issues, map 1.1 shows a metropolitan region. The exercises emphasize urban analysis at the regional scale. The reason for this emphasis is that urban planning and policy need to be based on regional considerations.
Urbanization

Since the beginning of the industrial revolution (about 1750), there has been a huge increase in the proportion of the world’s population living in cities as opposed to small towns and rural areas (Davis 1965). We are still in the midst of a monumental shift in the nature and extent of human settlements. The combination of massive world population growth and urbanization has produced an exponential increase in the number of very large cities and huge urban agglomerations where multiple cities blend together.

In thinking about urbanization, there are three concepts to keep in mind: (a) increases in total population, (b) the proportions of the population in a region that are urban and nonurban, and (c) the physical size of a city or agglomeration. All three concepts are related and all three usually occur simultaneously, so it is easy to confuse them. A simplified set of graphics can help to illustrate these relationships.

City population size refers to the absolute city population. Figure 1.1a illustrates an increase in city population size from 100,000 people in 1950 to 250,000 people in 2000—a 150 percent population increase in fifty years.

Urbanization refers to the proportion of the population that lives in urban areas as opposed to nonurban areas like rural areas and small towns. Figure 1.1b illustrates two countries with different levels of urbanization. In the country on the left, half of the country’s population is

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Figure 1.1a  Increase in city population.

1950 population  
100,000

2000 population  
250,000

Figure 1.1b  Different levels of urbanization (two countries).

50% Urban  
50% Nonurban

75% Urban  
25% Nonurban

Figure 1.1c  Increase in city physical size (no increase in population).

Population 100,000  
City area 50 sq. miles

Population 100,000  
City area 70 sq. miles
urban, and half is nonurban. In the country on the right, three quarters (75 percent) of the country’s population is urban, and 25 percent is nonurban. Urbanization is usually analyzed at the level of a large geographic area, such as a country.

City physical size refers to the area of a city measured in units like square miles. Cities with constant or declining populations usually stay the same physical size. So do cities like San Francisco, which are surrounded by already incorporated cities and natural barriers like the Pacific Ocean and San Francisco Bay. If a city can annex additional land, it is likely to add area as its population grows. In figure 1.1c, the physical size of a hypothetical city has grown from fifty square miles to seventy square miles while its population remained constant.

**World urbanization**

Demographers are social scientists who study the human population. The word demographer comes from the Greek word *demos* (people). Keeping track of the precise number of people on earth and specifying what percentage of the human population lives in urban areas is a difficult task. Data is unreliable for many countries. Countries’ own definitions of what is and is not an urban area vary from country to country. Conditions are changing rapidly. The best existing estimates come from experts at the Population Division of the United Nations Department of Economic and Social Affairs. United Nations (UN) demographers estimate the world population to be 6.3 billion people (UN 2002). They estimate that a little less than half of this population (47 percent) lives in urban areas (UN 1999). According to the UN, most of the world’s population—nearly five billion people—now live in less-developed regions of the planet.

The UN estimates that the world population is growing by about 77 million people a year. Demographers forecast that the world population will increase to 8.9 billion in 2050. The population of more developed regions—currently at 1.2 billion—is expected to remain about the same in 2050. Despite the AIDS epidemic, the population of less-developed regions is projected to rise from 4.9 billion today to 7.7 billion in 2050 (UN 2002). UN demographers also predict increasing urbanization. If their forecasts hold true, at some point in 2007 a baby born in a city or one new migrant to a city will tip the balance, so that more than half of the human population lives in urban areas (UN 1999).

Maps can help us see the global distribution of the world’s population, different levels of urbanization in different countries, and the distribution and size of world cities. In the balance of part I and in exercise 1, you will learn more about the historical growth of world cities and urbanization and will create your own maps analyzing these important issues. But first a word of advice about reading maps.

Maps 1.2, 1.3a, and 1.3b show some critical information about world cities and about the extent of urbanization in different countries of the world. Social science research requires researchers to specify what exactly they are measuring—the unit of analysis. The unit of analysis in map 1.2 is different from the unit of analysis in maps 1.3a and 1.3b. Map 1.2 uses cities as the unit of analysis; maps 1.3a and 1.3b use countries as the unit of analysis. The symbology of the maps is also different. Map 1.2 represents cities as points; maps 1.3a and 1.3b represent countries as polygons. You will learn more about procedures like specifying units of analysis and the visual representation of spatial information with appropriate symbology in this book and accompanying exercises. For now, look critically at maps 1.2, 1.3a, and 1.3b, both for their content and the way in which they were constructed.

One of the vexing issues in urban analysis is how to define a city. The area of a legally incorporated city is often a poor descriptor of the urban area where the city is located because suburbs and other smaller jurisdictions are really part of the same urban area. The UN uses the term **agglomeration** to refer to a distinct urban area and provides past, current, and projected
estimates of the population size of more than four hundred urban agglomerations (UN 2004). Most urban agglomerations consist of a well-known city and their adjacent urban area, such as the London agglomeration and the Paris agglomeration. But some agglomerations—such as the North Ruhr-Rhine agglomeration in Germany—include several large cities and the continuous band of urbanization between them.

Map 1.2 shows the location of urban agglomerations with more than five million people in 2000 as defined by the United Nations (UN 2004). Taking a careful look at map 1.2, you will see that each agglomeration is symbolized as a single point. All the points are the same size, even though the populations of these large agglomerations range from a little more than five million (the Madrid agglomeration) to nearly thirty-five million (the Tokyo agglomeration). We can’t tell from this point data how urbanized the respective countries are.

Map 1.2  Urban agglomerations with more than five million people, 2000.
Source: United Nations

In map 1.3a countries—not urban agglomerations—are the unit of analysis. Map 1.3a shows data from the World Bank on the percent of the population that was urban in different countries in 2003 (World Bank 2004). It presents the results of a cross-sectional analysis of conditions at one point in time. The countries in map 1.3a are colored different shades of orange to symbolize the percentage of their population that is urban: the most urbanized countries are dark orange, the least urbanized countries light orange. Map 1.3a tells us about the percentage of the population of a country that is urban, not the population size of individual urban agglomerations within the country. Rather than points, the countries are symbolized as polygons (enclosed shapes with many sides). Map 1.3a shows that in 2003 the United States, Canada, and most West European countries were more than 75 percent urban, as we might expect. So were many South American countries and the entire continent of Australia.

Some other highly urban countries in map 1.3a may come as more of a surprise. For example, countries with the highest percentages of their population urban include Saudi Arabia (mostly desert with a large percent of its population living in cities newly built with oil money). Almost all of the lightest orange areas in map 1.3a are in Africa and Southeast Asia: the least urbanized parts of the world today. Map 1.3a shows what percentage of the population is urban in different
countries. It does not show how fast the urban population of cities is growing. Map 1.3b answers that important question.

Map 1.3b symbolizes the countries whose urban populations are growing most rapidly—over 4 percent a year—in dark orange and the countries whose urban populations are growing least rapidly—between 0 and 1 percent a year—in light orange. Countries that are losing population are symbolized in beige. Almost all of the countries that are urbanizing very rapidly (dark orange) are in Africa. Most eastern European countries are de-urbanizing (beige).

It would be interesting to see a data graphic comparing the variables mapped in maps 1.3a and 1.3b to see if there is a relationship between how fast the urban population of each country is growing and the percentage of each country’s population that is urban. In chapter 8, you will see

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**Map 1.3a**  Percent of population urban by country, 2003.

*Source: World Bank, World Development Indicators 2003*

**Map 1.3b**  Percentage change in the urban population by country, 2003.

*Source: World Bank, World Development Indicators 2003*
how a kind of data graphic called a scattergram shows this relationship very clearly for selected countries.

The balance of this chapter sets the stage for what will follow by further describing population growth, urbanization, city size, and the problems and opportunities they present.

**Urban problems: A new concern**

At the beginning of the twenty-first century, it is difficult to imagine a world without cities. But there were no cities at all for most of human history. Until a few centuries ago almost all of the largest cities in the world today were smaller than Peoria, Illinois, which in 2000 had a population of about 113,000.

Social scientists do not agree on when human beings emerged or the first cities were built. Depending on which paleontologist you believe about which bone fragment qualifies as human, human beings have lived on earth for about 2.5 million years. Depending on which archaeologist you believe about which human settlement is big enough, dense enough, or has enough cultural attributes to qualify as a city, cities have existed for about 5,500 years: about 1/5 of 1 percent of human history.

Until the nineteenth century, very few people lived in cities. The great majority of the world’s population lived in rural areas and small towns. What cities there were had small populations and covered little land area. Cities we think of as very important in the eighteenth century and before were very small.

Map 1.4 shows the population size of six of the biggest cities in Europe in 1750. The two largest, London and Paris, had populations of 676,000 and 560,000 people, respectively (Chandler and Fox 1974). Virtually all of the inhabitants were concentrated in core city areas. Vienna, Rome, Madrid, and Berlin had populations of fewer than 200,000 people each. These are very small population sizes compared to the populations of these cities today. The United Nations Population Division estimates the 2003 population of the Paris agglomeration (region) to be 9.8 million and the population of the London agglomeration to be 7.6 million people (UN 2004).

**Population growth and urbanization**

The U.S. Census Bureau’s world population clock, described in box 1.1, estimates the population of the earth to be over 6.3 billion people and growing very rapidly. Until recently, the population
of the earth was much smaller and the rate of population growth also much less. What happened and why? What is happening now? Where might we be headed? Spatial analysis and data visualization about urbanization can help us answer these questions. Anyone doing such analyses needs to be careful because urban population data is not very reliable and different sources use different definitions.

Information on the current population of cities is abundant but conflicting and incomplete. A number of different government agencies estimate the current population of cities, countries, and the entire world. As mentioned, the U.S. Census Bureau’s population clock provides a running estimate of the population of planet Earth. The UN estimates the population of over four hundred urban agglomerations with more than 750,000 people (UN 2004). The World Bank continuously updates estimates of countries’ populations (World Bank 2004).

The U.S. Census has conducted a complete enumeration of the entire U.S. population every ten years since 1790 (U.S. Census 2002a). In the future, the U.S. Census will do annual studies of large samples of the U.S. population rather than a single decennial census (Peters and MacDonald 2004). The census provides demographic data grouped for the entire U.S., each state, every incorporated city (and other census designated places), and other census-defined areas such as consolidated metropolitan areas, Public Use Microdata Areas (PUMAs), census tracts, block groups, and blocks. State sources may provide up-to-date population estimates for counties and cities within the state.

Information on the population of cities in the past is contradictory and not very reliable. Only a few dedicated urban demographers have attempted to assemble historical city data. Kingsley Davis (1908–1996) carefully studied the size of European cities from the Middle Ages until the late twentieth century (Davis 1965). Davis concluded that the industrial revolution drove the rapid and massive urbanization of Europe. Beginning about 1750, advances in water- and then coal-powered machinery produced a revolutionary change in the way that material goods could be produced. Mechanization of agriculture meant that many fewer people were needed to produce enough food to sustain the rest of the population. More and more people left the land for cities and factory work.

Davis found that urbanization—the proportion of the population living in urban as opposed to nonurban areas—proceeded very slowly in England and other European countries until about 1750. When the industrial revolution occurred in England, urbanization increased rapidly, until England was predominantly urban, and then leveled off. Davis describes the pattern as an attenuated “S” curve beginning slowly, rising quickly as urbanization proceeded, and then diminishing as England became nearly fully urbanized. Shortly after England began to urbanize, Germany and other European countries followed the same trajectory: a process Davis describes as well represented by a family of “S” curves. The “S” curves that Davis discusses depict urbanization—the proportion of a society’s population living in urban areas—not growth in the number or population
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size of cities. Figure 1.2 illustrates Davis’s notion of how a family of “S” curves describes the process of urbanization.

The most thorough studies of city population sizes at different times in history were compiled by Tertius Chandler and Gerald Fox (Chandler and Fox 1974) and in a second study by Tertius Chandler alone (Chandler 1987). These two remarkable books contain population estimates of world cities at different historical epochs with documentation of how the estimates were made.

Not everyone accepts Fox and Chandler’s estimates of the populations of cities in the past, and more reliable estimates for some cities and some time periods are constantly being developed. But no one has attempted a comparable synthesis of population estimates for all cities through all of history. In exercises 1 and 5, you will work with Fox and Chandler’s data to explore the population of world cities at different times. In exercise 1, you will also work with contemporary United Nations data on the population of urban agglomerations today and data on cities that scholars classify as global cities.

Immigration and the growth of cities

Cities’ populations may grow as a result of combinations of different factors—including an increase in births over deaths, the blending together of formerly separate settlements to form a larger city, or from immigration from the same country or from foreign countries (Davis 1965).

In the United States, foreign immigration has been a driving force in urbanization since the first European colonists arrived in the early seventeenth century (Daniels 2002). The number of foreign immigrants and their countries of origin have changed over time. During the great Irish potato famine of 1848 a wave of Irish immigrants came to the United States (Golway 1997). Later in the nineteenth century, most immigrants to the United States came from southern and central Europe (Daniels 2002).

The 2000 U.S. Census found that 31.1 million people living in the United States in 2000 were foreign born (U.S. Census 2002b). A little over 40 percent of the foreign-born population were naturalized U.S. citizens in 2000. Between 1990 and 2000, the foreign-born population of the
United States increased by 57 percent from 19.8 million to 31.1 million people (U.S. Census 2002b).

Today, Hispanic immigrants from Mexico, South and Central America, and Asian immigrants from China and other Asian countries are fueling American urbanization. In 2000, over half of the foreign-born population in the United States—16 million people—were from South and Central America, Mexico, and the Caribbean. Thirty percent of the foreign population in 2000 was born in Mexico. Twenty-eight percent of the foreign-born were from Asia.

Map 1.5 is a thematic map showing the percent of the population in the San Francisco Bay Area who were born in foreign countries by census tract. In exercise 2, you will learn how to classify San Francisco Bay Area census tracts and create thematic maps with color ramps similar to map 1.5.

Immigrants and the descendents of immigrants contribute to the diversity of cities. In some San Francisco neighborhoods more than half the population in 2000 was foreign born. Maps 1.6a and 1.6b show the distribution of Asian/Pacific Islanders and Hispanic residents of San Francisco in 2000.

Specks in the wilderness
Just how dramatic world urbanization is can be well illustrated using an example from U.S. history. An examination of the size of cities in colonial America at the time of the American Revolution with comparably sized cities today illustrates just how tiny population sizes were a few centuries ago.

Map 1.5 Percent of the population foreign born, San Francisco Bay Area, 2000.
Source: 2000 U.S. Census of Population and Housing
Immigrants add diversity and cultural richness to neighborhoods like San Francisco’s Chinatown.
Source: Photodisc

**Map 1.6a** Number of Asians/Pacific Islanders in San Francisco by census tract, 2000.
Source: 2000 U.S. Census of Population and Housing

**Map 1.6b** Number of Hispanics in San Francisco by census tract, 2000.
Source: 2000 U.S. Census of Population and Housing
For students of American colonial history, Philadelphia, New York, and Boston loom large. In the political and intellectual history of the United States they were indeed significant. But in population size and spatial extent, they were tiny. These and other colonial cities illustrated in map 1.7a were what urban historian Carl Bridenbaugh called “specks in the wilderness” (Bridenbaugh 1938). The largest cities in America at the time of the American Revolution—Philadelphia and New York—had only about 25,000 people each (Chudacoff and Smith 2005). Map 1.7b shows five U.S. cities with 2000 populations comparable to the five U.S. colonial cities with the largest populations at the time of the American Revolution. Never heard of North Attleborough Center, Valley Falls, or Hanahan? Well . . . that’s the point.

The colonial cities were also small in physical extent. Because most residents had no other means of transportation than their feet, these walking cities could be traversed by foot in less than half an hour.
Not only were the colonial cities of what was to become the United States small, the urban population of the colonial cities was also very small relative to the total population of the colonies. The first U.S. decennial census in 1790 found only one American in twenty living in cities—5 percent of the population (U.S. Census 2004).

**Suburbanization and balkanization**

The word suburb (from the Latin words “under” and “the city”) was first applied to irregular settlements of merchants and traders outside the city walls of European cities. Since cities were often located on high ground for defensive reasons, these first suburbs were literally urban areas under (sub) the cities. These first suburbs grew up in the early Renaissance period beginning as early as the eleventh century. Later the word suburb came to refer to any human settlement on the fringe of existing cities.

Today most urban growth is occurring in suburbs on the urban fringe. Typically when enough population has grown up at a sufficient density, a suburban area is incorporated as a new legally incorporated city no longer governed by the county where the city is located and separate from other cities in the region.

Metropolitan regions of the United States are fragmented into many different government units—counties, cities, and special districts. Each city and county has its own separate government. Each regulates land use and makes decisions regarding the character of urbanization within its borders.

There are a large number of different local governments in most metropolitan areas. For example, metropolitan San Diego, California, has nineteen different local governments. As noted previously, the San Francisco Bay Area has 109. The Pittsburgh, Pennsylvania, metropolitan area has 418 different local governments (Orfield 2002).

A term commonly used to refer to this extreme fragmentation of authority is **balkanization**. The Balkan Peninsula—North of Greece and across the Adriatic Sea from Italy—has been characterized for most of the last two millennia by small nation states fighting with each other. Map 1.8 illustrates the balkanization of local government authority in the San Francisco Bay Area. It shows the nine Bay Area counties (light green) and 101 cities (orange with gray borders). Counties outside of the Bay Area are symbolized in gray.

There are only a few examples in North America of bold attempts to plan and govern regions in innovative new ways. In the Minneapolis–St. Paul, Minnesota, region, taxes are shared so that less affluent jurisdictions receive some additional money from wealthier jurisdictions (Miller 2002). In metropolitan Toronto, Canada, separate fringe jurisdictions have been fully consolidated into the city of Toronto itself. In the Portland, Oregon, region, Metro is a regional elected supegovernment that plans for the urban area of three counties and twenty-four cities and provides some services on a regional basis (Abbott 2001, Ozawa 2004). You will read more about the Portland area in chapter 12 and explore planning and policy issues in the Metro region in exercise 7.

**Urban problems and opportunities**

Urbanization can bring both problems and opportunities. Cities are incubators of technological change and culture. The growth of cities presents opportunities for economic development, modernization, and cultural advance. Urbanization can promote economic prosperity and higher standards of living, access to education and culture, and social mobility. But urbanization often also brings a host of problems including sprawl, congestion, and a loss of livability. Spatial analysis can show policy makers how to capitalize on opportunities that urbanization presents and how to cope with the problems it brings. This section describes some of the problems and opportunities
Urbanization presents and how spatial analysis can help illuminate what they are and how to respond to them.

**Urban areas growing too large, too fast**
Concern with city size and growth rates focuses on three main issues: (a) the population size of some urban agglomerations is becoming unmanageably large, (b) the biggest cities in the world are becoming unmanageably spread out, and (c) growth rates in many urban areas are so fast that government cannot provide infrastructure fast enough to meet human needs.

Urbanists use different terminology to refer to large urban areas. Sometimes they use the word cities. As discussed earlier, the UN prefers the term urban agglomerations. A common term for the largest cities is megacities. The UN considers an urban agglomeration with more than ten million people a megacity. Many urbanists fear that the population of some cities is growing too large. The megacities of Tokyo, Mombai (Bombay), Delhi, Mexico City, and São Paolo, Brazil, already have populations exceeding twenty million (UN 2002). Urbanization at this scale strains the capacity of a region to provide resources to support the urban population.

Megacities may have dense cores, but most are surrounded by low-density development that covers large amounts of land. Huge, low-density development imposes long commutes. Traffic congestion and air pollution in most megacities are much worse than in even the largest cities in the developed world (Gilbert 1996, Lo and Yeung 1996, Rakodi 1997).

Some cities—regardless of their absolute size or how spread out they are—are growing too fast. Often their residents’ need for urban services is outstripping the ability of government to provide services. Infrastructure is out of balance with development. In slum areas of cities in fast-growing developing countries, many residents have no indoor water, sewers, or electricity. In
some booming U.S. suburbs, schools are on double session, wastewater goes untreated, and traffic congestion is a serious problem (Weitz 2000).

The growth of metropolitan fringe areas presents metropolitan regions with the opportunity to decentralize. Planned new communities can be built. Developers can build attractive, well-designed new developments that fit into the regional fabric. Moderate- and upper-income families may be able to buy single-family homes with yards. Modern office space can usually be built at lower costs than in central cities. There is a large literature on how to develop regions (Duany and Plater-Zyberk 2001, Calthorpe and Fulton 2001). But too often fringe development proceeds piecemeal—poorly planned and uncoordinated among jurisdictions.

Urbanization in metropolitan regions can take many different forms. Population may be concentrated in one or a few areas with most of the remaining area empty farmland and open space. Alternatively, uniform low-density development may cover large areas of a region.

**Sprawl and density**

In urban areas, density is measured by the number of people per unit of area. For example, if there are five houses on one acre of land, with three people living in each house, the density would be 15 people to the acre (5 houses x 3 people each = 15/1 acre): a moderate residential density. If there were four 20-story apartment buildings on an acre, each with 100 residents, the density would be 400 people per acre: a very high residential density.

From a planning perspective density is a two-edged sword. Development at very low densities consumes land and creates sprawl. Low-density development makes it economically impossible to support public transit systems and perpetuates auto dependency. On the other hand, many people don’t like density. They would prefer to live in a low-density area—a suburb of single-family homes on individual lots.

The U.S. Census Bureau each year estimates both the population and the amount of urbanized land in the United States. The census estimates show that the average density of urban areas in the United States is decreasing. In the twenty-five largest metropolitan areas the population grew by 20 percent between 1970 and 1990, but the urbanized land area grew by 46 percent (Orfield 2002). Development at very low densities tends to snake out along transportation corridors and leapfrog some distance from the urban fringe. This creates patchy, low-density sprawl. Sprawl often uses up farmland and open space, increases infrastructure costs, requires more driving (with attendant air pollution), and may increase economic and racial segregation. Sprawling development may affect the fiscal structure of a metropolis. If new office development occurs in affluent edge cities, central cities and older suburbs will not get the property tax revenue the new development would generate if it occurred within their borders.

Most citizens and most policy makers believe that sprawl is bad (Weitz 2000). Sprawl development is arguably less efficient than compact, city-centered growth. New urbanist contrarians Peter Gordon and Harry Richardson at the University of Southern California dispute these common assumptions (Gordon and Richardson 2000). They argue that sprawl is a rational private market response that distributes population efficiently.

Statistics on sprawl are not nearly as effective as maps that visually show the extent and nature of sprawl. For example, map 1.9 depicts eastern Contra Costa County. It shows the area that was urban in 1984 in gray and the additional area that became urban between 1984 and 2000 in orange cross-hatching. Prime farmland as it existed in 1984 is in dark green. The cities of Brentwood, Oakley, and Antioch are indicated. Both land within incorporated cities and unincorporated county land at the urban fringe became urban during this sixteen-year period. The amount of prime farmland—a source of the best Bay Area corn, peaches, and other produce—has shrunk, particularly in and around the city of Brentwood.
Map 1.9 could show urban planners how much sprawl has occurred in eastern Contra Costa County and where. It could provide guidance to city and regional planners as to how to achieve more compact, efficient growth patterns that provide housing and also preserve prime farmland.

**Mobility problems**

Mobility in cities is a worldwide problem. It is often time-consuming and unpleasant to get from one place to another within cities—particularly by car. Traffic congestion is a major negative side effect of urbanization virtually everywhere in the world. It has many causes: population growth, increased per capita auto ownership, more miles driven on average by each driver, and individual desires to drive alone rather than carpool (Downs 1992). The near impossibility (physical and financial) of most governments everywhere in the world to build enough new roads to meet expanding need further compounds the problem.

Maps 1.10a and 1.10b show geographical units called census tracts in the southern part of Santa Clara County—the most southerly of the San Francisco Bay Area counties. Census tracts are one of the most important and most widely used of all the geographic units for which the U.S. Census reports information. Each census tract contains about four thousand people—a large enough number of people that the Census is confident that releasing detailed information on attributes of the census tract will not compromise the privacy of any individual. Census tracts with more than one thousand people age 16 or older who reported in the 2000 Census that they drive to work alone are outlined with dark black borders. In map 1.10a the key census tracts outlined in black are labeled with the number of people who drive to work alone. In map 1.10b the key census tracts are labeled with the number of people who carpool to work. For visual clarity the other, less problematic, census tracts are not labeled.

Maps 1.10a and 1.10b could suggest to transportation planners and local officials where it might make sense to organize carpools. Census tracts where there are a large number of people who drive to work alone are good candidates for programs to encourage carpooling. Further spatial and statistical analysis of the demographics and driving behavior of workers in these
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Map 1.10a  Number of people age 16 and older who drive to work alone, selected Santa Clara County census tracts, 2000.
Source: 2000 U.S. Census of Population and Housing

Map 1.10b  Number of people age 16 and older who carpool to work, selected Santa Clara County census tracts, 2000.
Source: 2000 U.S. Census of Population and Housing

Traffic congestion is a major negative product of urbanization.
Source: Photodisc
areas could help congestion management programs. In exercise 2, you will analyze carpooling in southern Santa Clara County. Chapter 8 includes a multicolumn chart showing data on driving behavior in these census tracts and a discussion of how data graphics can help policy makers see policy problems and opportunities.

The separation of jobs and housing
Jobs are essential for individuals to earn a living and for municipalities to generate revenue to pay for public services and to minimize welfare costs. But jobs are not evenly distributed in metropolitan areas. In most regions, jobs and job growth cluster in some areas and are sparse or almost entirely absent from others. Where the jobs are is often not where the people who want to fill the jobs are. There is what economist John Kain calls a spatial mismatch between jobs and housing (Kain 1968). Jobs and housing are not in balance (Cervero 1991 and 1996).

Spatial mismatch between jobs and the workforce creates problems. Some middle- and upper-income homeowners now live in California’s Central Valley where housing costs are comparatively low, and they commute two or more hours to work in high-tech Silicon Valley jobs where wages are comparatively high. According to the Job-Center Housing Coalition—a Northern California organization that advocates increased jobs-housing balance—in 2004 a registered nurse in San Jose earning $56,650 a year needed to make an additional $81,683 per year to afford the median-priced home in the Silicon Valley region (Job-Center Housing Coalition 2004).

People with low incomes and people without cars are particularly hurt by spatial mismatches between housing and jobs. Some low-income domestics and fast food restaurant workers reverse commute from inner city neighborhoods to work in the suburbs. In addition to imposing hardship on the workers involved, this kind of spatial mismatch adds to transportation congestion and air pollution from automobile emissions. GIS allows regional planners to see where spatial mismatches exist and help them develop strategies to improve the jobs-housing balance, a topic discussed in greater detail later in this chapter.

Livability
Urbanization creates problems of livability. Crowding, noise, long commutes, and poorly functioning public services make many large cities and rapidly urbanizing places much less livable than smaller, more stable communities. People living in these large cities and fast-growing places may have greater opportunities than people living in small towns and rural areas, and in some respects their quality of life is better. They may make more money than their rural counterparts and have access to educational, cultural, and other resources that big cities afford. But their day-to-day life is often less pleasant and sometimes more dangerous and less healthy than in rural areas and small towns.

Urban solutions
Solving urban problems is often difficult. Urban planning often takes place “in the face of conflict” (Forester 1987). There is rarely enough money to do things as well or as quickly as activists would like. But imaginative theory and solid examples of successful solutions abound (Downs 1994). Following is a discussion of how theorists propose to capitalize on opportunities urbanization creates and address issues of city population size, rapid growth rates, sprawl, traffic congestion, and livability. In addition to discussing theory, the following section provides examples of successful programs.
Urban growth management

Many cities have adopted urban growth management plans (Porter et al. 1996). These plans usually look far into the future—often to build out—and envision what should be built where. In fast-growing residential communities, comprehensive growth management ordinances usually have tempo control provisions that regulate the timing of when housing can be built. Many growth management plans require concurrency between population growth and infrastructure. Without concurrency, public infrastructure such as water and sewer services, schools, and firehouses may lag behind new housing units and new residents. As a result, there may be water shortages and sewage treatment problems, schools may be overcrowded, and response times for firefighters to get to fires may be unacceptably high. Tempo controls are one way to achieve concurrency. Careful capital budgeting with a capital improvement plan that matches infrastructure to growth is another way to achieve concurrency.

Petaluma, California, is an attractive small city north of San Francisco that has taken growth management seriously. The 1979 “Petaluma Plan” pioneered growth management. Once the white leghorn chicken capital of the world (according to Petaluma) and the seat of an annual arm-wrestling championship today, Petaluma retains small-town charm in an expanding metropolis. The best-known feature of the Petaluma Plan was a limit of five hundred on the number of residential building permits that would be granted each year. Petaluma used a point system whereby a committee ranked proposed residential development and assigned points for features of the development the city valued. The projects with the highest number of points were awarded building permits.

Economics 101 suggests that limiting housing supply in the face of high housing demand will increase housing prices. Strict growth management may cause development to spill over into other nearby communities. Some communities have deliberately or inadvertently created growth management systems that have greatly limited the supply of housing and deserve to be criticized for their exclusionary land-use practices (Downs 2004). Petaluma is often criticized for being exclusionary. In fact, Petaluma’s growth management system was not nearly as restrictive as plans in many other cities (LeGates 1989). Petaluma zoned a larger amount of land for residential development than most Bay Area cities. Petaluma’s 500 units per year limit on residential building permits did prevent some housing construction in boom times, but in the long term Petaluma permitted more residential building than comparable Bay Area cities. Petaluma provided some incentives for affordable housing. Today Petaluma is an attractive community with a compact form, a greenbelt surrounding most of the city, infill development on empty lots in the middle of the city, and balanced development in different parts of town. The 2000 U.S. Census reported 8,458 Latinos, 2,170 Asians, 606 African-Americans, and 2,085 other minorities among Petaluma’s 60,000 residents (U.S. Census 2000a).

Distributing density

Most urban planners recognize that density is unpopular and sometimes problematic. But planners also know that higher densities are necessary to reduce sprawl and provide for efficient public services. The only way out of this dilemma is to increase average densities for a region but distribute the density in a sensible way. Quite high-density development is appropriate in some parts of a region, such as downtown central business districts. Low to moderate density may be appropriate in residential areas. Very low density is appropriate in agricultural areas.

Urban planners have identified ways to increase average density in regions and at the same time not overwhelm areas or alienate citizens. Quite high density is appropriate around light-rail stations and other major transit nodes. Residential density can be increased in cities by building more units on infill sites and by creative design such as building housing units in air rights over
retail space. Relatively high-density commercial and office space is appropriate along main streets and transit corridors. Well-designed neighborhoods can be attractive despite relatively high densities. The same Americans who protest increased density in their own cities love the character of neighborhoods in Paris with four- and five-story attached apartment buildings.

Sensitive distribution of density requires careful analysis, collaborative planning to assure the support of neighbors, and good design. Done well, it can produce compact, efficient development that people like.

Garden cities, greenbelts, and urban limit lines
At the turn of the twentieth century, British social visionary Ebenezer Howard proposed garden cities of about 32,000 people, each surrounded by a permanent five-thousand-acre greenbelt devoted to agricultural and recreational use (Howard 1898). What is remarkable about Howard’s vision is that people acted on it. Over a hundred years ago, an organization named the Garden City Association purchased land about fifty miles from London and built Letchworth as a garden city following Howard’s principles (Hall 2002). Soon afterward, the Garden City Association began work on a second garden city named Welwyn. Both Letchworth and Welwyn are attractive, functional cities today that still serve as models of good urban planning.

Sprawl can be managed and sometimes eliminated altogether by drawing urban limit lines around cities and requiring all growth to take place within the limits. Many European cities have clear urban limit lines. In these cities lively, dense urban areas stop abruptly and fields begin rather than sprawling out through low-density tract homes and tacky fast food outlets.

Urban limit lines raise fundamental issues about the relationship between government and private property and fairness to property owners whose ability to use their land as they choose is limited. Proscribing what can be built where and when creates winners and losers among property owners. It may be good public policy to limit new development outside an urban limit line for as long as twenty years. But the owner of land just outside the urban limit line may see a huge drop in the value of the land. Many property owners who have been affected in this way, or fear that they will be, are involved in a powerful national property rights movement. Conversely, it may also be good public policy to rezone land near a light-rail stop to permit much higher density residential development than elsewhere in a neighborhood, but that regulatory decision will almost certainly greatly increase the value of the land and provide a windfall for the property owner. Defining all of the gains and losses and attempting to compensate landowners for all value lost as a result of regulation or capturing the unearned increment in land value that occurs as a result of regulation is virtually impossible. Defining when a regulation is so severe as to constitute a “taking” of land requiring government to pay just compensation to the owner has been the subject hundreds of lawsuits and a great many learned legal opinions. While this is not the appropriate place to review the takings issue and the property rights movement, it is important always to think of all of the parties affected by land-use regulation and work for the fairest possible regulations.

Infill development
A different approach to providing affordable housing involves infill housing on underutilized land in older neighborhoods. Infill development is often undertaken by community-based housing development corporations (HDCs) or community development corporations (CDCs). In addition to providing shelter, HDCs and CDCs can build human capital by involving residents themselves in planning and carrying out affordable housing projects. Streets of Hope (Medoff and Sklar 1994) is an excellent account of how Boston’s Dudley Street Triangle neighborhood revitalized their own local area and got affordable infill housing built.
In Oakland, California—a city of 380,000 people across San Francisco Bay from San Francisco—Jerry Brown ran for mayor successfully in 1999 with a pledge to get enough housing units built in the down-at-the-heels center of Oakland to house ten thousand new residents: Brown’s so-called 10K Downtown Housing Initiative (Oakland CEDA 2004). Brown reasoned that relatively high-density condo, apartment, and loft development would bring in enough new residents to pump up local businesses, create more cultural activity, and revitalize Oakland. In addition to streamlining building permits and providing economic incentives, members of Brown’s administration used GIS to help fulfill this campaign pledge. Cities have records of landownership almost always accompanied by cadastral maps—maps showing the location and ownership of land parcels. Planners in the Brown administration mapped vacant parcels in Oakland and made this information available to developers. Map 1.11 shows vacant parcels in downtown Oakland that were zoned for two to four residential units as of 2004.

The Brown administration succeeded in increasing housing construction in downtown Oakland, and GIS contributed to the program’s success. According to the Oakland Community Economic Development Administration, as of July 2004, the 10K Downtown Housing Initiative had resulted in thirty-five residential projects with 4,969 housing units (Oakland CEDA 2004). Because housing units house more than one person per unit on average, Oakland had nearly accomplished Brown’s goal of providing housing for ten thousand new residents by 2004.

**Unlocking gridlock**

Oxford University geographer Colin Clark has termed transportation “the maker and breaker of cities” (Clark 1957). Increasingly, urban planners see good transportation planning linked to development as critical to successful cities. Most urban planners feel transportation options today are unbalanced—that people are forced to use automobiles because cities do not offer them enough options to walk, ride bicycles, or use light rail, buses, or other public transportation.
Increasing transportation choice is critical in unlocking gridlock. It is also an important key to creating more efficient and more livable communities.

**Multimodal transportation**
Overwhelmingly, the main mode of transportation in the United States today is the private automobile. If fewer people used automobiles or used them less frequently and for fewer miles, highways and streets would be less congested. In order to get people to switch from automobiles to other forms of transportation, there must be transportation options that people consider as good or better for some of their transportation needs.

Public transit systems include railroads, subways, and other forms of mass transit, buses, and light-rail systems. Mass-transit systems are very expensive. Railroads as a transit alternative pose financial and technological challenges. Bus systems in many American cities are poorly funded, unreliable, and unattractive. Often buses have become transportation of last resort, avoided by people with the money to afford other options. While reinvigorating and extending any of these transit options may be possible in a given situation, other modes of transportation appear to offer particular advantages.

Light-rail systems are less expensive to build and operate than mass-transit systems. Except in the very densest cities where very high-volume ridership can support the enormous cost, light-rail systems are a more realistic option for relatively high-volume public transit than subways and mass transit.

Bicycling and walking are much more widely used transportation options in Europe and other parts of the world (Beatley 2000). Efforts to increase bicycle use and promote pedestrian activity are important ways to increase mobility. The exercise they provide contributes to health.

**Transit-oriented development**
Land-use planning and transportation planning in the San Francisco Bay Area and elsewhere have often proceeded without any coordination at all. Zoning laws may limit the density of residential development in an area where a transit system is being built so that too few people live in the area to make the transit system financially feasible. In other areas, zoning may permit more development than the area’s transportation system can handle.

There has been a movement among urban planners in the last ten years to better link transportation with housing and other development. **Transit-oriented development (TOD)** plans call for much greater residential densities around transit nodes such as light-rail stops (Bernick and Cervero 1997, Ditmar and Ohland 2003). Spatial analysis of transportation systems and land-use densities is very useful in transit-oriented development planning.

**Balancing jobs and housing**
One way to address the problem of spatial mismatch between areas where people live and where jobs are located involves improving **jobs-housing balance**. Urban planner Robert Cervero pioneered systematic analysis of the balance between jobs and housing (Cervero 1991 and 1996). Given the complexity of living and working patterns and the number of households with two or more wage earners, achieving a perfect balance between housing units and the workforce that lives in a single city is unrealistic. However, analyzing the nature and extent of imbalance and encouraging regional collaboration to achieve better balance can shorten commute times, relieve traffic congestion, and reduce air pollution.

California funds a number of interregional partnerships (IRPs) to encourage regions to plan together. The IRPs include cities and counties that do not ordinarily consider themselves part of the same region. Often members of an IRP have not collaborated in the past. Sometimes they have
actively competed with each other. Working together as an IRP, these jurisdictions are encouraged
to jointly develop strategies to increase jobs-housing balance in the extended region. The purpose
of interregional partnership analyses is to promote development of new housing near jobs and
new employment centers near housing. For example, an interregional partnership (IRP) has been
created between some counties in the San Francisco Bay Area and adjacent counties to the east
that are not part of the Bay Area. This IRP has used GIS to analyze jobs-housing balance in the
extended region.

Similar projects in the San Diego and Santa Barbara regions are also using GIS to create
interregional plans to achieve better jobs-housing balance. The partnerships identify, map, and
analyze sites suitable for large new housing construction projects. They look for locations where
jobs are plentiful and housing scarce. They conduct spatial analyses using GIS for areas covering
more than one traditional region as defined by COG boundaries. Interregional partnerships do
similar GIS analysis of sites suitable for new commercial and industrial development in areas that
have few jobs, more affordable housing, and higher housing vacancy rates.

**Making infrastructure work**

Infrastructure—particularly transportation infrastructure—shapes urban development. Examples
from two widely different locations—the city of Curitiba, Brazil, and the state of Maryland—show
how infrastructure planning can shape growth.

Curitiba, in southern Brazil, has a population of more than 1.6 million people. Curitiba is
remarkable for having made visionary decisions about its future urban form and developing
appropriate infrastructure to govern its long-range growth (Rabinovitch 1996). Planners in
Curitiba decided that as the city grew it would be essential to move very large numbers of people
efficiently and economically to and from the city center. They decided that a high-volume bus
system would be appropriate given Curitiba’s financial resources, rather than a more expensive
subway system. Accordingly, Curitiba laid out large radial streets served by very frequent, high-
capacity buses specially built for the city by Volvo. The buses are designed to permit dozens of
people to board and de-board at once. Curitiba is a much more functional and attractive city than
many other cities of comparable size and resources.

Among U.S. states, Maryland has been a leader in concentrating infrastructure to promote
compact, city-centered development (Porter, Dunphy, and Salvesen 2002). In the late 1990s
and early twenty-first century, Maryland channeled all state infrastructure funding to areas
where planners felt urban growth should occur—so-called “smart growth” areas—including
existing municipalities, land inside the beltway between Baltimore and Washington, D.C., and
fast-growing areas near existing developed municipalities. Many communities today have been
inspired by Maryland’s example and are pursuing smart growth strategies (Porter, Dunphy, and
Salvesen 2002).

Despite many urban problems, there is reason to be optimistic about urban futures. We know a
lot about problems of sprawl, traffic congestion, and spatial mismatch between jobs and hous-
ing. Theorists have developed ideas about how to tackle these problems and there are hundreds
of excellent, successful examples of theory translated into practice making urban areas more
efficient, less congested, and more livable.

One of the most promising new tools to help us diagnose problems and find opportunities to
make urban areas better is GIS software. Chapter 2 introduces GIS.
**Terms**

*agglomeration.* A large urbanized area, including one or more cities, and the urbanized area around the city or cities. In some cases, an agglomeration may include urbanized land between two or more cities. The United Nations uses agglomerations as its unit of analysis to report on the population of large urban areas.

*balkanization.* Fragmentation of local government authority. Most metropolitan areas of the United States are governed by dozens or hundreds of separate county and city governments. These governments often plan and regulate development independently of or in competition with their neighbors. Like the little countries of the Balkan Peninsula, local governments tend to look out for their own self-interest rather than the common regional good.

*census tract.* An area defined by the U.S. Census Bureau within which demographic and other information collected by the census is reported. Census tracts usually contain about four thousand people. They vary in geographical extent. A great deal of urban spatial analysis uses census tracts as the unit of analysis.

*council of governments (COG).* A voluntary organization of the cities and counties in a metropolitan region. Member governments share the costs of the COG and in turn the COG provides data, helps coordinate development on a regional basis, and conducts region-wide projects. COGs don’t have the power to impose their plans on member governments, but facilitate regional decision making.

*garden city.* An alternative to the large, sprawling cities and conurbations of nineteenth century England. Ebenezer Howard (1850–1928) proposed social cities of about thirty-two thousand people surrounded by greenbelts. The municipal corporation would own the land in a garden city and the increment in land value as land increased in value would be held in public trust for the citizens. Garden cities inspired by Howard were built in England and other countries and remain a powerful alternative to unplanned sprawl.

*greenbelt.* Ebenezer Howard proposed five-thousand-acre greenbelts of undeveloped land around garden cities devoted to agricultural and recreational use. Howard felt a greenbelt should serve as a natural boundary to keep the city a manageable size and create separation from other social cities. Howard also envisaged greenbelts as sources of homegrown produce and recreational opportunities. Many cities today have what they call greenbelts—undeveloped land at their fringe—though few are the size or perform all the functions that Howard envisioned.

*infill development.* A development on vacant or underused property in an already developed area. Many cities encourage infill development with modern land uses at appropriate densities. Infill development of affordable housing can promote equity.

*jobs-housing balance.* When there are enough housing units for the workforce in an area, the area has achieved jobs-housing balance. Often jobs and housing are out of balance. Jobs are located in some areas; housing in other areas. Some metropolitan areas are pursuing policies to balance jobs and housing. If jobs and housing are in better balance, people will have shorter commutes, and the metropolitan area will work more efficiently.
livability. The quality of being an attractive, pleasant place to live. Many urban areas concentrate on economic goals at the expense of livability. Today progressive cities are consciously pursuing policies that will make them more livable.

transit-oriented development (TOD). A type of development at relatively high density around a transit node such as a light-rail stop.

urban growth management. The idea of regulating the development of a community by specifying the timing and character of its development community-wide over a long period of time. Comprehensive growth management is different from permitting growth to proceed governed only by land-use regulations such as zoning, subdivision controls, and building codes.

urbanization. The process by which an area becomes urban. As a society urbanizes, a larger proportion of the total population lives in cities and a smaller proportion lives in rural areas and small towns. Very rural societies like Mali have not urbanized much; very urban societies like Denmark are nearly completely urbanized.

urban limit line. An urban limit line (sometime called an urban growth boundary) distinguishes land intended for development in the near future from land that will not be developed until some time in the future. Some cities establish urban limit lines in order to promote more compact growth and reduce sprawl.
Questions for further study

1. Historical urban demographer Kingsley Davis says that it is theoretically possible for the population of cities to grow as the country where the cities are located becomes less urban. Using Davis’s definition of urbanization, explain this apparent paradox.

2. Usually, as the population of a region grows, the percentage of the region’s population that is urban grows, the number of cities grows, the area of the cities grows, and the population of the largest city in the region grows. But these relationships are not necessarily true. Geographic barriers to expansion, war, technology, changing economies, and many other factors can affect population growth or decline, urbanization, city population size, and city size. For example, a depressed Welsh coal-mining town with little demand for coal, surrounded on all sides by other incorporated towns, in a prosperous region of Wales where high-tech businesses are booming in other nearby cities is likely to experience population decline and no change in the size of the city’s land area at the same time that the region in which the city is located is urbanizing. Describe situations in which you believe it is likely that

   a. the population of a region is increasing, but the percentage of the population that is urban is decreasing;
   b. the population of a region is decreasing, but the percentage of the population that is urban is increasing;
   c. the population of a city is increasing, but the area of the city remains the same;
   d. the area of a city is increasing, but the population is decreasing.

3. Based on your own visit to the U.S. Census population clock at www.census.gov/ipc/www/popclockworld.html, what is the population of the earth now? How much has it changed since 11:57 AM Eastern Standard Time on Saturday, November 30, 2004, when the population estimate recorded on the clock was 6,397,241,883 people?

4. Identify a town near you with a population of about twenty-five thousand people. This was the size of the largest city in North America at the time of the American Revolution. How big is this city compared to the place where you live? The capital of your state?

5. How many different units of local government (cities and counties) are there in the metropolitan area you are most familiar with? Does it make sense to have this many different units of local government? How would you use maps and spatial analysis to identify areas where local governments need to work together on regional solutions in the region where you live?
Annotated bibliography

The classic definition of urbanization and description of how urbanization occurred in European history is Kingsley Davis’s “The Urbanization of the Human Population,” *Scientific American* (Davis 1965).

Tertius Chandler collected population figures on city population size at different times in human history in *Four Thousand Years of Urban Growth* (Chandler 1987) and, together with Gerald Fox, in *3000 Years of Urban Growth* (Chandler and Fox 1974).

The United Nations Population Division estimates the past, present, and projected future size of more than 400 urban agglomerations (United Nations 2004).


Peter Calthorpe, an architect and planner based in Berkeley, California, describes a new urbanist vision for the future in *The Next American Metropolis* (Calthorpe 1993). Calthorpe and California planner and journalist William Fulton apply new urbanist thinking to regional issues in *The Regional City* (Calthorpe and Fulton 2001).

Peter Medoff and Holly Sklar’s *Streets of Hope* (Medoff and Sklar 1994) is a fascinating and inspirational account of how one lower-income Boston neighborhood took control of its own destiny and developed and successfully carried out a plan to redevelop the area.