POPULATION ESTIMATION AND PROJECTION TECHNIQUES

A guide to methodologies for forecasting population growth for Florida's local planning agencies

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PURPOSE

Chapter 9J-5, Florida Administrative Code, contains the minimum criteria for review of local comprehensive plans. This rule, amended as of September 30, 1986, directs that the "comprehensive plan shall be based on resident and seasonal population estimates and projections". Since many of the plan elements, such as Future Land Use, Housing, and infrastructure, are directly based on population data, these resident and seasonal population figures become critical to the community in assessing future needs for services and facilities.

Local planning agencies have the option of using official state data or of developing their own estimates and projections. A local government which chooses to use its own methodology is required by Chapter 9J-5 to submit a "description of the methodologies utilized to generate the projections and estimates". This paper will show several examples of professionally accepted methodologies whereby local planning agencies can calculate these figures for resident and seasonal populations. The examples shown below are not designed to be all inclusive, but are shown in order to acquaint the non-professional analyst with several simple means of forecasting population figures when trained specialists are not available for such a project.

The intent of Chapter 9J-5, FAC, is that each local government's demographic effort be based on a logical, well-founded method of forecasting population growth. There are, in fact, many acceptable methodologies which may be used, and the intent of this document is permissive in that regard.

INTRODUCTION

The success of local government comprehensive planning depends to a great extent on the accuracy of population estimates and projections. The rate of population growth within a community will determine future requirements for housing, transportation, recreation, schools, and other public and private facilities. Local planning agencies, therefore, should attempt to forecast as accurately as possible their projected growth by using the most appropriate techniques and methodologies and by applying their best professional judgement to the analysis of prevailing local conditions.

While Florida's population growth is on of the highest in the nation, there is still a wide variation of growth rates within the state. Many communities have experienced explosive growth, while some have seen an actual decline in their population in recent years. The demographer of local planner cannot assume that past trends will continue, yet he must base his population forecasts on what is normally an historic data series relevant to his county or municipality. To make the task easier, official state population projections for each county, with high, medium, and low ranges, are periodically compiled and published, relieving the county planner of the need to collect and analyze original data and to make independent growth projections (cities, as we shall see later, will be required to make their own projections, since only estimates of current population are available from state sources). In some cases, however, local planning agencies may wish to use their own data sources and methodology, especially if unusual local conditions indicate that official state projections are not considered valid for their particular community. If the latter option is chosen, the planning agency should make its estimates and projections based on professionally accepted methodologies and should precisely document the details of their assumptions and computations. This documentation will be reviewed along with the comprehensive plan and will constitute part of the criteria used by DCA in determining compliance with growth management legislation.

GENERAL CONSIDERATIONS

Demography, according to most authorities, is still more of an art than a science, despite great strides in sophistication and computer-based methodologies of recent years. The following observation by Donald Pittenger perhaps puts the discipline in its proper perspective:

> Not all populations grow. If they do grow, that growth is not necessarily steady. Likewise, declining populations need not decline steadily. Some populations neither grow much or decline much; they may remain stationary for considerable periods of time. All of this suggests that population forecasting could be a tricky business.*

The three components of population growth are births, deaths, and migration. By combining birth figures with mortality figures for a given area, we arrive at a net figure known as natural increase (or decrease). Data are readily available for historical fertility rates and mortality rates, and these may be applied to local demographic information to compute projected natural increases, if desired. The third component, migration, is a much more elusive commodity. Net migration figures are the result of balancing in-migration and out-migration figures. In the case of Florida's local governments which are facing volatile growth rates, this will be the predominant and most complex component of change.

* Pittenger, Donald B. (1976), Projecting State and Local Populations, p. 35

Migration rates, additionally, are tied strongly to economic conditions and can be correlated with such variables as available labor force, per capita income, unemployment rates, and cost of living levels. Florida's migration figures are also determined in large measure by environmental factors, such as quality of life, temperate climate, and recreational opportunities. One can readily understand the state's booming population growth when viewed in these terms, while also realizing that the same factors would tend to moderate growth through migration in certain stabilized communities.

A population estimate is not the same as a population projection. An estimate attempts to define population for a specific time in the past (such as a period midway between the last two census counts - an "intracensal estimate") or for a specific date near the present and based on the last official census (a "postcensal estimate"). An estimate does not attempt to predict the future. A projection, on the other hand, is concerned with future population levels. Projection methodologies are based on certain assumptions about future conditions and, in conjunction with selected data series, try to assess population levels and characteristics for specified times in the future. The accuracy of the projection is directly affected by the validity of the underlying assumptions, and this becomes the demographer's and the planner's greatest challenge.

Both population estimates and projections, which are based on historical data series, rely upon statistical methods for their computations. The local planner, regardless of the methodology he has chosen, must ensure that he is using sound statistical procedures. For example, if the projection is to be made for fifteen years into the future, then at least fifteen years of historical data should be used as the basis for the projection. Also, at least three population counts from past census enumerations (1960, 1970, 1980) should be used whenever possible. Adherence to these guidelines will normally yield more reliable results.

It is important to understand that increased sophistication in projection methodology does not necessarily produce greater accuracy. Some of the more complex, computer-based models in current use are designed to assimilate and analyze voluminous amounts of data in order to yield detailed projections for specific age-sex-racial groups (or cohorts). Such detailed information at the county and city level, if generated through local resources, would be prohibitively expensive to produce and would be of questionable value for the general needs of the local planning agency. More importantly, however, these projection figures would not necessarily be any more accurate than those produced by simple mathematical extrapolation or ratio techniques, which are feasible for any level of local government.

Demographers are agreed that forecasting accuracy tends to increase as the size of the population group being observed increases (e.g., a projection of Florida's total population would be more accurate than a projection for Duval County); as the projection time period decreases (forecasts for a ten-year period would be more accurate than for a 20-year period); as and the level of net migration decreases (Calhoun County's projections would tend to be more accurate than Osceola County's). These demographic principles result from the concept that changing conditions (economic, social, political) cause a shift in trends over time and these changes tend to affect smaller population groups more radically. The local planning official who is best prepared to analyze, or at lease foresee, these changes will be able to more accurately project his community's growth rate. For example, a large city which has built out to its corporate limits and which plans on no additional annexations, could reasonably expect its population growth projections to be fairly accurate over the next ten to fifteen years, barring any drastic changes in population densities, economic conditions, or environmental quality. On the other hand, a small city with large undeveloped areas that expects to attract new industry or educational facilities in the near term, and which currently enjoys a relatively low cost of living, could probably expect very high migration rates and, hence, a sizeable loss in accuracy in its population projections, even for a very short range forecast.

A fundamental obligation of the planner, then, is to continually monitor the various changes within his community and to assess the possible impacts of these changes on future population levels. The viability of the comprehensive plan will be measured in terms of its ability to accommodate increasing population, and failure to foresee a period of explosive growth can render the plan virtually ineffective as a growth management tool. Both general and specific assumptions will be the bedrock of the population projection process. We can fairly safely assume that there will be no foreign invasion or major earthquake during the planning period, but many other vital questions must be addressed, as will, when attempting to accurately estimate current population and to project future population. It is reasonable to expect, for example, that past trends will continue for the next five years? Or two years? Has the economic climate changed? Are unemployment rates climbing? Is per capita income keeping pace with statewide levels? Do school enrollments show a marked increase over previous estimates? If the municipality reasonably expects to annex neighboring unincorporated areas in the next several years, have the populations of these areas been included in the plan? What can we discern from current vacancy rates in local hotels and motels that might show a new trend in seasonal population? These and other key variables must be included in the planning formula to adequately assess the direction that population trends are taking.

Finally, the local planning agency must be aware of the various applications of its estimates and projections. Each county is different in terms of the jurisdictions of the several service districts, but for all local governments budgetary impacts of future levels of service are a major consideration when analyzing growth characteristics. If a county chooses to base its plan on the official high-range projection, for example, and if that county provides countywide sewer service and equipment, then these assumed high growth rates should be reflected in the county's capital improvement element where sewer-related costs and revenues are programmed. In the case of a municipality which is presently providing water service to a contiguous unincorporated area, the growth potential of that area must be considered, since its required share of the capital improvements budget would be determined by the projected population growth. The same relationship applies to virtually every required element of the comprehensive plan. High levels of growth will require an increase in services and facilities. Therefore, the population forecasts should be as realistic as possible for budgetary purposes, and, more importantly, neighboring governments must be in agreement on the means for providing services and facilities to growing areas and on how to properly allocate projected population among the various service districts.

COUNTY AND CITY PRORATION OF POPULATION FIGURES

Each county and the municipalities located within each county must work together to ensure the total county population is appropriately apportioned between municipalities and the unincorporated county. In practical terms, this means that all individual city estimates and projections for a given time period, plus figures for unincorporated areas, should aggregate to the total county figure provided by official state data sources for that same time period. This will require a mechanism, mutually acceptable to the county and the several municipalities within the county's jurisdiction, whereby each unit agrees to use a proportionate share of the forecast population data in accordance with rational formulas for such proration. This is not to say that historical proportions will necessarily apply for current and future time periods, but the responsibility for allocating populations must be shared by all local governments. Moreover, a determination of these formulas and allocation procedures must be made early in the planning process in order to preclude individual cities from possibly forecasting a grossly disproportionate share of its county's population. Failure to agree on this point could conceivably lead to distortions in internal population totals and, as a result, to inaccuracies in assessing the needs for infrastructure and services to support these populations.

Additionally, each county has a responsibility to generally control its population forecasts to a proportionate share of the official state total figures. Rule 9J-5 permits the county to use either a high or a low projection figure from official state-provided sources, rather than the medium figure, so long as a "detailed description of the rationale" is provided to explain this section. (Note that, in this case, the methodology need not be explained, since the figures themselves are from official state sources. However, to select other than the medium projection figures implies that the county has factored in certain assumptions which lead it to believe that its growth rate will exceed or lag the state's best forecast for the time period in question. There is nothing inappropriate in this process -- indeed, the local planning agency may well have the better judgement and knowledge of local conditions--but, from the Department's perspective, all 67 counties must roughly aggregate to the state-wide total and, without rationale for using non-standard figures, the individual county's assumptions might be questioned during the review process.)

The official state population figures published by the Bureau of Economic and Business Research include data by individual county. These projections, however, include the entire population of the county, and do not break out the unincorporated areas. For purposes of analyzing service districts within the county, and for determining county census city responsibility for providing these services, each county must be able to allocate population among its municipalities and unincorporated areas. These allocations, in turn, can then be related to service jurisdictions within the county.

<u>TYPES OF METHODOLOGIES</u>

This section will describe, in general terms, the currently recognized methods by which population estimates and projections are made. An in-depth definition and sample calculation for each are beyond the scope of this paper, but the reader will be referred to recommended sources for further detail. Emphasis will be placed on the two types of methodologies which are appropriate to the majority of local planning agencies.

With regard to the provisions of Chapter 9J-5, the methodology groups listed below, including any of these subcategories or variations listed herein, or any composite form of these methodologies, such as averaging the results from two or more methodological approaches, will be considered by the Department to be professionally acceptable.

ESTIMATION:

As we saw above, population estimates are concerned with present-day conditions. For the planner's purpose, a current estimate attempts to show "today's population figures, and is derived from the latest census count. The three main groups of estimation methodologies are:

a) Mathematical Extrapolation
b) Ratio, and
c) Cohort-Component

The general description of these methodologies is given in the following section under "PROJECTIONS", since the statistical procedures are similar for each.

Annual estimates of current population are published annually by the Bureau of Economic and Business Research (BEBR) for both cities and counties, and these estimates are recognized as official state data. Using BEBR estimates, then, as the basis for the comprehensive plan constitutes compliance with Rule 9J-5, and all local governments are encouraged to do so. Should the local government choose to develop its own estimates in lieu of BEBR data, however, there are several available techniques under each methodology which are considered to be professionally acceptable. Examples are the arithmetic, geometric, and logarithmic variations of the extrapolation methodology. Also, ratio-based techniques such as proration, apportionment, direct ratio, vital rates, administrative records, ratio-correlation, and the housing unit method are acceptable. The cohort-component method has few variations, but among them are the adjacent cohort technique, Component Methods I and II, and composite techniques of using extrapolation or ratio methods in conjunction with cohort-component data.

PROJECTIONS:

The four major categories of projection methodologies are:

a) Mathematical Extrapolation
b) Ratio
c) Cohort-Component
d) Economic-Demographic

Each type has its distinctive advantages, limitations, data requirements, level of complexity, and applicability to the professional planner. For local government purposes, the mathematical extrapolation and ratio methods are recommended, in that they are relatively inexpensive, simple to employ, and capable of yielding results quickly. A brief description of each follows.

1. <u>Mathematical Extrapolation</u> techniques involve the manipulation of data on a given population, without comparison to other populations, in order to calculate a continuation of a trend. Depending on the change, or lack of change, in the trend, one may employ: An arithmetic extrapolation (straight-line, or constant amount of change over time); geometric extrapolation (constant percentage change over time); or a version of the logistic curve (a shift occurs in the trend over time). Extrapolation techniques require historical data series, measured at two or more intervals,

which can be plotted or arranged to show a pattern or trend. Simply projecting the trend forward (using, for example, graph paper) indicates the current or future level of the data on the line or curve. The techniques of extrapolation are best suited to measurement of population totals only, and no analytical value is derived from them. They are, however, simple to apply, and require comparatively little data or technological complexity. These methods are referred to as direct, in that they obtain desired data (total population figures) from existing data of the same category.

Extrapolation techniques are suitable methodologies for local planning agencies in many cases, so long as the limitations of the techniques are understood. The basis assumption is that past trends, as depicted by the historical series of data used, will not change appreciable in the future. Depending upon the growth potential and characteristics of the particular community, this may not necessarily be a valid assumption. For this reason, estimates and projections derived from extrapolation techniques should be limited to short time periods (ten to fifteen years, maximum) and the resultant figures re-evaluated frequently.

2. Ratio methodologies are based on the relationship of one set of data to a larger set of similar data. Also referred to as share techniques, they encompass a wide variety of methods and approaches. They are a means of indirect measurement, as opposed to extrapolation methods, in that they rely on measurement of trends and data from a "parent" population for comparative purposes. Ratio-based methodologies, along with extrapolation, comprise the vast majority of estimation methods used by local governments. This category includes simple proration, apportionment, direct ratio, vital rates, shift-share, share of growth, and density models. Most ratio methods utilize symptomatic data, which are assumed to have a direct relationship to population growth. Symptomatic data includes such things as school enrollment, voter registration, auto registration, drivers licenses, electrical hookups, size of labor force, or any other data which the analyst determines to be most symptomatic of growth trends for his community.

Ratio techniques have the advantage of relying on the more stable and statistically accurate data from the parent population. Moreover, these data are published and updated frequently for national, state, and county areas, and planners with access to these data sources can easily apply ratio techniques to derive their appropriate share. The assumption is that trends occurring in the larger area will be shared by the smaller. The differences in the trends, if any, must be projected at the local level based on best available local data, such as housing unit forecasts, density constraints, school enrollments, utility customers, etc.

3. The Component method, which involves the separate calculation of births, deaths, and migration data (components) by

age, sex, and racial groups (cohorts), is normally not appropriate for use by local governments. It is an extremely complex and sophisticated methodology, as it entails computation of natural increase and net migration data since the last census, with adjustments made for shifts in institutional and military populations. For this reason, it is normally used at the state and national levels, where data sources and processing capability are more highly developed.

The wealth of detailed data generated by cohort-component methods is available through U.S. Census Bureau documents, particularly the decennial census. These data can, in turn, be manipulated by state and local agencies for estimation and projection purposes by the extrapolation and ratio methods noted above. Additionally, official state-generated population figures are derived in part from cohort-component methodologies, and these, in turn, constitute base-line population figures for local government use.

The major advantage of the cohort-component method is the analytical value of the derived data, which may be disaggregated to show detailed characteristics of the population. Underlying assumptions (such as specific fertility rates) can be varied to produce differing results. The availability of this detailed information to the local planner, who can use it for his own estimation and projection purposes, is an obvious advantage.

4. Economic-demographic methodologies are used only for projecting future population levels and are based on economic factor analysis. Economic variables, such as unemployment rates, per capita income, labor supply, and production rates, are tied to birth, death, and migration components by means of complex computer programs. Thus, different assumptions can be used in the formula to project a different set of outcomes, depending on estimates of future economic conditions. Like cohort-component methodologies, economic models are extremely complex and costly to employ, and therefore not normally appropriate for use at the local level.

DATA SOURCES

An important planning consideration to keep in mind is that population estimates and projections can, and should, be revised whenever more current or accurate data become available. Most relevant to any demographic effort, of course, is the decennial U.S. census, which provides the most detailed and accurate statistics available. When the 1990 census is published (approximately mid-1992), planners at all levels will be able to update their present population forecasts and, in turn, re-evaluate the adequacy of their comprehensive plans. In the meantime, the 1980 Census remains the best data base upon which to build population forecasts. Official, state-generated demographics data are derived from the 1980 census count and are updated periodically by means of sophisticated methodologies and inputs from federal, state, and local agencies. The state estimates and projections become, in turn, the best available data for the local planner's purposes, since they are the most current.

In order to accomplish meaningful and accurate population estimates and projections, the planner must choose the optimal methodology(ies) for his purposes and then obtain the appropriate data. The following sources are a recommended minimum set of reference materials. Also, see Figure 3 for a data reference.

1. U.S. Bureau of the Census: Publications include the decennial Census of Population and Census of Housing, as well as the annual County and City Data Book, Population Characteristics, Special Studies, Population Estimates and Projections, and others. Details on these volumes may be found in the Census Bureau's Catalog, which is published annually.

2. Bureau of Economic and Business Research (BEBR), University of Florida; Publications include the Florida Statistical Abstract (annual), Florida Estimates of Population (annual), Population Studies Bulletins (e.g., Projections of Florida population by county, 1985-2020, Bulletin No. 76, April 1986; Population estimates and projections by age and sex: Florida and its counties, 1985-2020, Bulletin No. 77, June, 1986; and Estimates and projections of the black population by age and sex: Florida and its counties, 1985-2020, Bulletin No. 78, July, 1986), etc.

3. State Data Center (SDC), Division of Planning and Budgeting, Office of the Governor. Specifically, see Book 2 of the Florida Consensus Estimating Conference, "Population and Demographic Forecast", Spring, 1985.

4. Local Data Sources: Virtually every local government unit maintains, or has direct access to, a data base on such subjects as school enrollment, birth and death registers; listings of telephone, water, and electricity customers; housing permit applications; vote registrations; etc. These data are excellent indicators of past and current trends, and provide vital inputs to forecasting formulas. The local planner can generally make a direct correlation between these symptomatic data and population growth rates.

Two recommended volumes for a more detailed understanding of demographic techniques and methodologies are <u>Projecting State and Local Populations</u> by Donald Pittenger, and <u>The Methods and Materials of Demography</u> by Henry Shryock and Jacob Siegal. An excellent monograph by Dr. Stanley Smith of the University of Florida,, entitled "Population Projections: What Do We Really Know?", is also recommended for its discussion of the methodologies in use today and their comparative forecasting accuracy.

ESTIMATION AND PROJECTION PROCESS

With respect to official state estimates and projections, county governments have much more data available to them than do cities. These are estimates and projections published annually for each county, forecasting fifteen years or more ahead. In addition, these data sources include cohort and component estimates, which are not available for cities until the next census count. Therefore, counties may use state-generated county data alone, if they choose to do so, and not be concerned with developing their own methodologies. Cities, on the other hand, are required to at least make population projections, since the only official state data available for their use is the annual estimate of total population. (Recall that these data are based on 1980 census counts and, in theory, have become less and less reliable each year since then, barring any special census counts. The 1990 census will once again update the data base and provide a new benchmark, but meanwhile we must either be content with using state data sources of develop our own.)

Once basic assumptions have been agreed upon, the process of developing population estimates and projections can begin with higher levels of confidence. Current estimates of population, as noted above, are computed annually for all Florida counties and cities by BEBR, and are the recommended data source. If local governments compute their own estimates, they must use a professionally accepted methodology and document this process in the comprehensive plan, in accordance with Rule 9J-5 requirements and guidance contained in this document. An accurate, well-founded estimate of current population characteristics will indicate the present status of the community and the needed thrust of the comprehensive plan elements. For example, if the population estimate demonstrates conclusively that recent growth has far exceeded earlier projections, then the government's capital improvements construction schedule, based on the earlier projections, would need to be immediately revised. Other planning goals and objectives would undoubtedly need revision, as well.

Population projections, which attempt to assess future growth levels, should then be developed. These figures will be essential in forecasting future demands for services and facilities, and, therefore, must be applied in a consistent manner in each of the plan's elements. Although perfect accuracy is a desirable goal, realistically we must be content with reasonably close approximations, which, as stated above, are based on our best analysis of current and emerging trends. Using the current estimate as the base population figure, county planners must choose between using official state-generated projections or developing their own. City planners do not have this option, but must select an appropriate methodology and make their own projections. The choice of methodology will be based on the level of complexity required of the projected data, the data-processing resources of the community, and the availability of skilled demographic analysts to perform the desired computations. Simple, relatively accurate, cost-effective methodologies and techniques, such as the extrapolation and ratio methods listed above, are available to the local planners, so only in rare cases would a local government need to employ a high level of sophistication in making population projections.

Timeframes for population estimates and projections should reflect the approximate adoption date of the comprehensive plan, which may be estimated from the scheduled submission date required by Rule 9J-12. Also, Rule 9J-5 requires that planning time frames of five years and ten years, minimum, from adoption date be used.

EXAMPLES OF METHODOLOGIES (RESIDENT POPULATION)

As indicated above, the two methodology categories recommended for local government use are mathematical extrapolation and ratio-based methods. We will show two examples for a theoretical county government and two for a theoretical city. We have prepared data sheets, one each for the state of Florida (actual figures), and hypothetical county, and the hypothetical city, which will be used in the computations shown in the examples.

1. COUNTY EXAMPLE

Our theoretical county has enjoyed a moderate to rapid rate of growth in recent decades. There is one dominant city and several smaller cities within the county, which have generally grown at the same rate over the years. There is a considerable amount of developable land remaining within the county, and none of the municipalities is limited by approaching build-out in the next 20-25 years. Employment opportunities are strong and tend to reflect statewide trends.

MATHEMATICAL EXTRAPOLATION. Looking at trend data for the county (Data Sheet 2), it appears that growth has been fairly consistent since 1960. A graph of the data (Figure 1) confirms that growth from 1970 through 1985 is virtually a linear trend, with a very slight upward movement indicated for the last several years. The technique of arithmetic extrapolation involves simply projecting this straight-line trend into the future. The assumption, of course, is that the trend will not change.

Our data sheet shows that total growth for the period 1980 through 1985 was 22,225, or an average of 4,445 for each of the five years. If we consider this the most reliable or indicative trend, we would add 4,445 to the 1985 estimate, and the same amount to each year's resultant total, for as many years as the projection is desired. The result would be:

1985 Est.	1990	1995	2000
143,345	165,570	187,795	210,020

These straight-line projections could very well represent the true county population growth trend. The underlying assumption, however, that growth will continue as in the past, is extremely risky, and it may be more reasonable to expect a shift in the trend as the county grows. Note that Figure 1 also contains a theoretical BEBR projection for the county, which forecasts a slow-down in historical growth patterns. The BEBR projection may turn out to be too conservative as a true indicator, but it probably is more realistic than a long-range arithmetic extrapolation. Another methodology, them, should perhaps be considered.

RATIO. Ratio methodologies are based on a comparison of the county's share of a parent population, in this case the state. Analysis of both state and county growth patterns shows a strong correlation between the two, although the county has grown at a slightly faster rate that the state (1981 and 1984 were recent exceptions). From this observation we can make several assumptions: a) that growth in state population will be proportionally reflected in the county, b) there is a strong probability that both state and county growth rates will diminish slightly in the next ten to fifteen years, and c) the county share of state growth can be measured from available data and projected forward to indicate further trends.

The formulas for this particular ratio are:

$$\text{Constant Ratio} = \frac{\text{County Growth 80-85}}{\text{State growth 80-85}}$$

and

$$\text{Constant Ratio X Projected State Growth} = \text{Projected County Growth}$$

Since the state grew by 1,351,350 from 1980 to 1985, and the county grew by 22,225, the ratio of county to state growth is .0145133. Multiplying this constant by the projected state growth figures gives the following county growth amounts:

	1985-90	1990-95	1995-00
State..........	1,249,953	1,134,900	1,007,010
County...........	18,141	16,471	14,616

Projections for the county then become:

1985 (Est)	1990	1995	2000
143,345	161,486	177,957	192,573

The ratio method has many variations. The direct ratio technique demonstrated above used non-symptomatic data and, hence, is quite simple to apply. The trends can be re-evaluated annually by using more current data, such as BEBR's current population estimate. Also, other time periods could have been substituted for, in this case, the 1980-85 data. Wherever a valid correlation exists between the county population growth and data from a larger population, a ratio can be formed and the constant applied to future projections for the county's share. Other variations (and acceptable methodologies) include apportionment, proration, ratio-correlation, density model methods, share of growth, and other techniques which relate one or more data series to population growth trends.

2. CITY EXAMPLES

The hypothetical city in our example is located in the county used for the previous example, and is the county seat. The city is located near several major thoroughfares, including an interstate highway and two state highways. Within a short distance, in neighboring counties, are two of the state's larger cities, which offer major employment, cultural, and educational facilities. Because of its proximity to these metropolitan areas, the city has experienced a sizeable spillover effect in economic growth and residential development.

MATHEMATICAL EXTRAPOLATION. Population growth in the city, as reflected in Data Sheet 3, has been rapid. Between 1980 and 1985, the rate of growth exceeded both the state and the county rates, through not excessively so. In addition, the city's rate of growth has been steadily increasing each decade since 1960, which means that the amount of increase each year will be greater than the previous year (much like compound interest). A logical projection methodology, then, would be a mathematical extrapolation using a geometric rate of increase (same percentage of growth each year).

The assumption is made that, due to prevailing conditions in the city, as well as in the county and state, sustained growth at the present levels will continue as in the past or will increase slightly. The rate of growth from 1980 to 1985 was 22.26%, an average of slightly more than 4% when compounded annually. To aid in our example, however, we will simply divide the 5-year rate by five, and use 4.45% as an annual rate to project through 1990. Using a geometric extrapolation technique, we can project the next year's amount of growth by multiplying current population by .0445. If we add the result to the 1985 total, the figure represents the 1986 projected population. Using the same procedure, we can successively project each year's population for as many years as desired. (Note: to save a mathematical step, we simply use 1.0445 as the multiplier. This eliminates the need to add the former population count to the amount of growth. The result will be the next year's total population, including last year's amount of growth.) For example:

37,196 X 1.0445 = 38,851 (1986 projected population)
38,851 X 1.0445 = 40,580 (1987 projected population)
40,580 X 1.0445 = 42,385 (1988 projected population)
42,385 X 1.0445 = 44,272 (1989 projected population)
44,272 X 1.0445 = 46,242 (1990 projected population)

To project population growth for 1995 and 2000, we have only to multiply the 1990 figures by 22.26% (the latest five-year growth rate), add the results to the 1990 base figure, and derive the 1995 projection, and so on. Or, to save a step as we did above, simply use 1.2226 as the multiplier. This results in the following:

46,242 X 1.2226 = 56,535 (1995 projected population)
56,535 X 1.2226 - 69,120 (2000 projected population)

The resultant figures, of course, would be slightly different in the extrapolation were made year-by-year, since the previous year's amount of growth would then become a part of the next multiplication step. In any event, the projection would resemble the curve depicted in Figure 2. Eventually, the rate of growth will have to diminish, and may even begin to decline, as the city reaches equilibrium. In our example, however, there are no significant limits to growth as the present time.

RATIO. In the county example, we used a ratio technique which made a correlation between statewide population growth and county growth. Using a similar technique for the city, we will form a ratio between county population totals (the "parent" population) and city totals, in order to project city population based on its share of the county population. In this example, however, we will use an apportionment technique, which takes into account the population shares of the other cities, within the county. The assumption is that historical proportions of the county population shared by the several cities and the unincorporated area is a trend which will continue for the forecast period.

Using historical data since 1960, we have developed a matrix of the county total, individual city totals, and unincorporated area total populations for selected time periods. Without getting overly complex, we can easily calculate shares of the county population for each of the cities and the unincorporated areas. The chart might look like this:

	1960	1970	1980	1985
COUNTY	63,566	87,843	121,120	143,345
CITY A	16,908 (26.6%)	21,864 (24.9%)	30,423 (25.1%)	37,196 (25.9%)
CITY B	5,447 (8.6%)	7,204 8.2%)	10,258 (8.8%)	13,347 (9.3%)

CITY C	4,290 (6.7%)	6,412 (7.3%)	8,656 (7.2%)	10,095 (7.1%)
CITY D	1,512 (2.4%)	1,687 (1.9%)	2,587 (2.1%)	2,752 (1.9%)
UNINCORPORATED	35,409 (55.7%)	50,681 (57.7%)	68,796 (56.8%)	79,955 (55.8%)

The data indicates that City A (our hypothetical example) has maintained roughly a 25 percent share of the total county population since 1960. After 1970, however, that proportion has shown a slight periodic increase, most recently climbing to 25.9% in 1985, according to the latest estimate. A conservative analysis would be that the proportion would remain at 25.9% through the year 2000, and using projected county totals from the County Data Sheet as the control figures, we can project the city population as follows:

	COUNTY POP.		CITY A RATIO		CITY A POP.
1990	161,486	X	.259	=	41,824
1995	177,957	X	.259	=	46,090
2000	192,573	X	.259	=	49,876

or, by estimating that City A's proportion will increase each five years, we could project as follows:

1990	161,486	X	.264	=	42,632
1995	177,957	X	.269	=	47,870
2000	192,573	X	.274	=	52,765

Comparing these projections to those derived by extrapolation, we can see that the apportionment technique yields significantly lower projection figures. This is due to our using the county projections, which are forecasted to begin a decrease in growth rate, as the parent population, and also to using a more-or-less stable city share of county population. If the planner's judgement and knowledge of local conditions convince him that the ratio-derived projections are much too low; another option would be to average the results of the extrapolation and the ratio methods. This is often a wise decision, as it tends to moderate the extremes and to compensate for invalid assumptions in one methodology which might tend to unrealistically portray the potential growth pattern. Figure 2 shows the results of the apportionment method, as well as the results of averaging.

CHOICE OF METHODOLOGY

The decision of whether to use one methodology over another will depend largely on past growth patterns in the community. From these patterns, which may range from consistent to erratic, the trend for the next several years can usually be envisioned. Unfortunately, there is no hard-and-fast rule for which methodology to choose in all situations, since the individual characteristics of the community, as well as the nature of its plan, will also determine the shape of future trends. In general, though, there are some conditions that normally favor the use of one methodology over another.

The following conditions, for example, are normally conducive to the use of an extrapolation methodology:

a) A consistent, long-term trend in the rate or amount of growth.
b) A discernible shift in the population growth trend in recent years, indicating a distinct new trend.
c) Conclusive indications of stability, such as zero natural increase and net migration.
d) Completed development of virtually all available land within the corporate boundaries.
e) Requirement exists for a short-range projection period only.

Use of a ratio methodology would be appropriate under the following conditions:

a) Similarity of growth rates between the county or city and the "parent" population (state or county).
b) Definite correlation between the rate or amount of population growth and locally-generated symptomatic data (e.g. housing permits, school enrollment, utility hookups, etc.).
c) Consistent apportionment of population percentages among cities and unincorporated areas.
d) Extensive, reliable data base of local information.
e) Requirement for short-range projection only.

When analyzing past trends, the planner is cautioned to discount "special events" that may have occurred during the period being analyzed. These special events may have been singularly responsible for a significant, one-time shift in growth trends and would, therefore, not be indicative of expected future growth patterns. An example would be a recent annexation, which may have boosted the city's population by 20%. This one-time jump in the growth rate would add significantly to the population base of the city, and the new population would be added to future estimates and projections. However, the 20% growth rate should be factored out when trying to establish growth rate figures for a past period during which the annexation took place. Other examples would be the closing of a local factory or military installation, which would tent to cause abnormal out-migration; or the construction of a new county prison, causing a large increase in institutional population.

EXAMPLES OF METHODOLOGIES (SEASONAL POPULATION)

This population category can have significant impact on local facilities and services, and must be taken into account in the planning process by those local planning agencies where seasonal visitors are a factor. Whatever figure is calculated for seasonal population should be addressed, in the appropriate element, to the projected resident population for an accurate forecast of total required services and facilities. Planning officials should describe in the comprehensive plan the methodology used to determine seasonal population figures, as required by Rule 9J-5, and should explain where seasonal figures have been applied in determining levels of service and needed facilities.

The definition of seasonal population in Chapter 9J-5 refers to "tourists, migrant farmworkers, and other short-term and long-term visitors". Generally, if a person is not a resident, he is considered to be a seasonal inhabitant. It may be useful to think of residents as those people who would be counted by the Census Bureau as full-time inhabitants of the state, the county, and the city being enumerated. (The Census Bureau considers anyone living in a locality for more than half the year to be a resident of that locality.) Seasonal population, then, would indicate those people whose permanent residence is elsewhere, i.e. in another country, state, county, or city. By the definition in Chapter 9J-5, a businessman from Tampa would be a "tourist" while attending a one-day conference in Jacksonville; a retired couple from out-of-state would be "tourists" while spending five months per year in a rented Florida apartment; a family from Leon County would be "tourists" in Orange County while visiting a theme park; and a sportsman from the Panhandle would be a "tourist" while on a fishing trip to Lake Okeechobee.

There are, as we can see, countless situations where the individual does not meet the criteria of a permanent resident and must be classified as a "tourist". Similarly, a "migrant farmworker" could be a resident of one Florida county, but would be a seasonal inhabitant in another county to which he travels to perform seasonal farm labor. He might, in fact, reside in several counties as a migrant worker during a given year. The planning process should somehow attempt to assess the burdens and benefits that accrue from seasonal inhabitants, even though defining the magnitude of the impact will be extremely difficult.

Much of the difficulty lies in the lack of statistical data, by county, relating to seasonal inhabitants. The several state agencies that have an interest in seasonal population (e.g. Dept. of Commerce, Dept. of Labor and Employment Security, Dept. of Agriculture, etc.) do keep data for their particular purposes, but not in a format that is directly useable by the local planner. Therefore, the Department will allow more latitude in judging the acceptability of whatever methodology is chosen for estimating and projecting seasonal populations.

Despite the difficulty in obtaining comprehensive seasonal data, there are several categories of statistics which can be manipulated successfully to produce approximate figures. The Census Bureau, for example, provides data for counties and most cities on "Vacant Seasonal and Migratory Units" for each census year, which enumerate houses, apartments, condominiums, etc., that are intended for seasonal occupancy or migrant labor. To this can be added the data on hotel, motel, and transient apartment units listed for each county from other sources, as well as campground space, mobile home parks, etc., that normally are intended for seasonal or temporary use.

With this information on total units available for seasonal visitors for each county, we can begin to adjust the figures for vacancy rates, monthly fluctuations in occupancy of these units, average number of visitors per units available, length of stay, etc. The goal of the effort is to estimate and project the "worst-case scenario" within the county's capacity to accommodate seasonal inhabitants is maximized. This saturation level of potential seasonal population would dictate required electrical, water, and sewer capacity; traffic circulation patterns, recreational space and facilities; police and fire protection; medical care facilities; etc.

Once again, historical trends in the community may be the best indicator of future levels of seasonal population. Current local data is usually available in varying degrees, which can be factored in to depict the actual seasonal situation. For example, hotel/motel occupancy rates may be available through the Chamber of Commerce; the County Extension Agent may have detailed data on migratory farmworkers within the county; the Board of Realtors can perhaps offer information on seasonal rental properties; the Park Superintendent may have statistics on campground usage; average length of stay, and periods of peak activity; and so forth. It may also be useful to conduct a local survey by sampling housing facilities where seasonal population usually resides. These can often be accomplished by random telephone questionnaires to hotel, motel, restaurants, realtors, etc. There will usually be some legwork involved collecting the necessary data, but the payoff will be significant.

In reality, there are many counties and cities within the state where seasonal population is not a factor, except possibly where passing tourists put extra strain on traffic circulation and road maintenance. However, seasonal inhabitants are a major influence in most of Florida's coastal counties and larger cities throughout the state. The 40 million or so annual visitors to Florida cannot be disregarded if comprehensive planning is to succeed in protecting natural resources, providing required infrastructure, and managing growth.

An example of projecting seasonal population would be as follows. Consider a coastal county with tourist-related facilities such as:

Hotel units	450
Motel units	3820
Rental condominiums	550
Transient apartment units	290
Rooming house units	155
Mobile home and RV park units	60
TOTAL UNITS	5325

Statewide statistics indicate that the average party of tourists consists of 1.7 persons if traveling by air, or 2.5 persons if traveling by automobile. Let us estimate that 65% of the tourists in this county arrive by automobile, which gives us an overall average of approximately 2.2 persons per party. By similar estimation, we can figure that this party will remain 13.5 days in the state, but it is difficult to say how long they would remain in the county.

If all tourist facilities were occupied at one time, there would be approximately (2.2 X 5325 =) 11,715 visitors in the county. At the peak tourist season, say April 1st, this could be the saturation level if facilities were occupied at 100% of capacity. Additional visitors can be accommodated if campgrounds are figured in, as well as private residences where family or friends might stay, and any other facilities that the planner estimates are available. Let us estimate an additional 2000 visitors for these situations, or a total of 13,715.

Let us also assume that the local Chamber of Commerce or Hotel Association keeps data on occupancy rates, which can be used by the planner as trend information. If the occupancy rates at tourist facilities for the last five years, as of April 1st, were 91%, 93%, 93%, 95%, and 98%, respectively, it should be an indication that seasonal population pressure is steadily increasing and threatens to reach saturation levels imminently. Does the city have sufficient wastewater treatment capacity to handle its residents' needs as well as 13,715 seasonal inhabitants? Should the city impost impact fees for new hotels and motels to pay for the projected cost in new required facilities? Are new streets and parking areas needed to handle the increased traffic demands during the tourist season? Issues such as these are vital aspects of comprehensive planning, and must be factored in to the community's planning goals, objectives, and policies. Failure to do so could have disastrous effects in terms of the government's ability to accommodate needed services and facilities.

Another segment of seasonal population is the migrant farmworker. Admittedly, reliable statistics are difficult to come by, but the Department of Labor and Employment Security published statewide data which may be used as a stepping-off point. For example, citrus, sugar cane, and tomato crops require the greatest percentage of migrant farmworkers, with citrus being the leader by far. Overall peak activity is roughly between October and March. Approximately two-thirds of all seasonal agricultural harvesting is done by local workers (who would pose no additional strain on services and facilities).

The remaining farmworkers, about one-third of the total, are classified as foreign, interstate, or intrastate. In any case, they require some form of residential facility while engaged in crop harvesting. In addition, many seasonal workers bring their families with them, including school-age children, but figures on average family size are not readily available. Although migrant farmworkers comprise a small percentage of total resident population, they should be addressed in the comprehensive plan wherever applicable. Two areas where their impact is especially heavy is in low-cost housing availability and educational facilities.

The best method of obtaining local data on migrant farmworkers is by some sort of survey procedure, preferably through the farm owners or managers who are known to hire seasonal workers, and through the local school board administration, where student registration can be sampled for helpful data on migrant parents. (Two notes of caution: Sampling techniques will probably not yield reliable data, regardless of methodology, due to a tendency on the part of some farmowners to underreport numbers of migrants. Secondly, schoolchildren may not statistically represent the migrant population, depending on the county. The planner should probably not assume, for instance, that numbers of foreign and interstate seasonal workers can be derived from surveying migrant schoolchildren, since these groups may not tend to bring their children with them. Intrastate workers, on the other hand, would be more likely to enroll their children in the local school.) Another option is to use the expertise of the County Extension Agent in estimating migrant workers. He can perhaps apportion statewide data to the county level based on his experience and familiarity with local agricultural conditions. Or, a variation of the housing unit method could be used. Within many counties, there are migrant labor camps, licensed by the Florida Department of Health and Rehabilitative Services, which are available for seasonal farmworkers. A survey of these facilities during harvest season may yield data which could be correlated with other data series.

Generally speaking, estimating and projecting migrant farmworker population is a difficult task. These techniques may only result in partial enumeration, but the effort will at least produce baseline data for the community. The planning effort will undoubtedly be enhanced by the inclusion of these data, as the local planner will be more cognizant of the impacts and requirements of the seasonal farmworker.

SUMMARY

These extrapolation and ratio-based methodologies may be varied in many ways to make use of any number of data bases. Their value is that they utilize readily available data sources and that the figures can be manipulated with even a desktop calculator. It should be evident, in addition, that extrapolations and ratios are ideal mechanisms for forecasting population segments, such as school-aged children, to determine particular community needs for the future. The examples are typical of the techniques used for the majority of local population forecasting exercises, and should be applicable to all of Florida's city and county governments. The Department recognizes, however, that there will be many variations of many methodologies used by the different planning agencies, as their situation and expertise dictate.

While this paper does not attempt to list specifically all acceptable methodologies, it nevertheless has outlined the generic types which are considered by demographic professionals to be most applicable and appropriate for local use. Techniques other than those mentioned herein may be approved by the Department, but the burden of proof must be on the local government to explain its chosen methodology. In this regard, the Department intends to take a liberal posture, so long as justification is adequate.

DATA SHEET 1: STATE

CENSUS DATA

Total population in 1960	4,951,560
Total population in 1970	6,791,418
Total population in 1980	9,747,197

ESTIMATES (B.E.B.R)

1981	10,105,950
1982	10,375,330
1983	10,591,700
1984	10,930,389
1985	11,278,547

PROJECTIONS (B.E.B.R)

1990	12,528,500
1995	13,663,400
2000	14,670,500

AMOUNT & RATE OF GROWTH	AMOUNT	RATE
1980-85 (EST.)	1,531,350	15.7%
1980-81	358,753	3.681%
1981-82	269,380	2.666%
1982-83	216,370	2.085%
1983-84	338,689	3.198%
1984-85	348,158	3.185%
Annual Average	306,270	3.14%
1985-90 (Proj.)	1,249,953	
1990-95 (Proj.)	1,134,900	
1995-00 (Proj.)	1,007,100	

DATA SHEET 2: COUNTY

CENSUS DATA

Total population in	1960	63,566
	1970	87,848
	1908	121,120

ESTIMATES (B.E.B.R)

1981	125,116
1982	129,357
1983	134,211
1984	137,818
1985	143,345

AMOUNT 7 RATE OF GROWTH	AMOUNT	RATE
1960-70	24,282	38.2%
1970-80	33,272	37.9%
1980-85	22,225	18.3%
1980-81	3,996	3.3%
1981-82	4,241	3.4%
1982-83	4,854	3.8%
1983-84	3,607	2.7%
1984-85	5,527	4.0%
Annual average	4,445	3.66%

DATA SHEET 3: CITY

CENSUS DATA

Total population in	1960	16,908
	1970	21,864
	1980	30,423

ESTIMATES (B.E.B.R)

1981	31,680
1982	33,088
1983	34,213
1984	35,547
1985	37,196

AMOUNT % RATE OF GROWTH	AMOUNT	RATE
1960-70	4,956	29.312%
1970-80	8,559	39.147%
1980-85	6,773	22.263%
1980-81	1,257	4.132%
1981-82	1,408	4.444%
1982-83	1,125	3.40%
1983-84	1,334	3.899%
1984-85	1,649	4.639%
Annual Average	1,355	4.45%

BIBLIOGRAPHY

Chapin, F. Stuart, Jr. and Edward J. Xaiser. 1979. Urban Land Use Planning. Urbana: University of Illinois Press.

Freund, John E. 1970. Statistics. Englewood Cliffs, NJ: Prentice-Hall.

Grauman, John V. 1963. "Population Estimates and Projections" in The Study of Population, ed. Philip M. Hauser and Otis Dudley Duncan. Chicago: University of Chicago Press.

Pittenger, Donald B. 1976. Projecting State and Local Populations. Cambridge, MA: Ballinger.

Shryick, Henry S.; Jacob S. Siegal; and Associates. 1971. The Methods and Materials of Demography. U.S. Bureau of the Census. Washington, DC: Government Printing Office.

Smith, Stanley K. 1984. Population Projections: What De We Really Know?. Gainesville, Fl: Bureau of Economic and Business Research.

Spiegelmen, Mortimer, 1968. Introduction to Demography. Cambridge, MA: Harvard University Press.

U.S. Bureau of the Census. 1982. Census of Population: 1980 General Population Characteristics, Florida. Washington, DC: Government Printing Office.

U.S. Bureau of the Census. 1977. Guide for Local Area Population Projections. Washington, DC: Government Printing Office.

FIGURE 1: COUNTY EXAMPLE

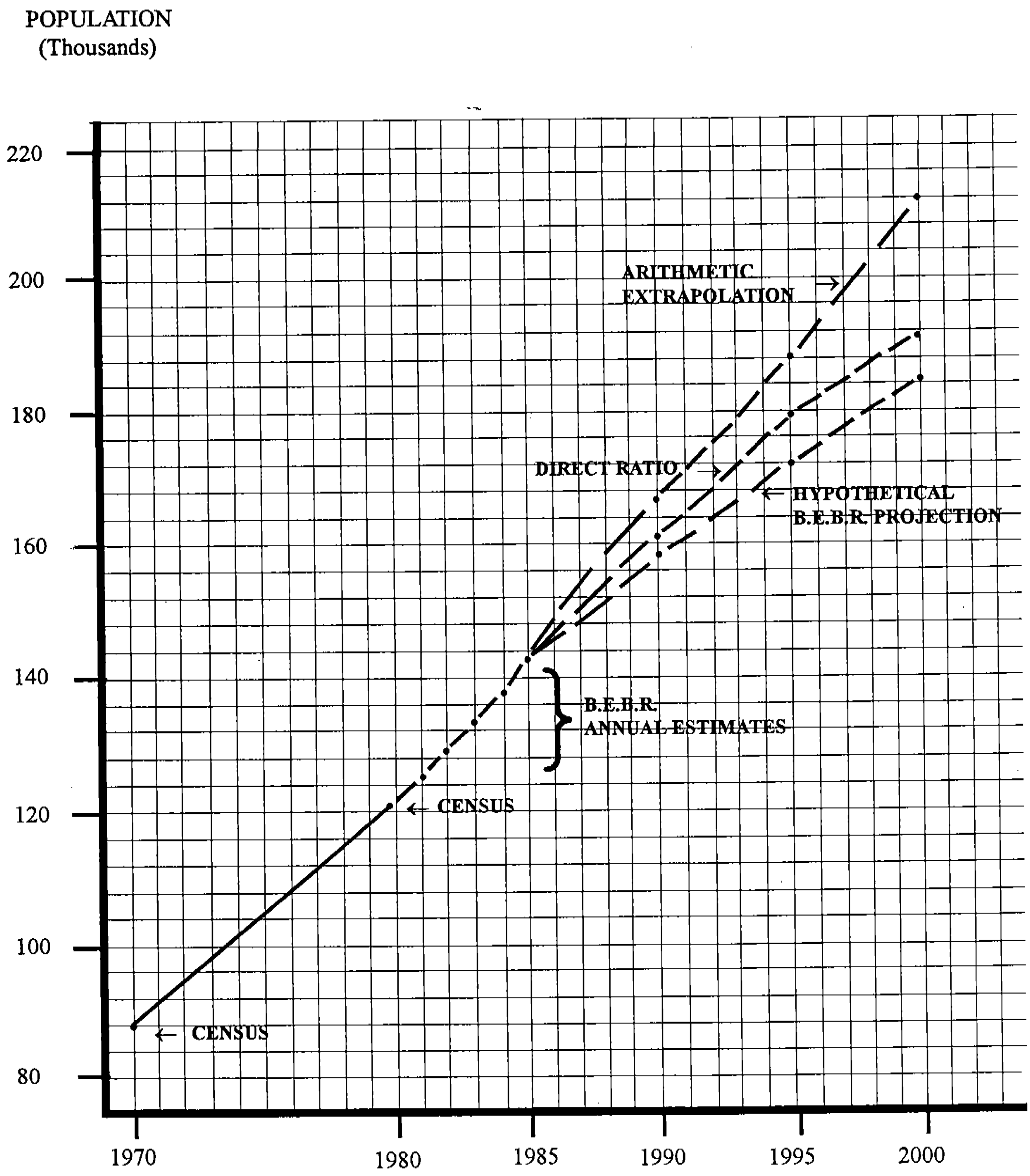

FIGURE 2: CITY EXAMPLE