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ABSTRACT

Presented is one of a series of reports introducing public agencies and other interested parties to the capabilities of policy analysis techniques. This publication focuses upon the role of population estimation and projection in regional analysis. The first section examines population estimation methods used by the U.S. Bureau of the Census and the California State Department of Finance, while the second section deals with age structure and its impact on demand for public services. The final section uses Santa Barbara County, California, as an example to illustrate how a local analyst can use a computer program to develop population forecasts and future age distributions. Included in the appendix is the entire computer program, written in FORTRAN IV. This tool can improve local population projections and may be used by local officials in making policy decisions. (Author/WB)

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POPULATION FORECASTING AND THE AGE-STRUCTURE: A SURVEY

John F. Jenkins-Stark

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POPULATION FORECASTING AND THE AGE-STRUCTURE: A SURVEY

by

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Urban Economics Program
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PREFACE

The Urban Economics Program at the University of California, Santa Barbara, was initiated in 1972 as a program of graduate studies in economics leading to the Master of Arts degree. This series of research reports is made possible with the support of the National Science Foundation Grant No. HES 75-10322.

Students in the program are trained in the latest economic concepts and techniques, with emphasis upon application to public policy analysis. These skills are made available to public agencies through student internships, formal Research Reports in Public Policy, and subsequent public employment.

The reports in this series are based upon research conducted by students, usually during the internship period. The purpose of this series is to introduce public agencies and other interested parties to the capabilities of policy analysis techniques. Any conclusions, recommendations or interpretations found in these reports are the responsibility of the authors and do not necessarily reflect the views of the National Science Foundation, the University of California, Santa Barbara, or the Urban Economics Program.

Robert T. Deacon
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ABSTRACT

Population estimation and projection are important aspects of regional analysis. To aid local analysts in understanding and using population figures, Section 1 of this paper presents currently used population estimation and projection methodology. An understanding of this methodology enables the analyst to improve specific population estimates.

Section 2 presents an often overlooked component of population analysis: the age-structure. This section offers examples where analysis of the population's age-structure can provide significant insight into the impacts of public policy decisions.

Finally, Section 3 explains the operation of a computer program written in Fortran IV which can enable the local analyst to develop his own population forecasts and future age distributions. Using Santa Barbara County as a case study, the reader is shown the important improvements in population projections which the local analyst and this program can produce over those provided by a higher governmental unit.

CONTENTS

INTRODUCTION

The population of a given geographical or political unit plays an important role in regional analysis and consequently in regional or local decision making. The absolute level, the rate of change, or the socio-economic characteristics of a given population quite often provide the impetus for action on the part of local governments. A brief reflection on the concept of population, and its above mentioned aspects, reveals numerous examples of projects or programs which are started, continued, expanded, or stopped predicated on present or anticipated population levels. For example, a local police department may request additional uniformed officers based on current or anticipated levels of population. Projected population increases may provide the justification for immediate investment in some form of mass transit.

From these examples, it is apparent that population plays an integral role in local or regional decision making. Often, local officials are not, nor do they pretend to be, trained demographers. These individuals depend upon some higher governmental unit for both present and future estimates of population levels and of population characteristics. Widespread acceptance of these estimates, either due to lack of knowledge about the subject or due to lack of analytical tools or effort, can create significant problems in terms of regional or local investment-planning decisions.

This paper consists of 3 basic sections. The first examines and explains the methods by which the two major sources of population figures for areas within the State of California, the United States Census Bureau and the State Department of Finance, derive post-censual and future population estimates. In addition, problems associated with the methods currently used are mentioned, enabling the reader to critically analyze specific uses of population estimates for those areas of interest to the local analyst.

The second section reviews a specific aspect of population figures often overlooked by the regional analyst - the present or future age structure of the general population. In conjunction with population projections, the age structure of the population can have significant implications for potential project or program decisions. With population estimation, population projection, and age structure in mind, specific cases are examined. Hopefully, insight gained in such examination can be applied to other regional decisions.

The third section combines the knowledge, methods, and techniques mentioned in sections 1 and 2 with a computer program for population projection. Using Santa Barbara County as a case study, the reader is shown, step by step, procedures by which the local analyst may develop his own population projections and the potential improvement these estimates may provide over those of higher governmental agencies.

At this point, a reminder is appropriate. Local policy decisions can be analyzed from a variety of perspectives using an assortment of tools. The purpose of this paper is not to conduct a total analysis of a specific local policy decision. Rather, an attempt is made to inform the reader of current population estimation and projection procedure, to examine the contribution a knowledge of a population's age structure can make to understanding the impact of a local problem or program, and to provide a tool with which the local analyst can perform his/her own accurate population and age distribution projections. As population is such an important aspect of local decision making, a thorough knowledge of the topics mentioned in this paper may be of invaluable assistance to local officials.

Section I

POPULATION ESTIMATION AND PROJECTION: UNITED STATES

At the national level, the U.S. Census Bureau produces three basic population estimates. The first, often referred to as the intra-censual estimate, attempts to compute population figures for each of the nine years prior to the latest decennial census. Such estimates are relatively unimportant to the local analyst and therefore are not discussed. With the post-censual estimate, the Census Bureau attempts to estimate the current population of the entire country and its various subregions. In many ways, the methods employed in these estimates are similar to those used by the State of California for local population estimation. Therefore, a closer look at this methodology is reserved for a later section. Finally, the Census Bureau provides population projections for the country and its subregions. Often, these projections are highly tenuous and their uncertainty is clearly stated in all Census Bureau publications.

Ultimately, the population projection procedure used by the U.S. Census Bureau plays an important role in local population estimation and projection. Therefore, a knowledge and understanding of that methodology could potentially provide the reader with the ability to critically analyze and evaluate estimates or projections of particular interest.

The U.S. Census Bureau uses the cohort-component method of population projection whereby each of the components of population change (fertility, mortality, and migration) are projected separately.* Initially,

*See U.S. Bureau of the Census, Current Population Reports, Series P-25 No. 601, "Projections of the Population of the United States: 1975 to 2050", U.S. Government Printing Office, Washington, D.C., 1974.

the projection utilizes estimates of the total population, including Armed Forces overseas, by sex, race, and single years of age on a specified base date. Each estimate is carried forward by age each year through the use of appropriate fertility, survival, and immigration rates. The base date population is updated periodically to provide more accurate projections.

Mortality projections used in the most recent census projection were prepared by the Office of the Actuary of the Social Security Administration (SSA). These mortality projections are based on an analysis of mortality trends and prospects by age, sex, and cause of death, but not by race. Only one set of mortality projections is used for all population projection series.

All population projection series except one assume a net immigration of 400,000 legal aliens per year. Because this level is determined by legislation, a significant increase or decrease may occur at any time. However, a sizeable change (e.g., an increase or decrease of 25%) would have a relatively small effect on future population. The assumed distribution of this immigration by age, sex, and race is based on recent trends.

Since mortality rates and annual immigration are expected to remain relatively constant, the most important component of population change is expected fertility. Fertility projections consist of three parts: cohort fertility rates, the timing pattern of fertility, and the period fertility rates. The ultimate cohort fertility rate is the average number of children born to a cohort of 1,000 women upon completion of childbearing. This ultimate rate reflects the level to be attained by cohorts of women who have not yet entered the childbearing ages. For cohorts of women now in the childbearing ages, projected fertility rates are consistent with the ultimate rates, but also are affected by the actual experience of the cohorts to date.

A single timing pattern of fertility is used for all projection series. An ultimate mean age of childbearing is assumed and a timing pattern of fertility calculated based on experimentation with various assumptions about marriage patterns, birth intervals, and parity distributions.* Generally, the mean age is selected on the basis of " . . . appearing at this time to be a reasonable choice."[1] The selection of one timing pattern for all three series reflects the fact that there seems to be no obvious relationship between the level of fertility and the mean age of childbearing.

The actual computation of projected births by year requires the knowledge of current or period fertility rates (also referred to as age-specific birth rates). For those cohorts not yet within the childbearing years, the procedure for determining age-specific birth rates is relatively simple. The previously determined ultimate fertility rate and the timing pattern of fertility are used to calculate the number of births each year from a cohort of 1,000 women as they pass through the childbearing ages. Upon completion of childbearing, a cohort of 1,000 women would have produced the number of births indicated by the ultimate fertility assumption. For the cohorts already in the childbearing ages, their most recent age-specific birth rate and the cumulative fertility of each cohort to date must be considered in projecting future births. These projections are then adjusted so that the observed and projected rates add to the ultimate cohort fertility rate set previously.

*Parity is the number of children ever born to a woman.

Table 1 shows the estimates of fertility rates for 1973 and projections of ultimate fertility rates by age. This table is the end result of the procedure outlined above. For example, the series I projection assumes an ultimate fertility rate of 2,700 births per 1,000 wo by the end of their childbearing careers. This assumption, together with a projected pattern of fertility (mean age 26 years) is used to calculate age-specific birth rates for the years 14 to 49. For every 1,000 women aged 24, the series I projection expects almost 218 births. Series III, on the other hand, assumes that ultimately there will be 1,700 births per 1,000 women and age-specific births at age 24 of 137 per 1,000 women.

Population projections are always technically correct because they indicate the population that would result if the underlying assumptions turn out to be correct. Therefore, a choice among alternative projections hinges upon an evaluation of the assumptions. If these assumptions could be determined in some quantitative manner, a statistical confidence interval may be established around each population projection. As the factors influencing population trends are not perfectly predictable, any indication of accuracy concerning a population projection is purely an individual or collective judgment.

Unfortunately, the Bureau of the Census suffers one of the problems of any large public bureaucracy, time lag. The initial lag occurs in the gathering of information and the dissemination of results. The most recent period fertility rates and age-specific birth rates are important factors in choosing the appropriate projection pattern. Yet, as late as October, 1975 the most recent figures available were for 1973 and these

TABLE 2.1 [1]

UNITED STATES AGE-SPECIFIC FERTILITY RATES

Age	1973[1] All races	1973[1] White	1973[1] Negro	1973[1] Other races	Ultimate Series I	Ultimate Series II	Ultimate Series III
Total	1,868.6	1,767.2	2,384.5	2,876.5	2,700.0	2,100.0	1,700.0
14 years	5.9	2.7	24.8	5.5	1.8	1.4	1.1
15 years	16.3	9.9	55.5	15.0	8.5	6.6	5.3
16 years	37.7	27.3	100.9	42.5	25.6	19.9	16.1
17 years	62.5	50.0	137.8	75.7	55.2	42.9	34.7
18 years	85.0	71.7	165.5	111.3	89.1	69.3	56.1
19 years	101.5	89.5	174.8	134.4	117.8	91.6	74.2
20 years	108.9	98.8	170.2	151.9	143.7	111.8	90.5
21 years	114.2	106.4	159.7	165.7	167.8	130.5	105.6
22 years	121.2	116.0	148.5	175.6	190.3	148.0	119.8
23 years	126.8	124.2	137.2	182.7	208.3	162.0	131.1
24 years	129.0	127.8	129.9	186.3	217.8	169.5	137.1
25 years	128.4	128.4	120.8	186.3	215.5	167.6	135.7
26 years	120.9	121.5	107.5	184.6	207.9	161.7	130.9
27 years	111.1	111.6	97.7	177.4	191.3	148.8	120.5
28 years	98.6	98.3	90.5	165.4	172.3	134.0	108.5
29 years	88.0	87.6	81.7	149.8	148.5	115.5	93.5
30 years	74.7	74.0	71.6	132.9	122.3	95.1	77.0
31 years	61.6	60.3	62.3	115.3	97.7	76.0	61.5
32 years	53.0	51.6	56.1	99.3	75.7	58.9	47.7
33 years	44.4	42.7	49.8	85.4	57.7	44.9	36.3
34 years	37.8	36.1	44.6	73.7	44.5	34.6	28.0
35 years	30.8	29.0	39.6	61.5	34.3	26.7	21.6
36 years	26.7	25.0	35.0	49.3	27.0	21.0	17.0
37 years	22.4	20.9	30.3	39.0	21.6	16.8	13.6
38 years	17.8	16.5	25.2	30.6	17.0	13.2	10.7
39 years	13.8	12.7	20.1	24.2	13.1	10.2	8.3
40 years	10.4	9.3	16.5	18.4	9.8	7.6	6.2
41 years	7.3	6.7	10.8	13.5	6.8	5.3	4.3
42 years	5.2	4.8	7.8	9.5	4.6	3.6	2.9
43 years	3.1	2.7	5.2	6.4	3.0	2.3	1.9
44 years	1.8	1.6	3.1	3.8	1.7	1.3	1.1
45 years	1.0	0.9	1.7	2.2	0.9	0.7	0.6
46 years	0.5	0.4	1.0	1.1	0.5	0.4	0.3
47 years	0.2	0.2	0.5	0.5	0.3	0.2	0.2
48 years	0.1	0.1	0.2	0.3	0.1	0.1	0.1
49 years	0.0	0.0	0.1	0.1	0.0	0.0	0.0
Mean age of childbearing	25.80	26.03	24.65	26.56	26.00	26.05	26.00
Median age of childbearing	25.20	25.46	23.40	26.03	25.58	25.58	25.58

[1]Rates for 1973 are based on provisional data on total births and 1970 to 1972 trends by age and race.

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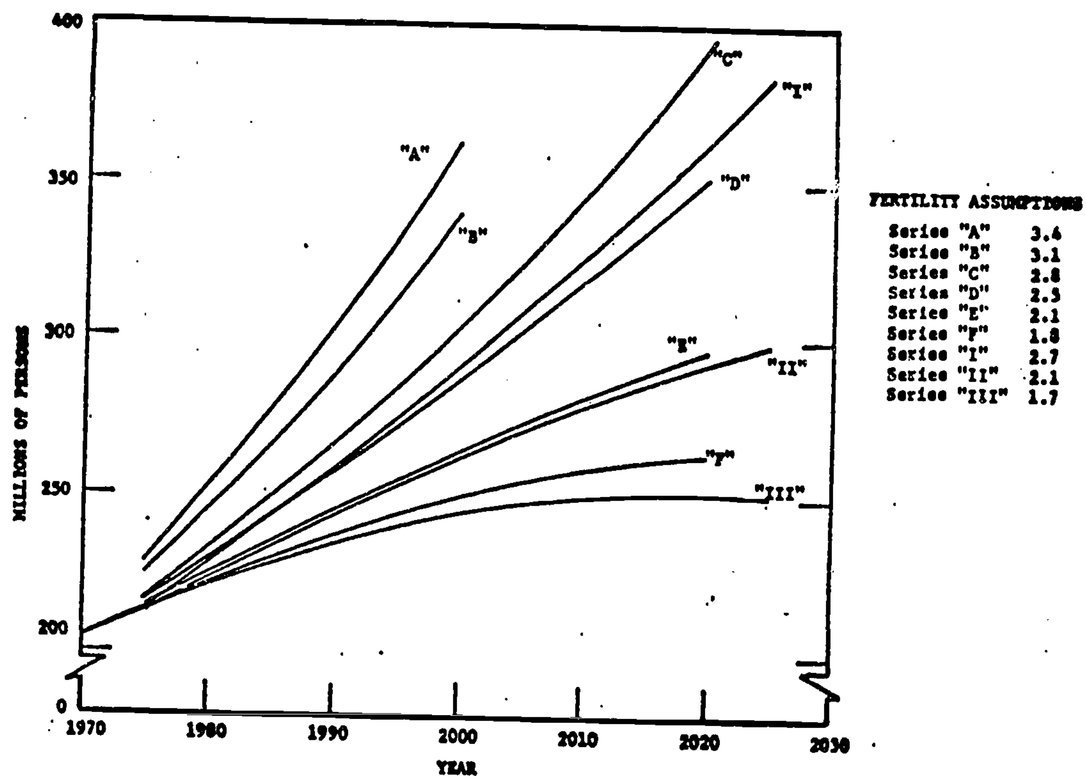
figures were based on provisional data. Such lags may conceal important changes from decision makers. Perhaps the most profound lag in recent years on the part of the Census Bureau has concerned the adoption of alternative fertility assumptions for its series of popultaion projections. At this point, some historical background is in order.

During the past two decades, four main projection series were developed, reflecting different future fertility assumptions. Beginning in 1964, the cohort-component method of population projection was adopted and the four projection series were labeled alphabetically. The first four alphabetical projection series, labeled A, B, C, and D, were published in 1965 and they represented ultimate fertility assumptions of 3.4, 3.1, 2.8, and 2.5, respectively. In 1970, the Series A projection was dropped as unrealistically high and Series E (2.1) was added to represent the lower bound. Again in 1972 a change was made as Series B was dropped as the high bound and a Series F (1.8) was added. Each addition of a lower bound reflected an update in the population base and reflected the prevailing ultimate fertility patterns.

In 1975, the alphabetical projection series was eliminated and three (Roman) numerical series substituted, I, II, and III. All three series start with the estimated population as of July 1, 1974. Although these revised projections utilize lower mortality projections and a revised age structure of immigrants, the significant differences with the alphabetical series are the fertility assumptions. The ultimate levels of cohort fertility are as follows: Series I - 2.7, Series II - 2.1, and Series III - 1.7. The switch to the new series of three alternatives is thought to ". . . better serve the needs of users." [2] (A statement which will be examined in more detail later.)

FIGURE 1

ALTERNATIVE CENSUS BUREAU PROJECTIONS FOR THE UNITED STATES

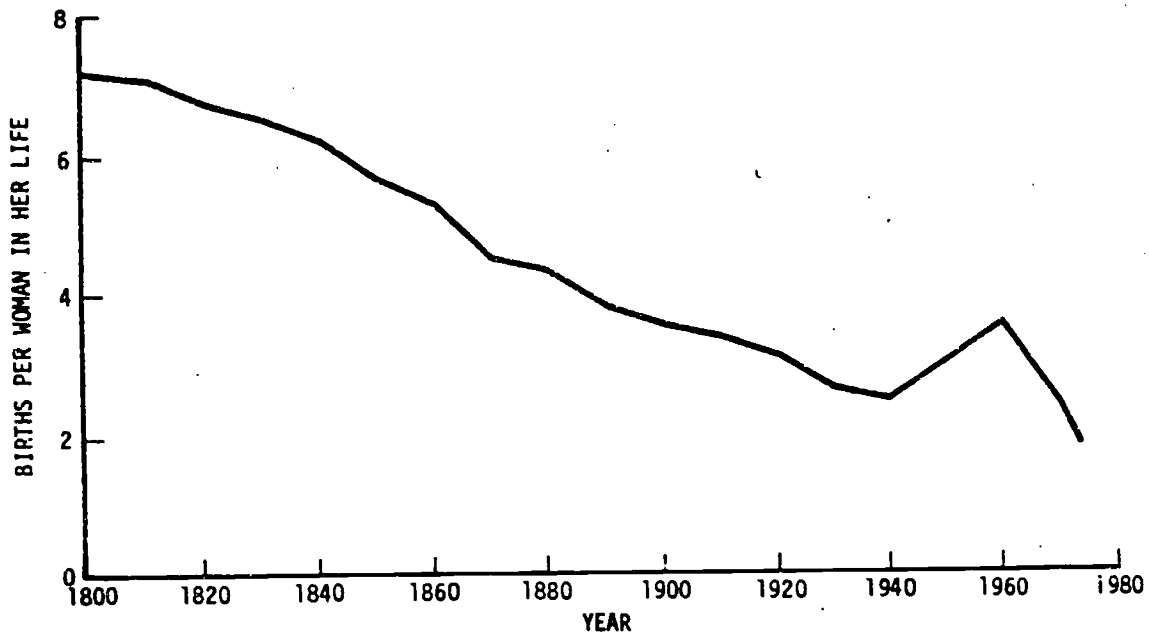


Source: H. Fox, A Look at Population Growth Projections for the United States and the State of California, General Research Corp. 1975. Calif. State Dept. of Finance Report, June, 1974.

The reluctance to adopt lower fertility assumptions neglected important historical trends. In 1972, the Bureau of the Census referred to its latest lower bound projection, Series F (1.8) with the disclaimer: "The choice of a fertility level for Series F is entirely arbitrary as there is no precedent in American demographic history on which to assign such a low level."[3] Below is a figure representing the period fertility rates from 1800 to the present. Although extrapolation is always tenuous, the historical trend is definitely down.*

FIGURE 2

UNITED STATES CURRENT FERTILITY RATES



Source: H. Fox. Population Forecatst and their Implications for Public Policy, General Research Corp. 1974.

In order to determine which of the alternative assumptions will serve as an official baseline, the most recent fertility trends are examined and periodic surveys are conducted in an attempt to discover the fertility expectations of American women. The current fertility rate in 1973 was 1.87 births per woman vs. 3.33 in 1967.[4] A continuing drift downward in fertility rates is further documented by the most recent population survey. Conducted in June of 1974, this survey shows that American women under 30 years of age are increasingly favoring the two child family. A portion of the results, shown below in Table 2 reveals

*For additional discussion concerning the economic determinants of fertility levels, see Journal of Political Economy, supplement 81, No. 2, March/April 1973.

that almost 73% of all married women 18 to 24 years of age expect to have fewer than three children. Compare this figure with the 1967 survey result of only 44.5% with such a preference.

TABLE 2

TOTAL LIFETIME BIRTHS EXPECTED FOR REPORTING WIVES 18 TO 24 YEARS OLD

Survey date, age, and race	Wives reporting birth expectations		Total lifetime births expected			
	Number	Percent	0 or 1	2	3	4 or more
18 TO 24 YEARS OLD						
1974, all races.....	5,053	100.0	17.0	55.7	19.4	7.8
White............	4,551	100.0	16.4	57.1	19.1	7.4
Negro............	424	100.0	25.9	42.0	20.8	11.3
1971, all races.....	4,987	100.0	12.4	51.6	23.7	12.3
White............	4,523	100.0	12.3	52.6	23.8	11.4
Negro............	427	100.0	13.8	41.8	21.1	23.2
1967, all races.....	4,161	100.0	7.4	37.1	29.8	25.7
White............	3,798	100.0	7.0	37.5	29.6	25.9
Negro............	342	100.0	10.6	33.1	32.0	24.3

Source: U.S. Bureau of the Census, Current Population Reports, Series P-20 No. 277. 1975.

The age at first marriage is a further influence to be considered when choosing the appropriate fertility assumption. Census and survey data show that an inverse relationship seems to exist between the age at first marriage and the level of cohort fertility. Evidently, for a given cohort of women, an increase of one year in age at first marriage corresponds to a decrease of .1 in the fertility rate.[5] Therefore, trends in recent marital patterns can have an important impact on future fertility rates and for that reason, must be taken into consideration.

Due to recent circumstances, the Census Bureau has opted for the Series II projection with an ultimate fertility rate at the replacement level of 2.1 and a cohort fertility around replacement level commencing with women presently in the young childbearing ages. The Series I and

Series III assumptions attempt to provide ". . . a one-child range that at this time appears likely to include future trends and fluctuations in fertility."[6] However, the Series I assumption (2.7) was set higher above the Series II assumption than the Series I (1.7) was set below Series II. The Census Bureau justifies this arrangement with the idea that for fertility to drop much below 2.0 births per woman, ". . . there would have to be a change in the prevailing social norm which favors at least two children per family and/or in the social and economic factors determining adherence to this norm."[7]

As alluded to previously, there may have been another reason, other than simply updating the data, for the Census Bureau to drop its four alphabetical projection series in favor of the three Roman numerical series. As mentioned, the most recent four alphabetical series, labeled C,D,E, and F, represented fertility assumptions of 2.8, 2.5, 2.1, and 1.8. To correctly analyze suggested programs or projects at the national level, one must make inferences about future population. For such information, the analyst would turn to the Census Bureau. Hesitant to choose either of the extreme estimates, Series C or Series F, inevitably the choice revolved around Series D or E. Due to experience in the fifties and sixties of population under-estimation, the chosen projection series was often Series D. Using the same 1972 base population, the choice of Series D over Series E would yield a 1990 U.S. population estimate larger by approximately 20 million people.[8] Keep in mind, the prevailing fertility rate in 1972 was approaching Series F.

The recent adoption of the numerical series of population projections appears to be an attempt to eliminate the above mentioned problem. By developing only 3 projections, the Census Bureau, in effect, forces the analyst to choose the middle one, Series II. Although the fertility assumption behind the Series II projection (2.1) is above that which currently prevails, it does form the basis for the Census Bureau's baseline projection based on a variety of surveys and studies. Undoubtedly, the three projections are a vast improvement over those which previously prevailed.

At this point, a brief review might be appropriate. The methods by which the Census Bureau derives its population projections and estimates has been explained. Although a number of components form each projection, by far the most important component of national projections is the ultimate fertility rate assumption. This rate reflects the expected number of births for each woman who is now beginning her child-bearing years. Recently, the Census Bureau has switched from four alphabetical projection series to three numerical series. This new group of projections, Series I, II, and III reflects ultimate fertility assumptions of 2.7, 2.1, and 1.7 respectively. That is, Series I assumes each woman will bear an average of 2.7 children as she progresses through the child-bearing years. A thorough understanding of the projection methodology is important before examining those projections and estimates developed by the California State Department of Finance.

Population Estimation and Projection: California

The State of California also utilizes a cohort-component method of population forecasting. However, because California is an open region, the more important problems are the estimation of the base data population and the estimation of future in-migration. The State publishes base population figures for each county using a combination of three methods. The "ratio correlation method" uses a regression equation to estimate the civilian population, including migration, for a given date. The independent variables used in the estimation procedure are: (A) net natural increase, (B) elementary school enrollment, (C) automobile registration, and (D) voter registration. The current (1975) equation for California is:

$$\text{Population} = .0453 + .1988\,(A) + .1404\,(B) + .2210\,(C) + .3906\,(D)$$

where A, B, C, D refer to the variables described above.[9]

The "component method II" uses vital statistics to measure natural increase and school enrollment to measure net migration. Because this method is specific to the civilian population under age 65, Medicare statistics are used to estimate the 65 and over population and military station statistics are used to estimate the military population.

The third and final method is referred to as the "driver license address change composite migration estimating method." Initially, the survived cohort of the civilian population under 65 years is calculated. A variation of the component method estimates migration of the population under 18. Drivers license address changes estimate migration of the population 18 to 64 years of age. In the latter case, the 1970 relationship of population to driver licenses is used in the estimation procedure. Added to this number are estimates of immigration from abroad, military station strength, and an estimate of the population 65 and over based on Medicare statistics. Where available, recent county special census data are incorporated.

Generally, the individual county figures are a simple average of the above three methods, adjusted for changes in the institutional population and controlled to a state total. Until recently, the state total was consistent with that published by the Bureau of Census.*

*The State has yet (1976) to adopt the three numerical projection series computed by the U.S. Bureau of the Census.

As mentioned, the State, analogous to the Bureau of the Census, uses the cohort-component method of population projection. Although the estimation procedures are similar for the fertility and mortality components, significant differences occur with the migration component. In- and out-migration for a state is extremely difficult to measure. For base population figures, there is no alternative to the use of symptomatic indicators as described above. Estimation of future net migration may be the most critical variable in the projection calculation and yet the most difficult to estimate. Based on the indicators mentioned above, net migration has varied considerably over time from a high of 357,000 in 1963 to about 16,000 in 1970. [10]

Once an estimate of state-wide net migration is made, future levels of net migration by county are established by allocation. These allocations are prepared in consultation with local planners and with state and federal analysts concerned with water, land, transportation, and environmental questions.* The allocation schemes are also based upon current and immediate past experience.

Using the nomenclature formerly employed by the U.S. Bureau of the Census, California has chosen three alternative projection series C, D, and E corresponding to fertility assumptions of 2.8, 2.5, and 2.1 respectively. The baseline projection, labeled D-100, refers to a fertility assumption of 2.5 and a net migration factor of 100,000 per year. According to the State, Series E and Series C represent ". . . two plausible but different future courses, one higher, one lower."[11] Furthermore, the State recognizes that currently each county has a different fertility pattern and therefore, age specific birth rates for

*Because a total migration figure for the State is chosen first, regions may be allocated migration based on the total figure rather than on region-specific information.

each county are developed and compared with those for the State. The projection procedure then allows any differences to diminish gradually and vanish by the year 2010.

TABLE 3

STATE OF CALIFORNIA PROJECTION SERIES

Title	Fertility Assumption	Net-Migration Assumption
Series C-150	2.8	150,000/year
Series D-150	2.5	150,000/year
Series D-100	2.5	100,000/year
Series E-0	2.1	0/year

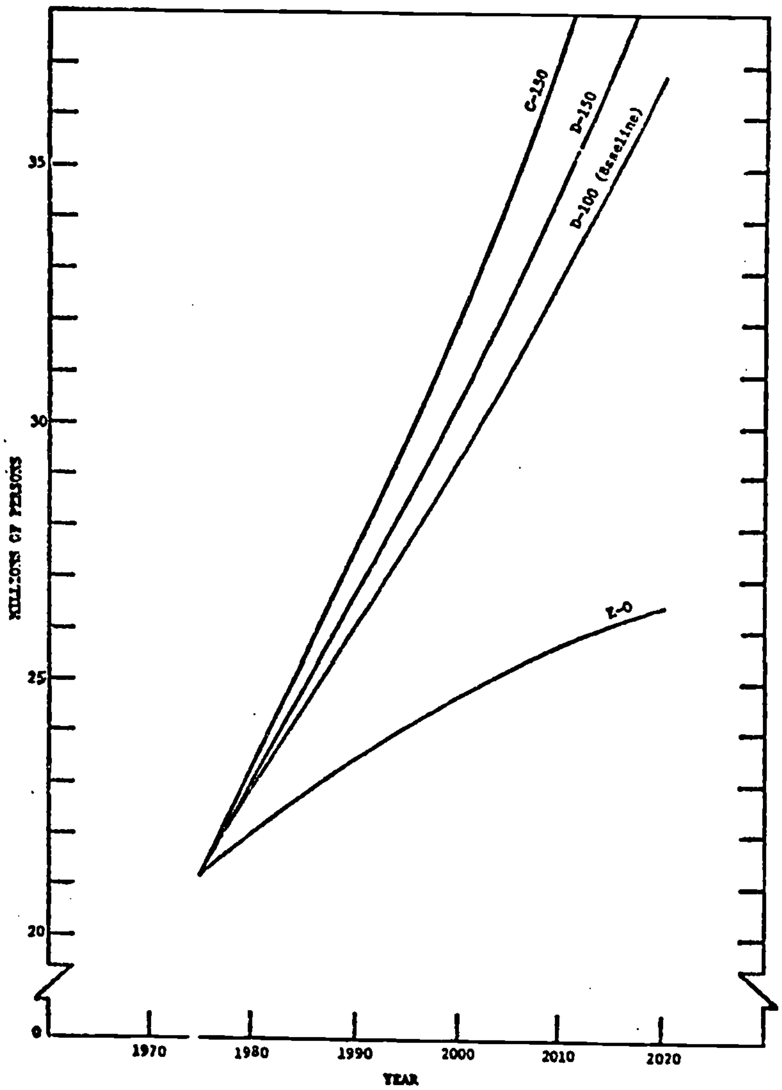
Table 3 lists each of the State's published projections and the respective fertility and migration assumptions.

As mentioned, the State has chosen Series D-100 as its baseline projection. From the previous discussion, the reader recognizes that this choice reflects the belief that each woman now entering her child-bearing years will produce an average of 2.5 children. In addition, the projection also assumes an annual net in-migration of approximately 100,000 per year allocated as previously described.

The State publishes these projections to the year 2020 for each County. Often, investment-planning decisions are based on these estimates, and for this reason they are important to the local analyst. Because population forecasting is a difficult and time consuming process, the analyst generally turns to the State for guidance. As revealed above, the analyst is presented with four projections of which Series D-100 is termed the baseline projection. A blind acceptance of these figures may lead to incorrect conclusions.

FIGURE 3

ALTERNATIVE POPULATION PROJECTIONS: CALIFORNIA



Source: H. Fox. A Look at Population Growth Projections for the United States and the State of California, General Research Corp., 1975. Calif. State Dept. of Finance Report, June, 1974.

As mentioned, the State uses a combination of three methods for current population estimation. Unfortuantely, each of these methods utilize variables which may be subject to considerable change over time. For instance, the Ratio Correlation method is based upon an observed relationship for the 1960-70 decade. Due to the changing age mix of the population, a point to be examined in Section 3, three of the four independent variables and their respective relationship to total population are altered by time. For example, elementary school enrollment, one of the variables, has decreased considerably in the last five years although there has been an increase in total population. Obviously, its usefulness as a population indicator has diminished substantially.

Similarly, the third estimating method, which involves driver license address changes, has lost much of its usefulness with the passage of time. This method estimates the number of migrants to an area from driver license address changes ". . . by using the 1970 relationship of population to drivers licenses for the ages 18 to 64 years."[12] In Section 2 the reason why using such a relationship may lead to erroneous results is examined.

Although not used directly by the State, a method frequently used by local agencies concerns estimated household size. Total population is estimated by multiplying the number of housing units by a factor for household size. To this total is added the number of individuals living living in group quarters. Generally, the household size factor is determined from the most recent census.

Unfortunately, the household size factor does not remain constant over time. Since 1970, there has been a dramatic decrease in the average number of people per household. For those agencies using this method, the decrease has led to substantial over-estimates of actual population. For example, Ventura County routinely estimated its July 1974 population at approximately 447,000. A special census conducted 6 months later revealed a true figure 15,000 short of the previous estimate. The difference is almost wholly accounted for by the mistaken use of past household size figures.

> On the average, 3.36 persons lived in each household in 1970. In 1975 the size of the average household is down to 3.0. This dramatic decline in household size had not been accounted for in earlier estimates. As a result, with the addition of each new dwelling, the population was estimated at a higher amount than would actually live at that residence.[13]

A brief examination of this figure's substantial change in recent years would reveal the invalidity of using an outdated household size figure.

Utilizing the knowledge gained from the discussion of the Census Bureau's methodology, one can immediately see problems associated with the State's baseline fertility assumption. There would have to be a massive change in the current values and practices of American women in order to achieve Series D-100's fertility level. All surveys indicate that neither is such a change taking place, nor can we expect such a change in the immediate future.[14] The State replies with the following statement:

> The completed fertility level of those still in the child-bearing period is, of course, unknown but there is yet ample time for a lifetime average of 2.5 or more for women. . . The increase in the crude birth rate from 14.4 per thousand in fiscal year 1974 to 14.9 in fiscal year 1975 may foreshadow this.[15]

Generally, the longer a woman postpones child-bearing the fewer children are produced. The State ignores this fact and relies on an increase in the crude birth rate to prove its point. Undoubtedly, the referenced increase is due to a change in the age-structure rather than a change in the attitudes concerning larger families.

The State's assumptions concerning net in-migration are difficult to question. As annual legal net immigration to the whole country has generally hovered near the limit of 400,000, one might genuinely expect 10% of that number to come to California each year. The State's allocation of this migration factor to each county is difficult to derive and therefore difficult to critically analyze. Even if the allocation procedure was obvious, no proven method of estimating future migration has been developed. Often, unless the migration component is obviously erroneous, the local analyst has no recourse but to accept the State's figures.

Improving Population Estimates and Projections

This section is not meant to provide sophisticated alternative techniques of population estimation or projection. If such techniques could be developed, local analysts have neither the time nor the resources to compute their own figures. However, with a thorough understanding of the methodology utilized by the State and Federal government, the analyst can make important alterations in the figures received from those sources. By including information from other sources and with the aid of the population projection program developed later, the analyst can quickly and easily derive population figures that may be more accurate for the smaller region.

There are a variety of sources from which information may be gathered. This information may be divided into two categories; that which applies to current population estimates and that which applies to population projections. Perhaps the foremost source for both types of information is the Census Bureau. This agency publishes a series of papers titled "Current Population Reports". In these reports, some of which have been referenced earlier, are the results from surveys and the latest population projections and estimates. Casual reading enables the analyst to stay abreast of current fertility patterns, women's expectations of future fertiltiy, marital and divorce trends, and household size estimates, often by region.

For current population estimates, the most logical source of additional information is the local public health department which compiles birth and death information by place of residence. Reliance on the State for these figures will be insufficient as they are frequently years behind in their compilation.

The number of housing units added to the area is also a valuable piece of information. Often, a local Board of Realtors can provide vacancy estimates based on survey data. However, remembering the Ventura example, caution should be exercised in the use of this data.

School enrollment data from local school districts is another source of additional information. Often, changes in enrollment not associated with previous changes in the number of births can signal changes in current migration patterns. However, school enrollment figures will be of less importance if the fertility rate continues to decline. Due to recent fertility trends, long term relationships between school enrollment and total population must, at best, be continually updated, if not ignored. However, school enrollment data can provide clues as to the size of the various age groups falling within the school attendance years.

Similarly, statistics from the local Social Security office can provide substantial information on that portion of the population collecting benefits. Although not specifically applicable to estimating total population, this data shows the relative changes in the older age groups. Combined with latest census information, Social Security statistics may reveal significant in-or out-migration.

Driver license address changes are also an excellent source of information on the migration component of current population estimates. This data is available each year by four age groups, <25, 25-44, 45-64, >64, and by type of migration, intercounty and interstate. Obviously, these figures do not provide all necessary migration information, yet they can provide important insights. Table 4 shows this data over the four years, 1970-74, for Santa Barbara County.

TABLE 4

NET DRIVER LICENSE ADDRESS CHANGES BY YEAR
FOR SANTA BARBARA COUNTY
(combined inter-county and inter-state)

	Age Groups				
Year	LT. 25	25-44	44-64	GT. 64	Total
1970-71	772	-542	31	159	421
1971-72	1016	-733	53	179	516
1972-73	1290	-127	129	205	1498
1973-74	1172	143	232	200	1746
Total	4250	-1259	445	743	4181

Source: California Department of Motor Vehicles.

There appears to be no reason why driver license information could not be obtained for areas smaller than a County. The information is entered in the Department of Motor Vehicles (DMV) records by zip code. With proper programming, the data could be retrieved in the same manner. For counties composed of two or more separate and distinct regions, address changes by zip code are invaluable. In Santa Barbara County, for example, the area is neatly divided into two areas: the North County (north of the Santa Ynez mountains) and the South Coast (the area south of the mountains). These two regions are divided geographically, economically, and socially. Address changes by zip code would provide the analyst with a third type of migration information: intra-county migration. Questions such as; "Are people moving from the North County to the South Coast?" could be answered. Sufficient prodding by local analysts may prompt the DMV to publish the information on their own. If such data is particularly important, the analyst may wish to ask for a special run of the DMV computer.

A final source of information concerning current population estimates is the Internal Revenue Service (IRS). Although not yet completed, the IRS has been directed, for revenue sharing purposes, to gather population data from income tax returns. As these tax returns list the number of dependents, they will be important sources of population data. However, there are many individuals who do not file returns either by choice or lack of necessity. Some method of relating total population to the IRS observed population will have to be developed. Even with this drawback, data from income tax returns promises substantial improvements to the current population estimating procedure. The local analyst should be aware of this new potential source of information.

To improve the State's population projections, the local analyst must look to other sources of additional information. As previously explained, projections for local areas are composed of two components; expected fertility patterns and expected migration levels. Although neither of these two components can be determined exactly for future years, valid adjustments to those figures used by the State can be made. First, Census Bureau publications provide valuable data concerning a variety of factors which affect future fertility levels. The Census Bureau also provides a baseline population projection whose assumed fertility rate may be compared to that used by the State.

Birth certificates filed with the county registrar may yield information detailing recent fertility trends. In Santa Barbara County,

TABLE 5

SANTA BARBARA COUNTY BIRTH DATA: 1974

	TOTALS	SANTA BARBARA	SANTA MARIA	LOMPOC	CARPINTERIA	GUADALUPE	COUNTY UNINCORPORATED
TOTAL BIRTH	3,555	873	603	426	117	72	1,464
RACE							
White	2,321	480	301	303	65	8	1,164
Negro	118	29	18	25	2	1	43
Indian	14	7	1	2			4
Oriental	75	11	15	9	1	2	37
Spanish	1,002	344	258	85	49	56	210
Other	25	2	10	2		5	6
AGE OF MOTHER							
Under 15	7	2	1	1		1	2
15	27	10	5	5	1	1	5
16	48	13	11	13	1		10
17	91	17	29	12	7	4	22
18	150	32	46	24	6	5	35
19	202	48	48	43	5	3	55
20-24	1,322	334	235	218	35	27	473
25-29	1,081	271	144	73	33	17	543
30-34	437	94	55	27	24	9	228
35-39	162	45	19	7	4	5	82
40-44	25	7	7	3	1		7
45-49	3		1				2
50 & over							
PREVIOUS CHILDREN							
0	1,568	437	270	203	54	27	577
1	1,166	255	196	153	35	18	509
2	413	83	72	34	16	12	195
3	209	48	29	23	6	8	95
4	95	22	20	6	3	3	41
4+	104	28	16	7	3	4	46
WEIGHT AT BIRTH							
Over 5.5	3,395	829	575	411	108	69	1,403
5.5 & less	160	44	28	15	9	3	61

Source: Santa Barbara County Schools Office.

the County Schools Office conducts an annual survey of birth certificates, recording the race, age, number of previous children, and residence (to census tract level) of the mother. Using this information (Table 5), the analyst can develop current fertility rates and compare them with the projected rates used by the State. In the case of Santa Barbara County, the discrepancy is quite obvious. Using 1974 population estimates, the current fertility rate is roughly 1.7. This figure is below the current fertility rate for the country and far below the ultimate fertility rate of 2.5 used in the State's projections.

Table 5 also shows the contribution to total population made by the various racial groups. The Spanish surname community, although only 17% of the total population, contributed 28.2% to the total number of births. This factor should be considered when comparing present fertility rates with those projected by the State.

Future migration is probably the most difficult factor to incorporate into a population projection. The local analyst may feel that improving State figures is an impossible task. However, checking a few key sources will allow the analyst to make that significant improvement. Obviously, zoning restrictions or building moratoriums will have an impact on future population.

In addition, demographers have used a concept borrowed from regional economists called the export/base multiplier. Briefly, the local economy is divided into two types of firms; export and service. An increase in the export sector of the economy entails an increase in the service sector also. Assigning population relationships to these sectors and projecting changes in the size of the export sector, one can determine required population changes.

Although forecasting future changes in the export sector is quite tenuous, staying abreast of economic conditions within the region provides the analyst with important clues concerning future migration. As is often the case, the local Manpower Area Planning Council, with help from the State Employment Development Department (EDD), may have conducted a study projecting future job opportunities within the region. In the past, these reports have depended quite heavily on extrapolation. In recent years however, the techniques utilized have increased in sophistication.

The local Chamber of Commerce can often provide detailed information on the expansion plans of nearby firms. Local newspapers, in cooperation with a variety of local business leaders, frequently publish annual summaries of business forecasts. In Santa Barbara County, the Santa Barbara News Press publishes an annual "Review and Forecast" with sizeable amounts of information about future prospects.

Any expansion plans should be reviewed with consideration to the type of firm involved. Expansion of companies mainly employing the unskilled may contribute little to new in-migration if there is a large pool of unemployed or under-employed workers. Firms requiring the services of the highly skilled, on the other hand, may increase in-migration.

One last point of warning should be mentioned concerning all population projections; examine the source. Unfortunately, there are certain inherent tendencies which can affect the validity of a projection developed or used by any bureaucracy. Often, these tendencies increase population estimates in an attempt to justify projects or programs.

By this point, the reader should be able, with the aid of other information sources, to critically analyze and improve population estimates prepared by other agencies. The analyst should compare current and projected population estimates and their respective assumptions with recent birth statistics, housing unit information, driver license data, up-coming IRS reports, Chamber of Commerce information, and EDD studies. Simple alterations to the State's figures, combined with the population projection program, can provide more valid overall estimates and projections and, at the same time, utilize minimal amounts of time and resources.

Section II

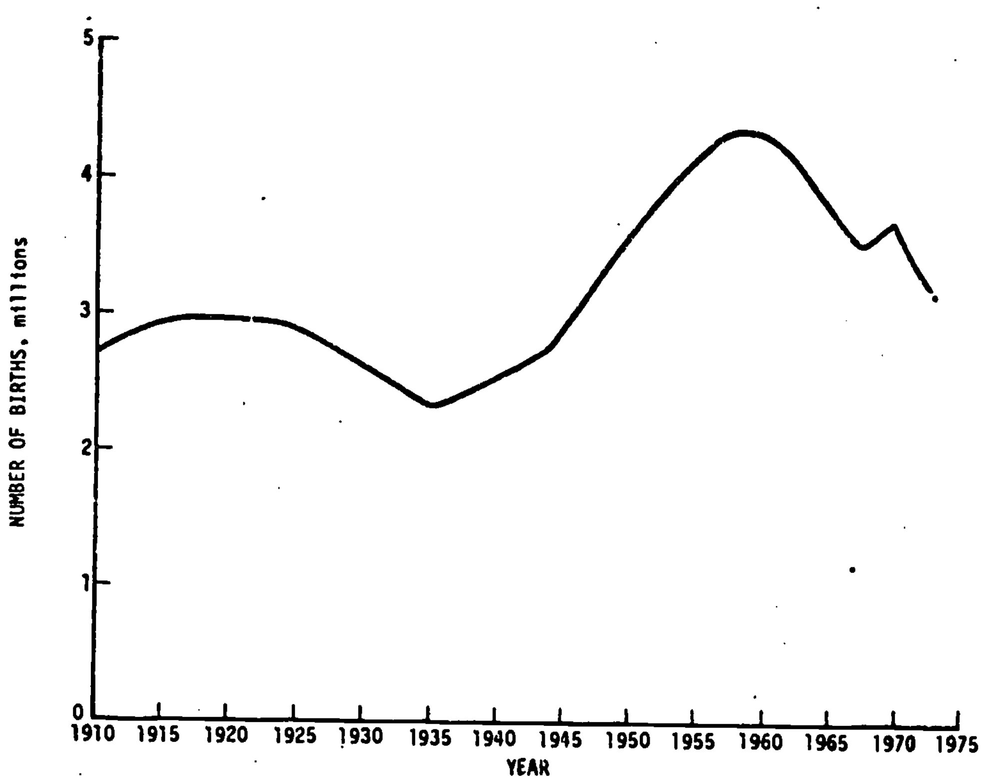
AGE STRUCTURE: UNITED STATES AND LOCAL AREAS

So far, we have examined population estimation and projection methodology and the important improvements that can be made. This section examines an often overlooked component of population which has important impacts upon regional policy decisions; the age structure of the population. The following pages examine exactly what is meant by age structure and its potential implications for regional analysis.

Since 1910, the United States has experienced wide variations in the number of annual births which reflected substantial changes in the current or period fertility rate. The annual number of births, shown in Figure 4, reached a low point during the depression years. Immediately

FIGURE 4

UNITED STATES ANNUAL BIRTHS



Source: H. Fox. A Look at Population Growth Projections for the United States and the State of California, General Research Corp., 1975.

after World War II, the number rose steadily to reach a peak in the late 1950's. Since 1960, the level has dropped precipitously except for a brief upturn in 1969 and 1970.

These significant changes in the level of births have produced disproportionate numbers of individuals concentrated in particular age groups. For example, Figure 5 shows the United States population by five year age group for 1960, 1965, 1970, and 1975. As is apparent, in 1960, the under 5 years age group was significantly over represented in the population. This fact reflected the high level of births that occurred in the late 1950's. Also apparent is the relatively small number of people in the 25-29 age bracket as a result of the low level of depression births.

By 1965, the downturn in annual births is starting to show up in the age structure. The peak population level is now in the 5-9 age bracket with an appropriate impact being felt in the elementary school system.

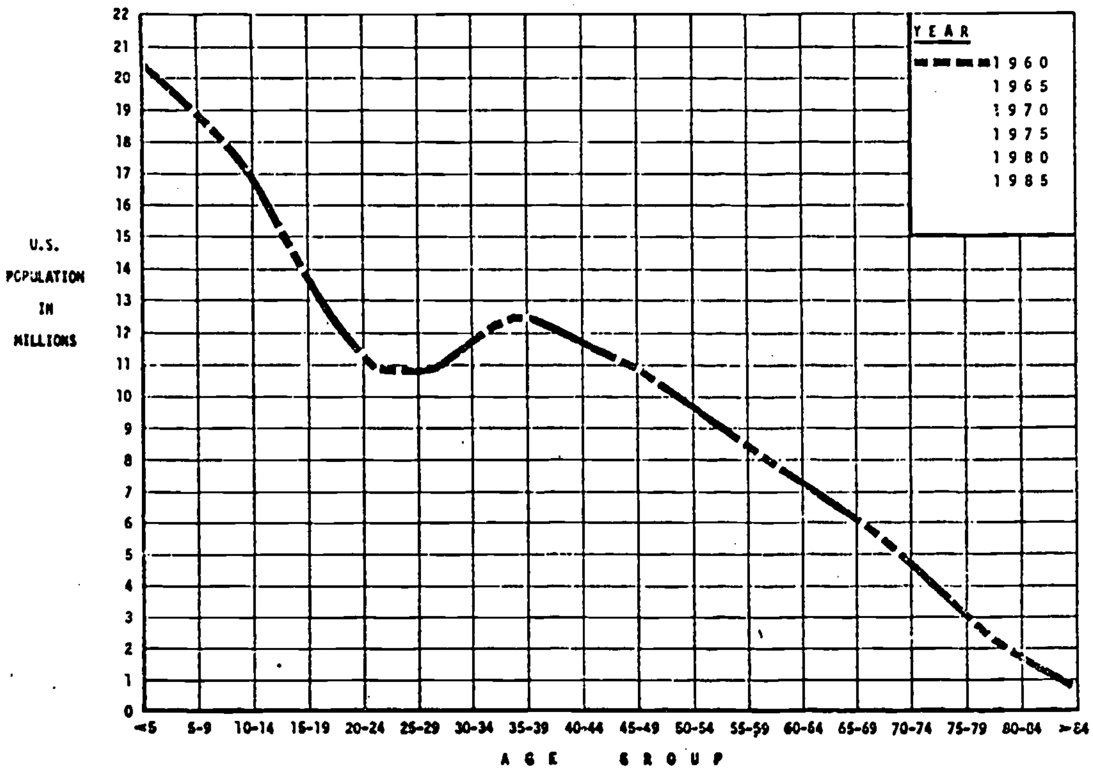
By 1970, the graphical representation of the age structure has clearly begun to resemble a wave. The huge age structure "hump" has now moved into the 10-14 age bracket with the appropriate movement of the age group trough into the 35-39 age bracket.

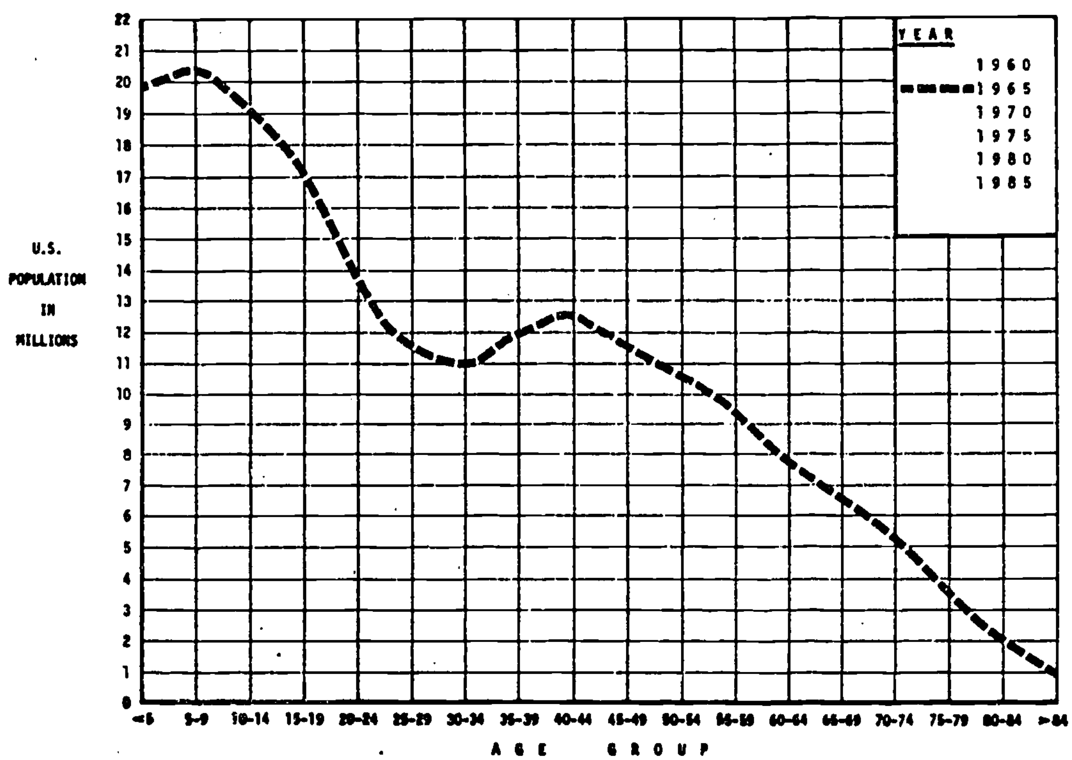
By 1975, there is a tremendous difference in absolute numbers exhibited by the age class bulge, which is now in the 15-19 age group. This peak age group is 50 percent larger than the 30-34 age group and 30.4 percent larger than those aged five or less.

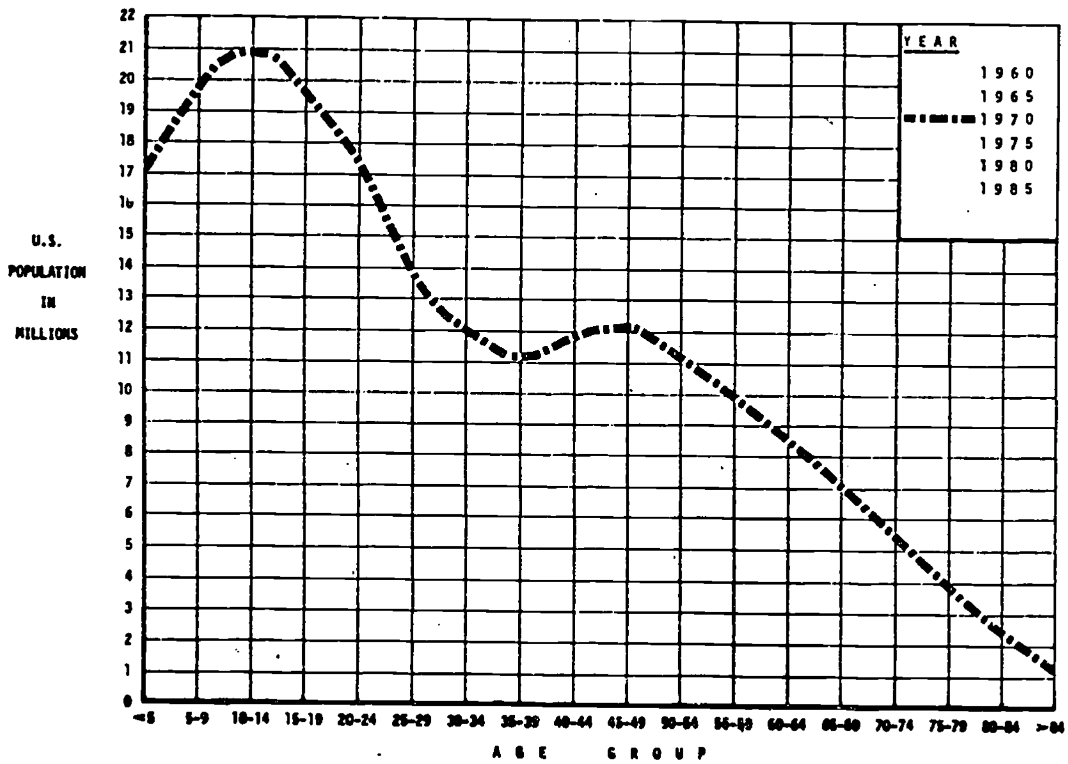
Determining the future age structure involves assumptions concerning future fertility levels. Using the Census Bureau's baseline forecast (Series II), Figure 6 shows the anticipated age structure for 1980 and 1985. Such projection is a relatively straightforward procedure.

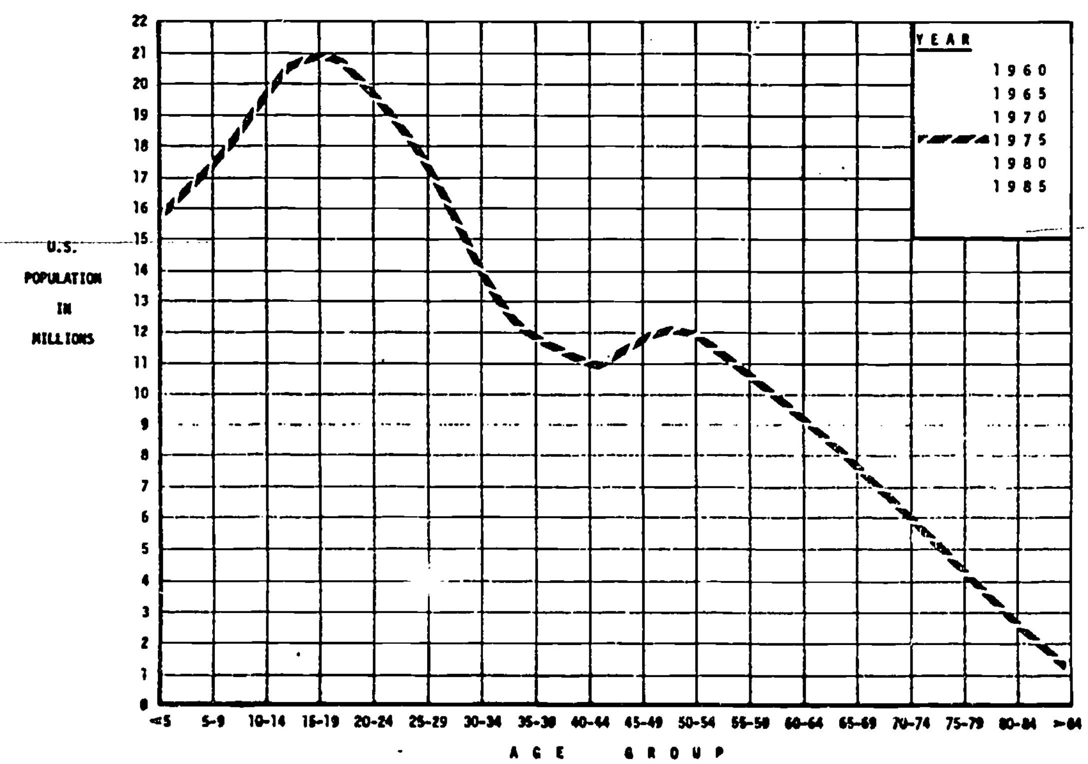
FIGURE 5

U.S. POPULATION BY FIVE YEAR AGE GROUP





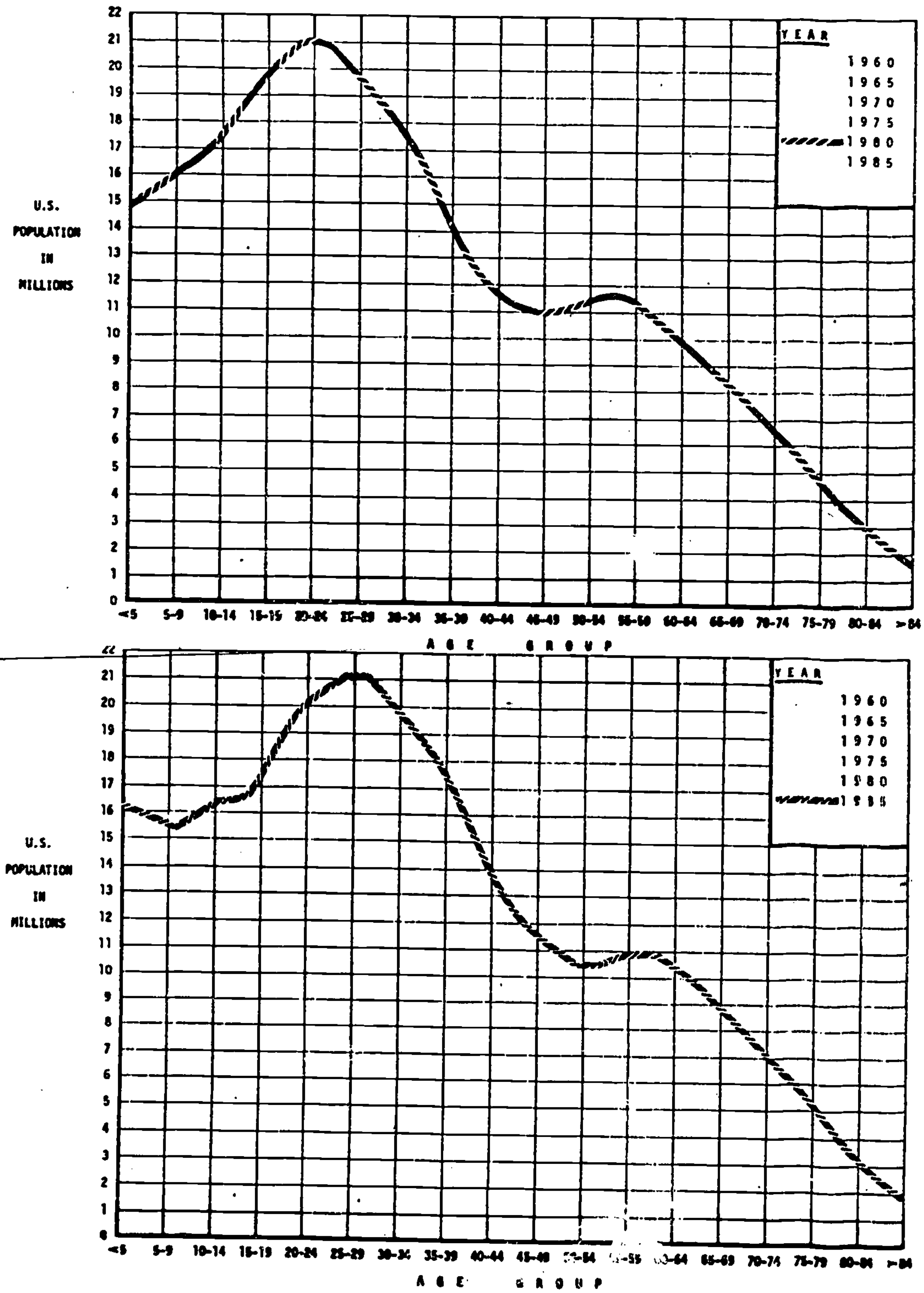




Source: H. Fox. A Look at Population Growth Projections for the United States and the State of California, General Research Corp., 1975.

FIGURE 6

UNITED STATES ANTICIPATED AGE STRUCTURE



Source: H. Fox, A Look at Population Growth Projections for the United States and the State of California, General Research Corp., 1975.

For instance, to find the number of 20-24 year olds anticipated in the 1980 population, one need only apply appropriate mortality rates and immigration factors to the present population within the 15-19 age bracket. For those not yet born, the Series II fertility assumption of 2.1 in conjunciton with the number of females of child-bearing ages yields the expected number of births over the next 10 years. As can be deduced from Table 6, between 1950 and 1970 most of the increase in population was in the age groups under 30 years. From 1970 to 1990, this increase will be concentrated in the age groups between 25 and 45. The slow passage of the population bulge through the various age classes must be incorporated into public policy decisions.

TABLE 6

UNITED STATES PROJECTED AGE DISTRIBUTION

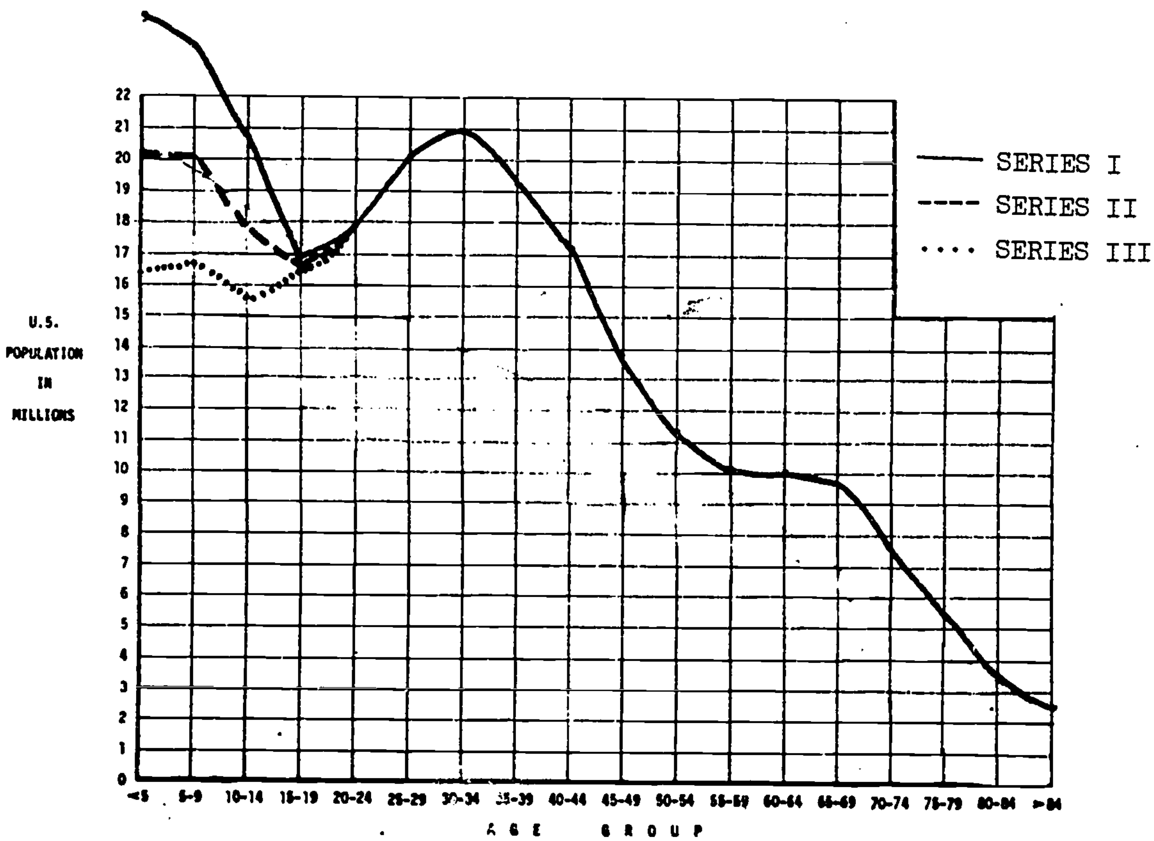
	Age Groups								
Year	10-14	15-19	20-24	25-34	35-44	45-54	55-64	65-74	75 & Over
1974	20,492	20,727	18,968	29,884	[illegible]	23,651	19,580	13,317	8,407
1975	20,062	20,943	19,404	31,114	22,721	23,562	19,867	13,549	8,621
1976	19,490	21,048	19,800	32,390	22,937	23,404	20,143	13,748	8,796
1977	18,879	20,959	20,227	33,529	23,413	23,137	20,446	14,010	8,906
1978	18,210	20,643	20,583	34,510	24,127	22,905	20,667	14,239	9,059
1979	17,706	20,649	20,851	35,652	24,812	22,631	20,882	14,460	9,211
1980	17,497	20,221	21,067	36,962	25,370	22,406	21,083	14,680	9,371
1981	17,611	19,651	21,172	38,326	26,125	22,225	21,249	14,875	9,521
1982	17,563	19,042	21,085	38,828	27,452	22,058	21,375	15,060	9,659
1983	17,322	18,376	20,971	39,544	28,692	21,965	21,458	15,242	9,825
1984	16,948	17,875	20,780	40,193	29,941	21,976	21,434	15,468	9,992
1985	16,544	17,668	20,355	40,841	31,150	22,036	21,366	15,725	10,199

Source: H. Fox. Population Forecasts and their Implications for Public Policy, General Research Corp. 1974.

Changes in the ultimate fertility assumption can produce significant changes in the projected future age structure. Figure 7 compares the projected 1990 age structure for the United States based on Series I, II, and III fertility assumptions. Note the considerable differences in number for those in their elementary school years. This changing age mix can have important impacts on present and future demands for public services.

FIGURE 7

ALTERNATIVE 1990 POPULATION PROJECTIONS FOR THE UNITED STATES



Source: U.S. Bureau of the Census, Current Population Reports, Series P-25, N. 601.

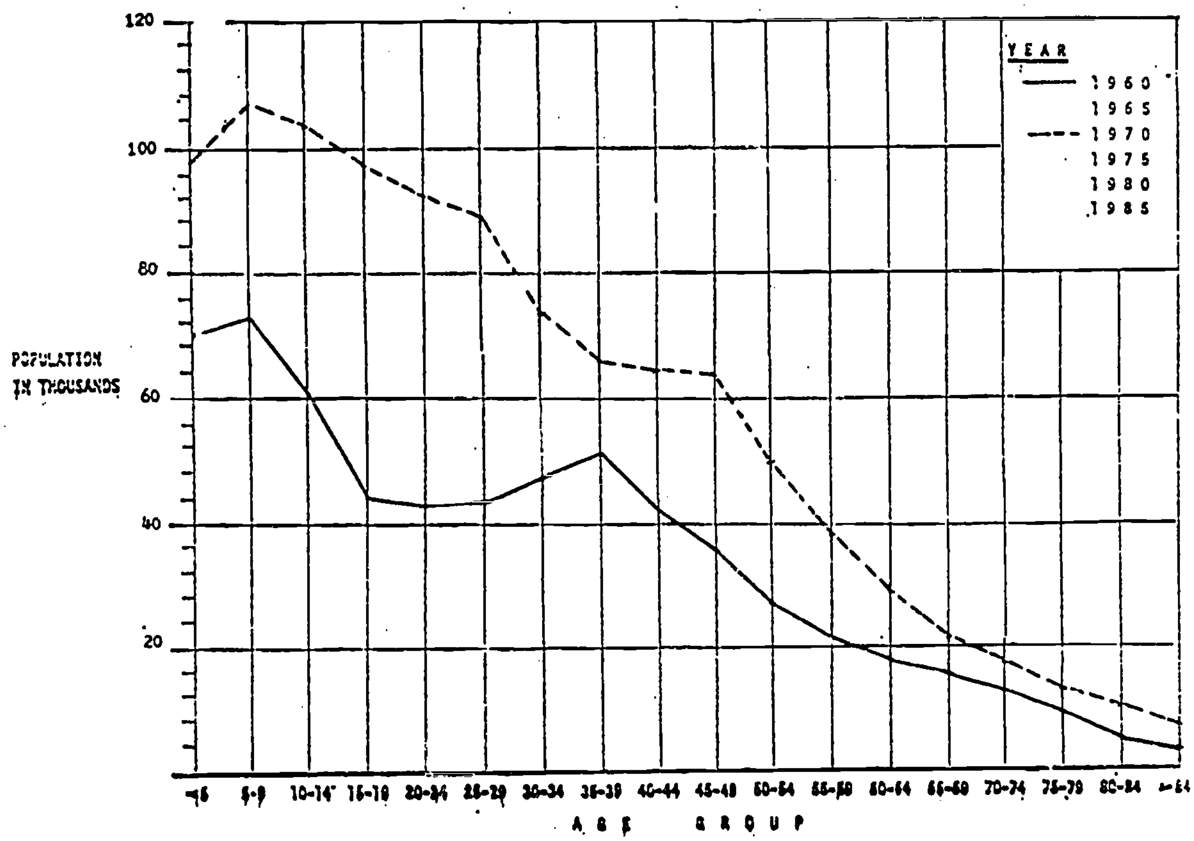
Briefly, then, the tremendous age class wave is the result of three major trends in births. First, births declined in the decade 1925-1935 from about 3 million to 2.3 million. The post-war years saw births rise from about 2.8 million in 1945 to 4.3 million in 1957. The last decade has seen the sharpest drop in the birth rate in history, resulting in 3.17 million births in 1974.

Regional analysts are quick to point out that national trends are usually not exhibited by local areas, especially those areas having large numbers of immigrants. However, the age structure as described above seems to exist, in one form or another, in all regions. Some areas may have the population bulge occurring slightly before or slightly after that of the nation. Invariably, all areas do have the bulge we described. Figure 8 shows the age structure for three California counties. Note the obvious similarities.

FIGURE 8

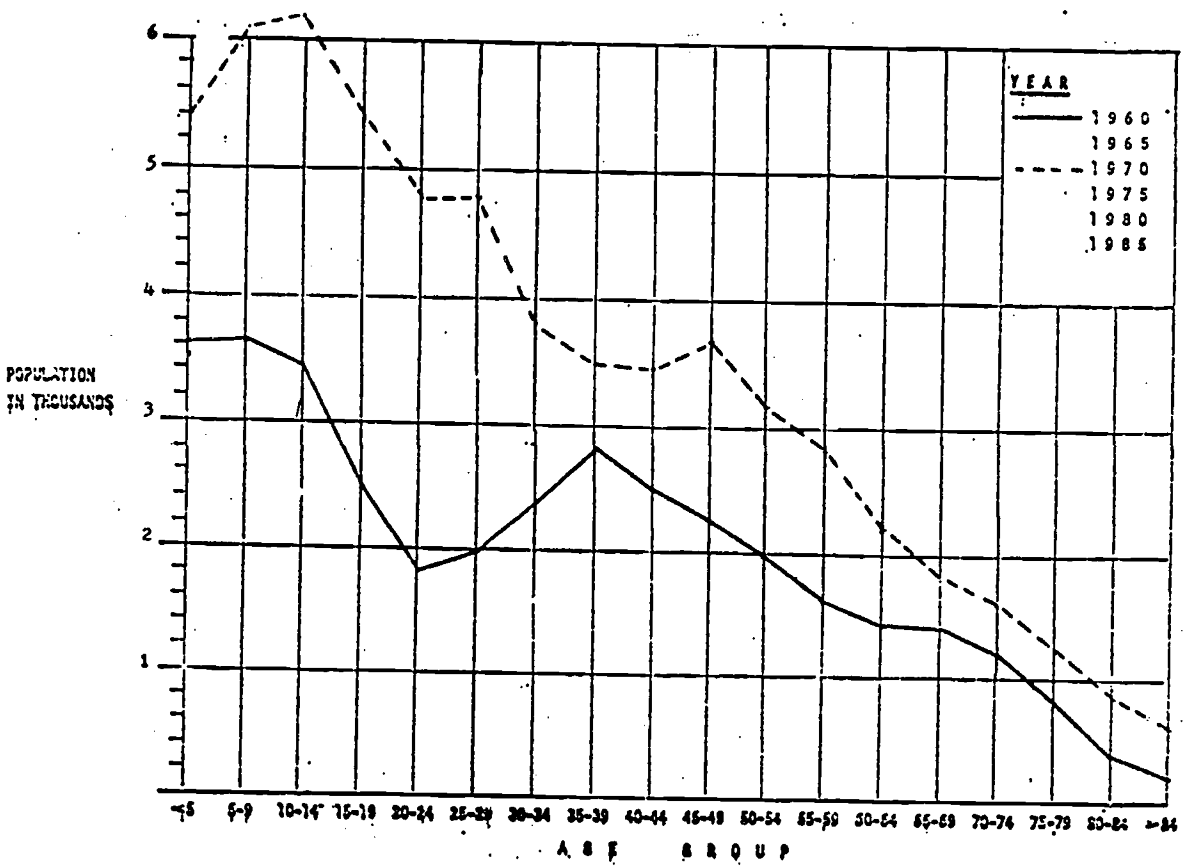
AGE STRUCTURE FOR THREE CALIFORNIA COUNTIES

SANTA CLARA



43

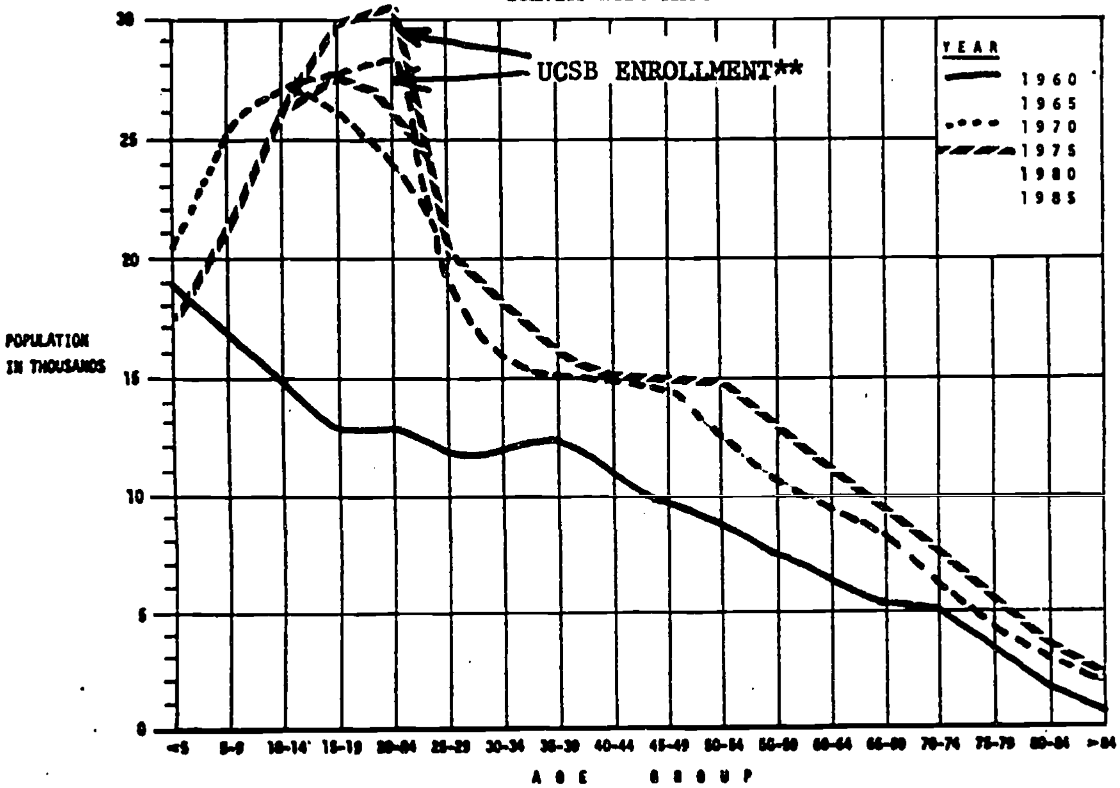
MODESTO



YEAR
1960
1965
1970
1975
1980
1985
POPULATION IN THOUSANDS
AGE GROUP

44

SANTA BARBARA*



Source: U.S. Bureau of the Census, General Population Characteristics; California, 1970.

*The 1975 distribution is based on the recent special census for Santa Barbara County.

**There is a branch of the University of California within Santa Barbara County and its student body represents a significant portion of the County's total population. Therefore, UCSB enrollment is purposefully distinguished in the above distributions.

45

Age Structure: Case Studies

In the past, local analysts became accustomed to examining the demand or need for public services in per capita terms. The existence of the described age structure distortion totally negates such thinking. There are a variety of cases in the public sector for which a knowledge of the age structure can have a significant impact. Perhaps the simplest and most obvious example concerns the educational system.

As the population wave moves over time, its impact will be felt in the various grade levels. In many parts of the country, the peak is situated in the high school grades with the corresponding pressures on facilities and classroom size. Elementary school enrollment is relatively depressed as the backside of the population wave is now being felt particularly heavily in these grade levels.

Although the population wave has almost run its course through the educational establishment, there is still one area in which knowledge of the wave may help in decision making: junior colleges. Community colleges provide a wide variety of educational services to a variety of student types; adult education, and night school to name a few. However, this analysis is primarily concerned with those students coming directly out of high school and continuing their studies at the local community college. Those increasing numbers of students slightly older than the peak age group are producing enrollment pressures on local community colleges.

This initial portion of the population wave is one reason junior colleges have undergone tremendous expansion in recent years. Santa Barbara City College floated a bond issue in 1973 to purchase land and facilities for its expanding enrollment. A brief look at the 1975 age structure for the South Coast would reveal a peak at age 16. Within four years, this age group will have completed what are normally considered their junior college years. Unless dramatic policies of enrollment expansion are pursued, either through out-of-county young adult recruitment or in county adult recruitment, one can expect decreased enrollment pressures at the junior college level.

Criminal justice planning is another area in which a knowledge of the region's age structure can play a critical role. Historically, the various age groups have contributed a relatively constant share to total criminal activity. For example, Table 7 shows the percent distribution of arrests by age group, for 1973 crime index offenses. From the table, one can see that those in the 25-29 age group made up 8.8% of all arrests. From the next row in the table, one notices that those in the 25-29 age group represented only 7.4% of the total population. Dividing the 8.8% arrest figure by the 7.4% population figure yields a result termed the relative involvement rate. If the involvement rate is less than one, that particular age group contributes less to total arrests than its share of the total population would indicate. On the other hand, if the relative involvement rate is greater than one, that age group contributes a higher percentage to total arrests than its percentage share of the population. Examining involvement rates across age groups reveals the disproportionate share the younger age groups contribute to the total number arrested.

Interestingly, the involvement rates for all age groups have remained relatively constant over the years. Table 8 shows these figures for the years 1967-73. This consistency can aid criminal justice planners.

TABLE 7

ARREST DATA FOR CRIME INDEX OFFENSES: 1973

	Age Group													
	11-14	15-17	18-20	21-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	≥64	Under 10 and Unknown
Percent Distribution of Arrests by Age	16.5	25.9	17.0	13.5	8.8	5.1	3.3	2.5	1.8	1.3	.8	.5	.6	2.4
Precent Distribution of Resident Population by Age	8.0	6.0	5.7	6.8	7.4	6.2	5.3	5.5	5.7	5.6	4.8	4.3	10.2	N/A
Involvement Rate	2.06	4.32	2.98	1.99	1.19	0.62	0.62	0.45	0.32	0.23	0.17	0.12	0.06	N/A

Source: H. Fox. General Research Corp. Private correspondence.

TABLE 8

RELATIVE CRIME INVOLVEMENT RATES OVER TIME

	AGE GROUP												
YEAR	11-14	15-17	18-20	21-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and Over
1967	2.46	6.71	2.87	1.98	1.28	0.91	0.64	0.48	0.34	0.24	0.16	0.13	0.05
1968	2.60	4.68	3.08	1.95	1.25	0.86	0.63	0.46	0.32	0.22	0.16	0.13	0.05
1969	2.33	4.54	3.09	2.02	1.22	0.84	0.62	0.65	0.32	0.22	0.16	0.12	0.05
1970	2.17	4.65	3.23	2.02	1.22	0.86	0.63	0.46	0.32	0.22	0.16	0.12	0.05
1971	2.10	4.47	3.13	2.00	1.24	0.84	0.61	0.44	0.31	0.22	0.16	0.12	0.05
1972	2.10	4.29	3.00	2.09	1.22	0.86	0.64	0.45	0.33	0.23	0.16	0.12	0.06
1973	2.06	4.32	2.98	1.99	1.19	0.62	0.62	0.45	0.32	[illegible]	0.17	0.12	0.06

Source: H. Fox. General Research Corp. Private correspondence.

Due to the age structure wave and the higher relative involvement rates, most communities have experienced dramatic increases in juvenile crime. These increases place corresponding pressures on all aspects of the criminal justice system designed to handle the juvenile. Before planning new facilities or programs to handle the increased load, the analyst would do well to determine the local age structure. In most areas, the peak age groups are within a few years of age 18 and therefore are within a few years of leaving the juvenile justice system. Unless there is a dramatic growth in the overall crime level, one may confidently expect reductions in the amount of crime ascribed to juveniles as the peak age groups move on into adulthood.*

The distorted age structure impacts on the criminal justice system in other ways. The types of crime committed will change as the peak age group changes. Whereas shoplifting is a key problem due to the large number of adolescents, in a few years the key problem may be assaults. As a result, the analyst may wish to change the allocation of officers or change the enforcement emphasis.

The list of local programs or projects for which age structure analysis can be important is nearly endless. Recreation, transportation, and health planning are further examples of topics for which demands or needs should be analyzed in an age specific manner rather than on a per capita basis. Before moving on to the population projection program, there is one other topic to be covered briefly with respect to age structure: housing.

Age Structure: Housing

The supply of adequate housing has long been a concern of national and local governments. However, in recent years many local areas have placed this concern behind that of population growth. In past years, new housing construction signaled increased population for the community, as well as an economic advantage. Increasingly, regions are rejecting this hypothesis and instead pointing to the harmful environmental and fiscal effects caused by the new housing and its occupants. Petaluma, California

*Approximately 15% of the change in crime levels in recent years is explained by the changing age distribution. See L. Phillips & H. Votey, Jr., Journal of Political Economy, June, 1972, for further discussion.

enacted an ordinance restricting the number of new housing units to 500 per year in an attempt to control present and future growth. Other communities are examining both the ordinance and the recent Supreme Court action upholding the ordinance. Many of these communities would like to adopt similar legislation for thier regions. A knowledge of population and age structure can enable the local analyst to comment on the validity of this policy.

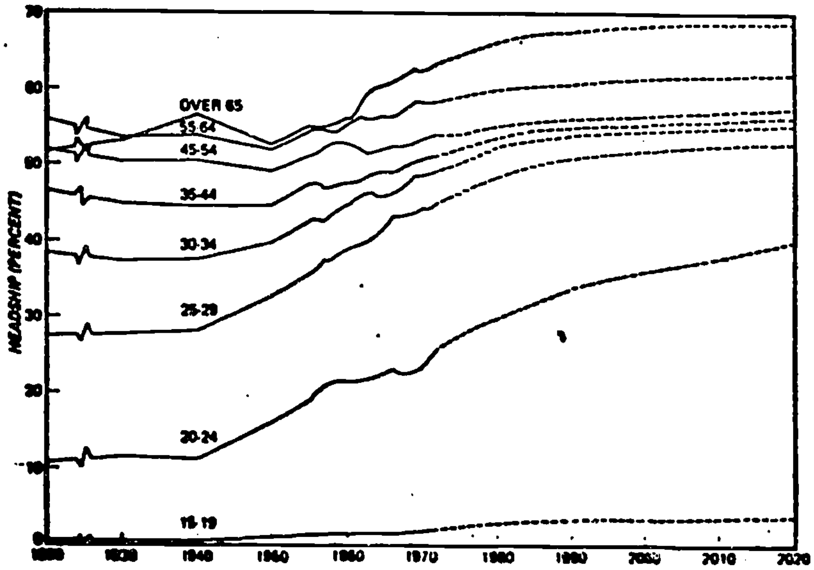
The age and income of individuals are probably the most significant determinants of household formation and the demand for certain types of housing units. These aspects of housing have remained remarkably stable over long periods of time in the United States. This stability is due primarily to regular patterns of income, income expectation, assets, family status, and preferences over the life cycle.[16]

Individuals generally form a separate household sometime in their 20's and by the age of 30, about 50% head a separate household. Headship rates - the ratio of household heads to total population - rise gradually until about 2/3 of all surviving individuals head a seperate household.

Since 1950, there has been a steady increase in headship rates, particularly among the younger and older age groups (Figure 9). This increase reflects the trend toward nuclei family units with younger and older generation members splitting off to form separate households. Current social and economic trends, liberalized divorce laws, equal opportunity for women, and continued government programs to subsidize housing for the poor and elderly, seem to indicate that the increase in single-person households will continue (Figure 10). However, one should remember that a major social or economic disruption could alter this trend.

FIGURE 9

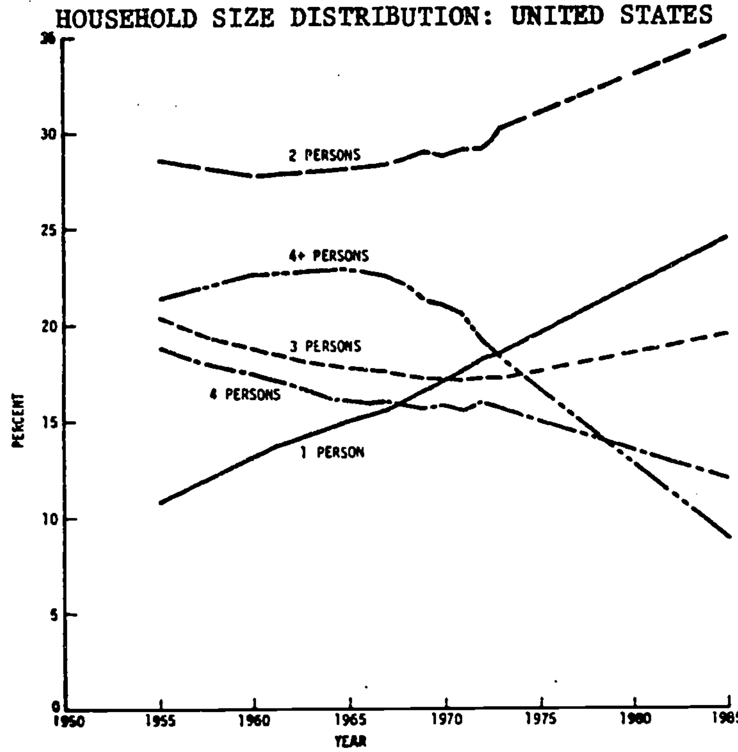
HISTORICAL HEADSHIP RATES BY AGE GROUP: UNITED STATES



Source: Thomas Marcin. The Effects of Declining Population Growth on the Demand for Housing, U.S. Department of Agriculture, 1974.

FIGURE 10

HOUSEHOLD SIZE DISTRIBUTION: UNITED STATES



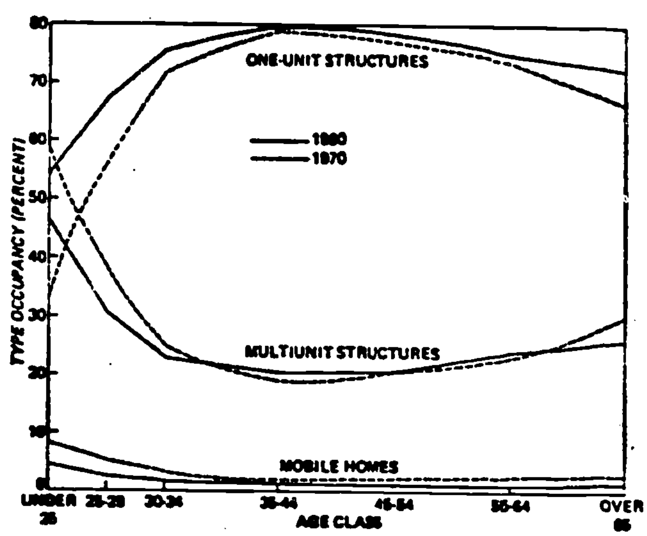
Source: H. Fox. Population Forecasts and their Implications for Public Policy, General Research Corp. 1974.

Also important is the type of housing unit the new household occupies. Typically, the young householder first occupies an apartment, then at about age 30 buys a moderately priced single-family home or townhouse. Later, due to an improved financial position, the householder will probably move to a more expensive home. With older age, the householder often retreats to a smaller retirement home, apartment, or a mobile home.

Between 1960 and 1970, there has been little change in the type of housing unit occupied by the middle-aged group. Nearly 80% occupied one-unit structures (Figure 11). There was an increase in multi-unit occupancy by the younger and older household heads. Mobile home occupancy increased for all age groups.

FIGURE 11

UNITED STATES HOUSING TYPE OCCUPANCY RATES BY AGE GROUP



Source: Thomas Marcin. <u>The Effects of Declining Population Growth on the Demand for Housing</u>, U.S. Department of Agriculture, 1974.

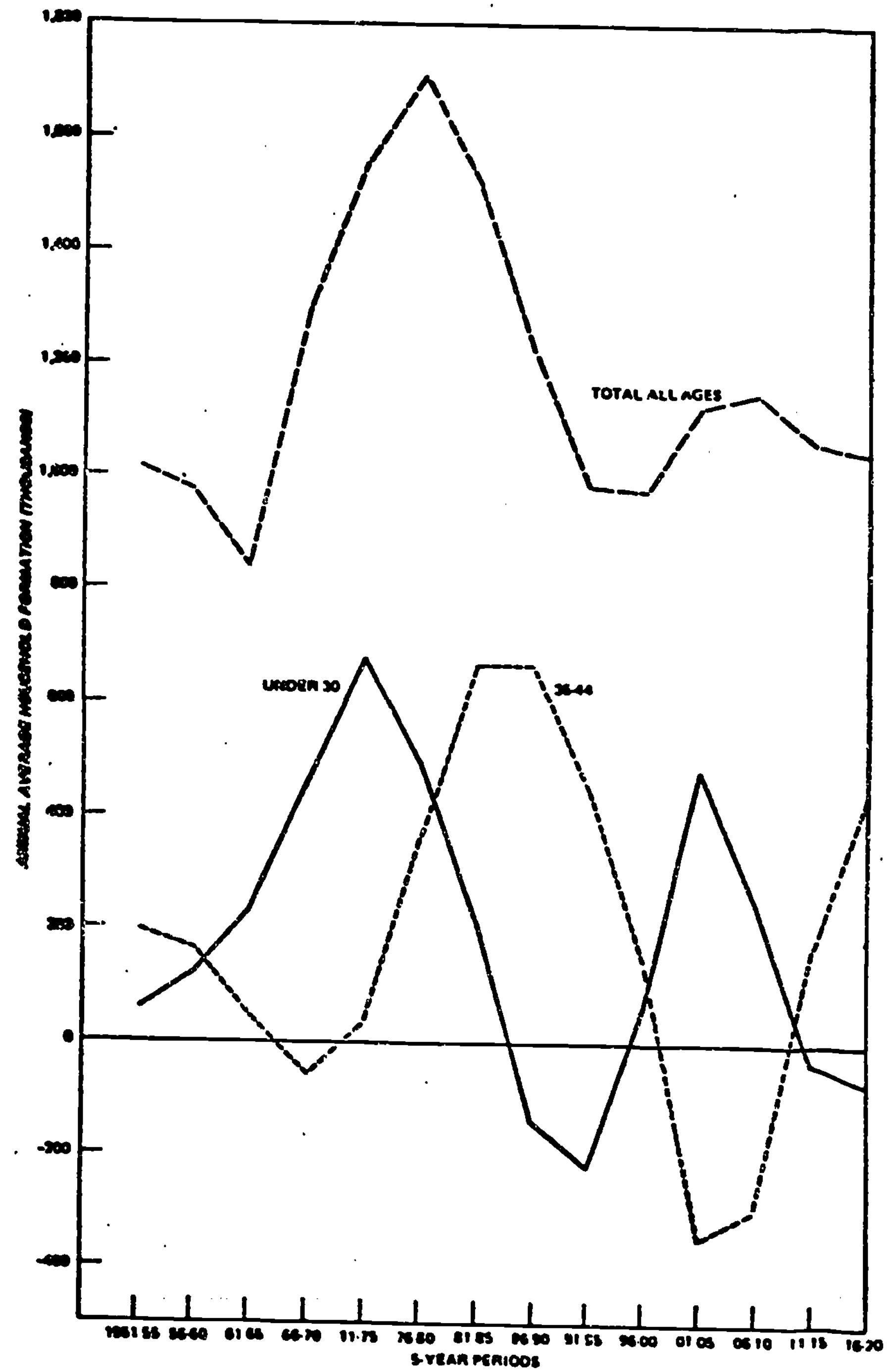
These occupancy changes between 1960 and 1970 are undoubtedly due somewhat to changes in preferences. However, one should remember that relative price changes between the three types of structures has probably been responsible for a major portion of the described shifts. Future price changes may further alter the housing type occupancy rates. For this reason, any projection of these rates may be somewhat tenuous.

By combining the household formation rates with the relevant age structure, the analyst can project the future level of household formations. Between 1950 and 1970, net household formation for the United States - the net increase in the total number of households - rose from about 1 million per year to over 1.6 million (Figure 12). Continued sharp increases in the number of persons in their 20's and early 30's will keep net household formation high until the mid-1980's.

In addition, changes in the age mix of household heads are occurring that influence the type of unit demanded. To illustrate the potential effects of such changes, consider two key age groups; (1) those households headed by persons under 30 who are most likely to demand apartments and mobile homes, and (2) the 35- to 44-year-old age group who typically occupy single-family dwellings. From 1966 to 1975 household heads under 30 increased by about 5.7 million, while household heads for the 35- to 45-year-old age group decreased slightly (Figure 12). This fact may, in part, explain why apartment and mobile home demand boomed in this period. In the latter half of the 1970's, the number of middle-aged household heads will increase rapidly while the number of households headed by persons under 30 will begin to decrease. The demand for single-family housing is likely to surge through the 1980's due to the changing population age structure. After 1990, the replacement demand will probably become the most important

FIGURE 12

AVERAGE HOUSEHOLD FORMATION BY AGE GROUP



Source: Thomas Marcin. The Effects of Declining Population Growth on the Demand for Housing, U.S. Department of Agriculture, 1974.

component of total housing demand.

As described, the types and numbers of housing units demanded are likely to change dramatically over the next 30 years if historic relationships of type of housing unit occupied to age of household head continue. These changes also point out an important fact; new housing units do not necessarily mean increased population levels. Rather, there is a significant need for more housing to accomodate present populations.

This fact is demonstrated by some recent statistics. The State of California, between April 1, 1970 and July 1, 1973, gained 617,139 housing units, but only an estimated 647,866 persons.[17] San Bernadino County gained over 30,000 new housing units between April 1, 1970 and January 1, 1975. Yet, the 1975 special census indicated a net gain of only 14,000 people and the vacancy rate increased a mere 1.4%.[18] In addition, the population gain was below the natural increase recorded by the local Public Health Department, indicating significant out-migration. Undoubtedly, these new housing units are being occupied by individuals from the age structure hump, leaving their parental dwellings and forming their own households. Section 3 will outline specifically the implications the age structure bulge has for housing needs within Santa Barbara County.

Section III

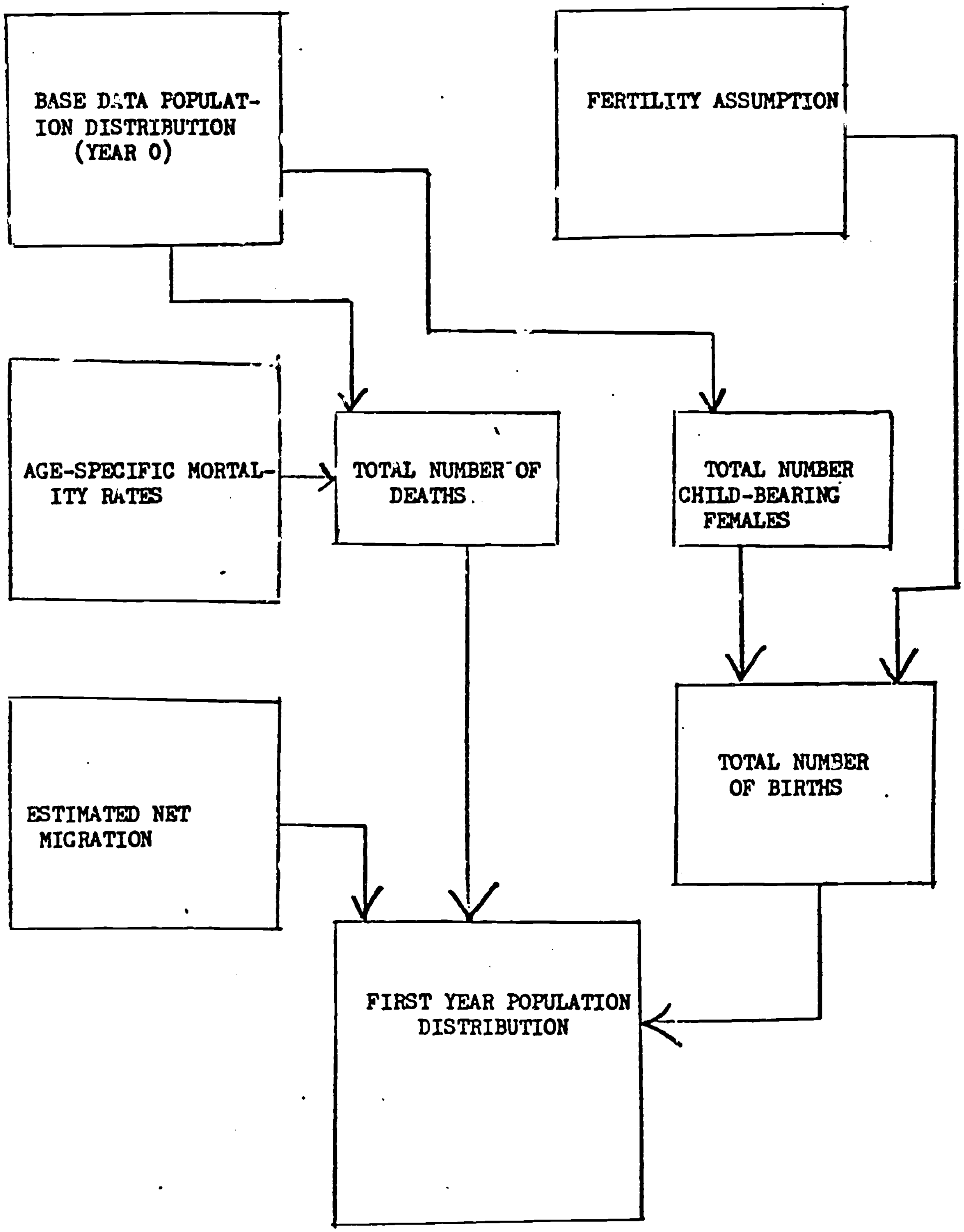
POPULATION PROJECTION PROGRAM

With the knowledge, techniques, and insight gained from Sections 1 and 2, the reader is ready to utilize an easy-to-use computer program for his own population projection and age structure analysis. Using Santa Barbara County as a case study, this section will point out the potential improvements the local analyst can make over projections provided by higher gorvernmental agencies. As will become apparent, the key to the program's success rests upon the use of recent fertility and migration information and the ease with which recently updated base information can be incorporated into the projection procedure. Using information available in 1970, this section estimates Santa Barbara County's 1975 population. This estimate is compared to those developed by the State Department of Finance and the recent 1975 special census. These comparisons serve as an important test of the program and the procedures utilized to implement it. In addition, this section explores the data and procedures incorporated into the program which reveal the impact of the changing age distribution on housing needs and job requirements.

Quite simply, the program advances, year by year, user supplied population distributions. By providing appropriate fertility and migration information, the user can develop specific population projections. Figure 13 shows the general flow of the projection program. Base data by age and race is supplied by the user. Mortality rates are applied to

FIGURE 13

GENERAL FLOW OF POPULATION PROJECTION PROGRAM



the base data before advancing each age group upwards. For example, the base data for age 1 is advanced to age 2 after applying an age-specific mortality rate. The result, after adding in migration, yields that number of two year olds in the first year of the projection series. From the base data, the number of child-bearing females is also extracted and age-specific fertility rates applied to generate first year births. These procedures are performed for each year and racial or ethnic group specified by the user.

The information necessary from the user consists of 3 basic categories; assumptions, migration data, and age group base data. Although the actual procedure for program operation is reserved for the appendix, a brief explanation of the elements within the above three categories is appropriate. An attempt has been made to make the program as easy as possible to use. However, by providing a number of options, the program allows the user to increase the sophistication and accuracy of the projections.

The assumption category consists of 9 elements. Table 9 lists these elements with a brief explanation if appropriate.

TABLE 9

ELEMENTS OF THE ASSUMPTION CATEGORY

1) Ultimate fertility rate for white women.
2) Ultimate fertility rate for black women.
3) Ultimate fertility rate for Spanish surname women.
4) Choice of migration allocation - user has the option of specifying 66 age-specific migration values or one single total migration figure.
5) Date of base data.
6) Choice of output - user has the option of either detailed or summary output.
7) Choice of age group allocation - user has the option of specifying 66 values for the base data age distribution or may supply only 14 five-year age group totals for each racial or ethnic group.

8) Number of projection years - user has the option of any number up to and including 20.
9) Fertility trends - user has the option of choosing a single fertility rate for each group in 1, 2, and 3 above, or the user may specify fertility rate trends indicating changes in fertility rates over the projection period.

The migration category consists of either a single value, or 66 values (<1, 10, . . .60-64, <64) depending upon the option chosen in the eighth element of the assumption category. At this point, the reader should not feel obliged to know how to specify each of these assumptions or options. Rather, the simple knowledge that they exist will suffice.

The first piece of data necessary for the program concerns fertility rates. Similar to the nation, Santa Barbara County has recently experienced large fluctuations in its current fertility rate. Table 10 shows estimates of the current fertility rate for the years just prior to and including 1970.

TABLE 10

SANTA BARBARA COUNTY ESTIMATED CURRENT FERTILITY RATES: 1960-1970*

Year	Rate	Year	Rate
1960	3.61	1965	2.84
1961	3.77	1966	2.59
1962	3.71	1967	2.48
1963	3.63	1968	2.45
1964	3.25	1969	2.47
		1970	2.45

*As there is no exact way of knowing the number of child-bearing females during non-census years or their age-specific fertility rates, these figures are of necessity based on relationships between the number of births and total population observed in census years.

Based on these estimates and the national trend in fertility rates (Figure 2), an appropriate upward bound on future fertility is 2.5 births per woman. Such a choice reflects the belief that future child bearing activity will hover near the 2.5 figure with age-specific fertility rates similar to those of the Census Bureau's Series I projection.*

However, the late 1960's saw increased activity in both the women's movement and affirmative action policies as they relate to women. Since these activities tend to delay if not eliminate some child bearing activity, an alternate (and lower) fertility rate assumption seems appropriate. The computer program is equipped to handle changes in fertility rates over the projection period. By choosing the correct option, the user need only specify fertility rates corresponding to those expected at the beginning of the projection period and those expected to exist at the end of the projection period. One method of systematically arriving at these two values involves plotting the recent historical pattern of fertility rates. Figure 13 shows such a plot. By simply drawing a line which appears to "fit" the points as accurately as possible, the fertility rate (if recent trends continue) may drop to 1.5 by 1975.** This trend in fertility rates (from 2.5 in 1970 to 1.5 in 1975) represents

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*To compute age-specific fertility rates, the program uses the following simple relationship:

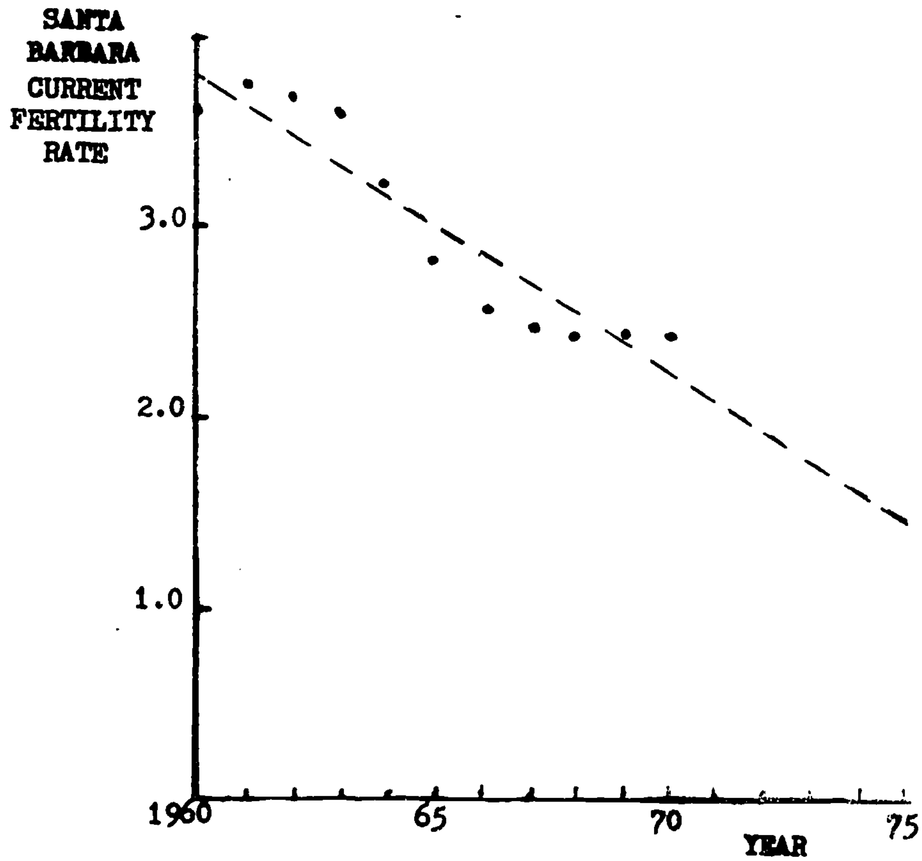
$$PASFR_i = (PUFR/SIUFR) \cdot CBASFR_i$$

where: $PASFR_i$ = program generated age-specific fertility rate for age i
SIUFR = Series I ultimate fertility rate = 2.7
$CBASFR_i$ = Census Bureau Series I age-specific fertility rate for age i
PUFR = User specified ultimate fertility rate

**A more sophisticated estimate would utilize regression analysis with time as the independent variable to estimate the 1975 fertility rate.

FIGURE 14

PLOT OF CURRENT FERTILITY RATES; 1960-70



the figures to be used in the lower bound projection.

Each of the chosen fertility rates (2.5 - upper bound and 2.5 to 1.5 - lower bound trend) represents a combination of the differences between racial or ethnic groups. As was shown in Table 5, the Spanish surname community contributes a disproportionate share of total births. Conveniently, the relationship between the Spanish surname and white fertility rates has remained relatively constant in recent years.[19] Using this relationship and the previously assumed fertility rates, the actual input fertility rates used in the projection program are as shown in Table 11. As blacks represent less than 2.5% of the County's population, they are lumped into the white population distribution.

TABLE 11

FERTILITY RATE ASSUMPTIONS FOR POPULATION PROJECTION PROGRAM

	Combined Fertility Rate	Specific Fertility Rate White	Specific Fertility Rate Span. Sur.
Lower bound Projection	2.5 - 1.5	2.2 - 1.3	3.7 - 2.2
Upper bound Projection	2.5	2.2	3.7

A figure for the migration category is much harder to come by. Inevitably, for regions the size of a county, drastic changes in population levels are caused by changes in migration levels. Yet, any estimation of future migration is purely judgemental, based upon a variety of symptomatic indicators. Table 12 shows estimated migration levels for the years 1955 to 1970 as computed by the Santa Barbara County Planning Department.* A continuation of the trend of recent years indicates a small and declining net migration figure (under 1500 per year). An average of the net migration between 1966 and 1970 yields an estimate of approximately 3044 per year.

These migration estimates are somewhat deceiving however, due to the inclusion of the University of California at Santa Barbara. Due to the invariable age structure of its students, UCSB enrollment must be removed from the base population distribution.** In addition, to correctly analyze recent net migration one must also consider any increases in UCSB enrollment over the period of interest. Total estimated migration

*Because recent estimates are based on results and questions from the 1970 census, they should be fairly accurate and provide useful insight into recent migration trends.

**Generally, the age distribution of those attending college does not change significantly from year to year.

TABLE 12

SANTA BARBARA COUNTY POPULATION GROWTH: 1955-1970

Year	Total Population	Increase over Previous Year		
		Natural	Migration	Less UCSB
1955	113,125	1326	1799	
56	116,562	1265	2172	1799
57	122,187	1488	4137	4243
58	133,437	1730	9520	9291
59	150,313	2394	14482	14325
1960	168,962	2902	15747	15480
61	182,812	3382	10468	9874
62	200,937	3659	14466	13876
63	216,250	2813	11500	10701
64	227,812	3493	8069	7001
65	236,344	3014	5518	3638
66	243,562	2592	4626	2976
67	294,812	2654	3596	2141
68	255,750	2504	3434	2491
69	260,312	2517	2045	1601
1970	264,324	2494	1518	484

Source: University of California, Office of the President.
Santa Barbara County Planning Department.

less increases in UCSB enrollment are shown in column 5 of Table 12. As the reader will notice, these new migration estimates are significantly lower than those previously mentioned. The average for the five years 1966-70 is now 1939 per year versus the previous estimate of 3044 per year.

With these recent trends in mind, the next task involves attempting to predict or anticipate future migration. Unfortunately, there is some difficulty in determining and locating those data sources available in 1970. Furthermore, a number of sources listed in section 2 are of more recent vintage. For these reasons, this section will avoid an attempt at a total analysis of the outlook existing in 1970. Rather, a brief examination will suffice. The January 25, 1970 Santa Barbara News-Press highlights the economic expectations within the County for the coming year. Interestingly, three important factors stand out in their analysis; housing starts, defense and NASA spending, and the 1969 oil spill.

Rising interest rates and housing costs were combining to create considerable pessimism regarding future building activity. For the entire State, housing starts were expected to decrease nearly 75,000.[20] Although these figures pertain to the entire State, the factors mentioned will have a significant impact on growth within the County.

Also mentioned in the News-Press article was the anticipated future reduction in defense and NASA spending. As a number of employers throughout the County were dependent upon the growth of these outlays, they have an important impact on migration. Unless new employment opportunities are attracted to the area as substitutes, we may expect some slowing of net migration.*

In addition, the Santa Barbara County economy experienced a shock to its tourist trade as a result of the 1969 oil spill.[21] This lag in tourist expenditures affects job creation in this sector and consequently any in-migration. Assuming that some time must pass before potential visitors forget about the oil spill effects, the

*Later analysis will show that job opportunities must increase at a faster rate than in the past in order to generate any net in-migration.

analyst can expect a continued lag in new jobs for this sector.

Although not mentioned in the News-Press article, another factor with potential impact on future migration was the student unrest and rioting which occurred in early 1970 at the Santa Barbara campus of the Univeristy of California. As students make up a substantial contribution to the income and consequently the employment opportunities for the County, any decrease in enrollment would have important impacts on migration patterns. Assuming that the unrest will have a dampening effect on enrollment, we may expect some time lag before enrollment continues its upward trend.

In 1970, there were no Employment Development Department employment projections for Santa Barbara County. However, the ease with which this model can be updated would have enabled the analyst to incorporate the findings of a General Research Corporation report completed in 1972 for the Santa Barbara County Schools Office[22] This report utilized sophisticated techniques to project future (1975) employment for Santa Barbara County. A simple comparision of this projection and the estimated increase in the county labor force would have provided some indication of the magnitude of future in-migration.

Due to the factors mentioned above, the author forsees the following migration scenario. Net migration will continue its decline for another year, falling to 200. Thereafter, migration will begin a slow climb so that by 1975, migration is back to its 1965-69 five year average of approximately 2500 per year. Such a scenario represents an annual average migration of 1350.* To avoid developing a vast number of

*The program is not currently set up to handle trends in migration over the projection period. A competent programmer could alter this situation if the user so desires.

projections, this migration figure is used for both the upper and lower bound projections. The baseline prediction will be the simple average of the upper and lower bound projections.

With the fertility and migration levels established, the next step is simply to specify the base data. As the 1970 population distribution for Santa Barbara County by single year of age is not available, we utilize the option contained in element #7 of the assumption category. This option allows the use of data on the 13 five-year age group totals less than 64 and the >64 age group total. The program takes each five-year age group total and allocates it to individual years according to the proportions observed in the 1970 census of the entire State.

For example, suppose a county has available base data by five-year age group only. To determine the number of one year olds in the first five year block, the program will take the proportion of one year olds to all those less than five for the entire state and multiply the result by the county's less than five age group.

$$\begin{pmatrix}\text{each age}\\ \text{(state)}\end{pmatrix} \div \begin{pmatrix}\text{five year}\\ \text{age total}\\ \text{(state)}\end{pmatrix} \times \begin{pmatrix}\text{five year}\\ \text{age total}\\ \text{(county)}\end{pmatrix} = \begin{pmatrix}\text{each age}\\ \text{(county)}\end{pmatrix}$$

Hopefully, the bias introduced by such an allocation scheme will be minimal.

In addition, UCSB enrollment has been removed from the base population data due to the invariable age structure of its students. Use of this procedure necessitates adding enrollment to the program results before comparison with the 1975 special census. In other regions, the

TABLE 13

AGE STRUCTURE BY 5 YEAR AGE GROUP FOR 1970

Category	Age Groups														
	< 5	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	>64	Total
White															
Male	79.6	100.4	104.2	93.0	76.4	78.8	63.5	64.1	60.0	61.5	52.7	45.2	37.7	86.5	1003.6
Female	77.8	92.3	100.0	95.6	65.1	74.9	76.5	61.9	63.3	65.5	55.9	49.9	46.3	129.5	1054.5
Total	157.4	192.7	204.2	188.6	141.5	153.7	140.0	125.9	123.3	127.0	108.6	95.1	84.0	216.0	2058.0
Spanish Surname															
Male	25.4	28.9	29.6	24.9	17.5	16.7	15.5	14.4	12.8	11.8	7.9	5.8	5.1	11.8	228.1
Female	24.5	32.0	27.9	24.6	19.9	16.9	15.4	12.4	13.6	10.1	8.5	6.6	5.0	13.2	230.6
Total	49.9	60.9	57.5	49.5	37.4	33.6	30.9	26.8	26.4	21.9	16.4	12.4	10.1	25.0	458.7
Total															
Male	105.0	129.3	133.8	117.9	93.9	95.5	79.0	78.5	72.8	73.3	60.6	51.0	42.8	98.3	1231.7
Female	102.3	124.3	127.9	120.2	85.0	91.8	91.9	74.3	76.9	75.6	64.4	56.5	51.3	142.7	1285.1
Total	207.3	253.6	261.7	238.1	178.9	187.3	170.9	152.7	149.7	148.9	125.0	107.5	94.1	241.0	2516.7
Percent															
Male	0.085	0.105	0.109	0.096	0.076	0.078	0.064	0.064	0.059	0.060	0.049	0.041	0.035	0.080	1.000
Female	0.080	0.097	0.100	0.094	0.066	0.071	0.072	0.058	0.060	0.059	0.050	0.044	0.040	0.111	1.000
Total	0.082	0.101	0.104	0.095	0.071	0.074	0.068	0.061	0.059	0.059	0.050	0.043	0.037	0.096	1.000

DEMOGRAPHIC ESTIMATES

Increase	Births	Deaths	Migration	Child Bearing Females	Total Juvenile	Total Adult	Average Age	Fertility Rates White	Fertility Rates Spanish Surname
0.0	0.0	0.0	0.0	640.7	868.2	1648.5	30.5	2.2	3.7

TABLE 14

AGE STRUCTURE BY 5 YEAR AGE GROUP FOR 1975

Category	< 5	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	>64	Total
White															
Male	73.8	81.1	102.9	106.5	94.6	77.6	80.1	64.5	64.8	60.2	60.8	51.0	42.4	97.0	1057.2
Female	67.8	79.6	94.6	102.4	97.8	66.6	76.5	78.0	62.8	63.9	65.6	55.4	48.6	144.2	1103.8
Total	141.6	160.7	197.4	208.9	192.4	144.2	156.6	142.4	127.6	124.1	126.4	106.4	91.0	241.2	2161.0
Spanish Surname															
Male	32.0	25.9	29.6	30.3	25.3	17.8	17.0	15.7	14.6	12.8	11.7	7.6	5.4	13.2	258.9
Female	29.4	25.1	32.8	28.6	25.2	20.3	17.3	15.7	12.6	13.7	10.1	8.4	6.4	14.9	260.5
Total	61.4	51.0	62.4	58.8	50.5	38.1	34.2	31.4	27.1	26.6	21.8	16.1	11.9	28.1	519.4
Total															
Male	105.8	107.0	132.5	136.8	119.9	95.4	97.1	80.2	79.3	73.0	72.5	58.7	47.8	110.2	1316.1
Female	97.1	104.7	127.4	131.0	123.0	86.9	93.8	93.7	75.4	77.7	75.7	63.8	55.1	159.2	1364.3
Total	203.0	211.7	259.8	267.8	242.9	182.3	190.8	173.9	154.7	150.6	148.2	122.5	102.9	269.3	2680.5
Percent															
Male	0.080	0.081	0.101	0.104	0.091	0.072	0.074	0.061	0.060	0.055	0.055	0.045	0.036	0.084	1.000
Female	0.071	0.077	0.093	0.096	0.090	0.064	0.069	0.069	0.055	0.057	0.056	0.047	0.040	0.117	1.000
Total	0.076	0.079	0.097	0.100	0.091	0.068	0.071	0.065	0.058	0.056	0.055	0.046	0.038	0.100	1.000

DEMOGRAPHIC ESTIMATES

Increase	Births	Deaths	Migration	Child Bearing Females	Total Juvenile	Total Adult	Average Age	Fertility Rates White	Fertility Rates Spanish Surname
26.1	34.6	22.1	13.5	707.8	836.9	1843.6	31.5	1.3	2.2

TABLE 15

AGE STRUCTURE BY 5 YEAR AGE GROUP FOR 1975

Category	Age Groups < 5	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	>64	
White															
Male	88.6	81.1	102.9	106.5	94.6	77.6	80.1	64.5	64.8	60.2	50.8	51.0	42.4	97.0	1072.0
Female	81.3	79.6	94.6	102.4	97.8	66.6	76.5	78.0	62.8	63.9	65.6	55.4	48.6	144.2	1117.3
Total	169.9	160.7	197.4	208.9	192.4	144.2	156.6	142.4	127.6	124.1	126.4	106.4	91.0	241.2	2189.2
Spanish Surname															
Male	38.5	25.9	29.6	30.3	25.3	17.8	17.0	15.7	14.6	12.8	11.7	7.6	5.4	13.2	265.3
Female	35.3	25.1	32.8	23.6	25.2	20.3	17.3	15.7	12.6	13.7	10.1	8.4	6.4	14.9	266.4
Total	73.7	51.0	62.4	58.8	50.5	38.1	34.2	31.4	27.1	26.6	21.8	16.1	11.9	28.1	431.7
Total															
Male	127.1	107.0	132.5	136.8	119.9	95.4	97.1	80.2	79.3	73.0	72.5	58.7	47.8	110.2	1337.3
Female	116.6	104.7	127.4	131.0	122.9	86.9	92.8	93.7	75.4	77.6	75.7	63.8	53.1	159.2	1383.7
Total	243.7	211.7	259.8	267.8	242.9	182.3	190.8	173.8	154.7	150.6	148.2	122.5	102.9	269.3	2721.0
Percent															
Male	0.095	0.080	0.099	0.102	0.090	0.071	0.073	0.060	0.059	0.055	0.054	0.044	0.036	0.082	1.000
Female	0.084	0.076	0.092	0.095	0.089	0.063	0.068	0.068	0.055	0.056	0.055	0.046	0.040	0.115	1.000
Total	0.090	0.078	0.095	0.098	0.089	0.067	0.070	0.064	0.057	0.055	0.054	0.045	0.038	0.099	1.000

DEMOGRAPHIC ESTIMATES

Increase	Births	Deaths	Migration	Child Bearing Females	Total Juvenile	Total Adult	Average Age	Fertility Rates White	Fertility Rates Spanish Surname
42.8	51.4	22.2	13.5	707.7	877.5	1843.4	31.1	2.2	3.7

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user may find it advantageous to remove the military population from the base data. Although Santa Barbara County does contain the rather large Vandenburg Air Force Base, the exact age distribution of its population could not be determined. Therefore, Vandenburg's population was not removed from the base data. Table 13 shows the base data entered into the program for both the lower and upper bound projections.*

The results of both projections are shown in Tables 14 and 15. The 1975 UCSB enrollment of approximately 14,600 must be added to each of the projections. The final results are shown in Table 16 together with the results of the 1975 special census. Although the final results

TABLE 16

COMPARISON OF POPULATION PROJECTIONS WITH THE 1975 SPECIAL CENSUS

Type	Result
Upper bound	286,700
Lower bound	282,650
Baseline	284,675
Special Census	280,600

appear extremely favorable, one must examine the components of population change, natural increase and migration, over the projection period to properly evaluate the computer program. As the lower bound projection is clearly more accurate, it will be used in the evaluation procedure.

Although natural increase and migration data for the years 1970 to 1975 was not examined until after the projection was complete, a comparison is once again quite favorable. Using Santa Barbara County Health Department data, the program missed computing the natural increase

*All numbers are in hundreds.

over the 5 year period by an average of only 246 per year. The major difference occurred in the prediction of births which were high by an average of 212 per year. Although the fertility rate did fall along the trend assumed by the lower bound prediction, the discrepancy may have been created by differences in age specific fertility rates, or by mis-specification of the base data.* As mortality rates generally remain constant over time, the prediction of deaths was extremely accurate; high by an average of only 34 per year.

Excluding UCSB enrollment, migration per year was also slightly mis-specified. Actual migration to the County averaged approximately 1250 per year versus the 1350 per year assumption. However, once again the error is relatively minor given the uncertainty in projecting migration. The above comparisons appear to lend a great deal of validity to the program and the methodology used to make the program work.

As for the upper bound projection, the major discrepancy was in the area of births. Using the constant 2.5 fertility rate, the program calculated births were high by an average 1025 per year. This discrepancy is clearly unacceptable and shows the improvement that can be had through the use of a changing fertility rate in the projection procedure.

A comparison of the final baseline projection with a projection completed by the State reveals the potential power of the computer program. As late as September of 1971, the Department of Finance estimated

*Mis-specification of the base data could result from the use of the 5 year age group totals rather than population by single year of age. Another factor affecting this discrepancy may be the mis-specification of migration levels.

Santa Barbara County 1975 population at approximately 286,000.[23] This projection corresponds closely with the 286,700 of the program's upper bound projection. However, our baseline prediction is closer to the final 1975 result by over 1300. Since public agencies usually make decisions with regard to changes in population levels, the baseline projection represents an improvement of over 8%. Given that the baseline projection could have been completed nearly a year sooner, the improvement is quite substantial. Furthermore, the ease with which the program may be implemented enables constant quarterly or six month updates. At each update, recent fertility trends and migration information could be incorporated into the projection procedure.

An additional feature of the population projection program is the printing of a histogram, for each year of the projection, representing the current population distribution (Figure 15). Such a feature graphically highlights the movement of the age distribution wave over time. This movement is further highlighted by two additional program routines; the estimation of total future households and the estimation of the future labor force.*

By using national household headship rates, the analyst can get an idea of the approximate number of housing units necessary in the future for either an expanding or static population.** For example, Table 17 shows the projected number of households for Santa Barbara County over the next 15 years based on 1970 household headship rates. For comparison,

*Each of these estimation procedures are contained in the main program and the results are automatically printed no matter which output option is chosen.

**These estimates assume that household formation preferences remain relatively constant over time.

FIGURE 15

GRAPHICAL REPRESENTATION OF AGE DISTRIBUTION

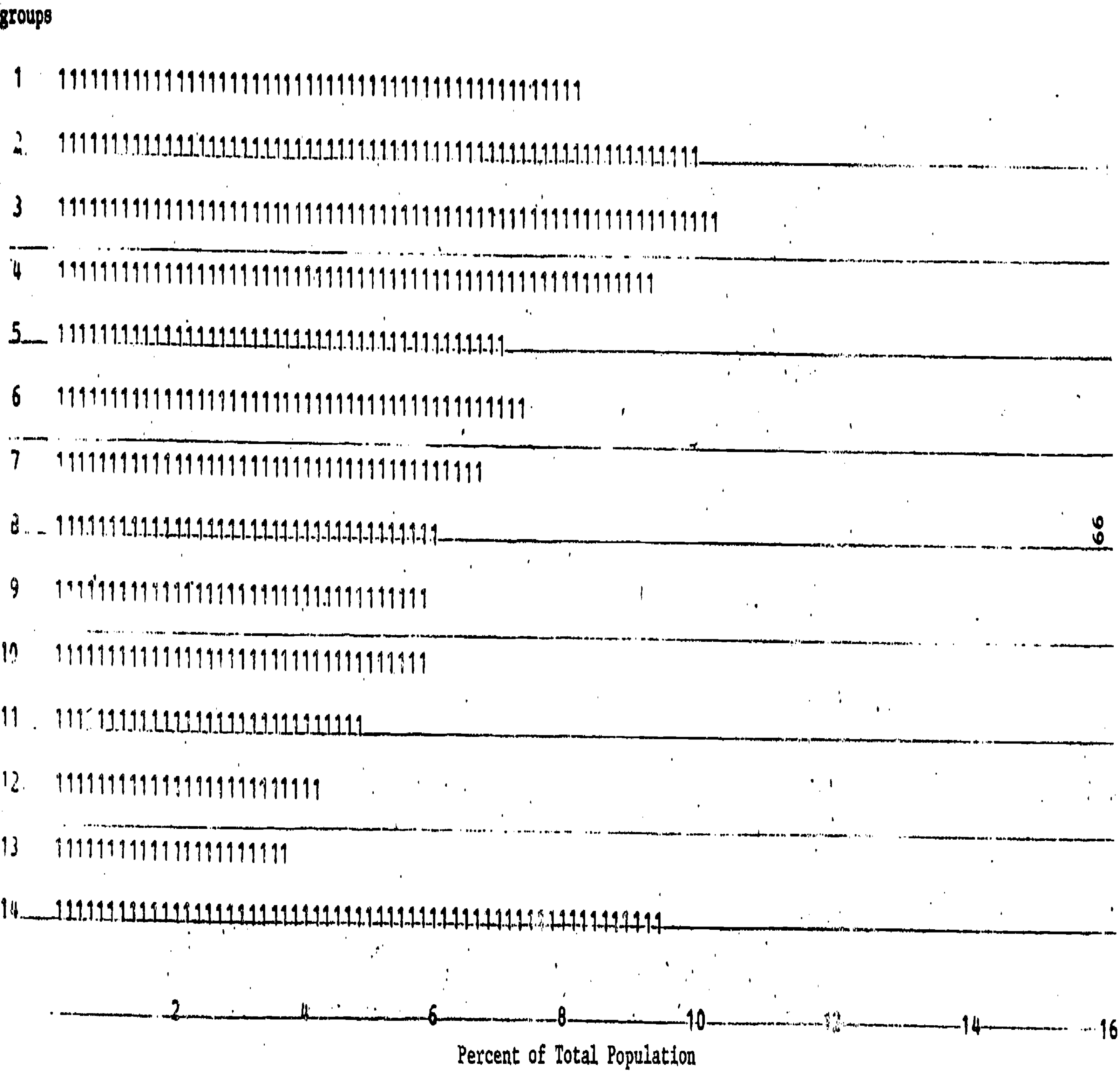


TABLE 17

PROJECTED NUMBER OF HOUSEHOLDS BASED ON HOUSEHOLD HEADSHIP RATES

	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	>64	Total
1970	7.1	39.4	82.4	82.0	76.4	74.8	78.9	66.3	62.3	54.6	154.2	778.5
1971	7.3	42.7	80.9	82.3	76.9	74.9	79.5	68.7	63.7	55.2	156.6	788.8
1972	7.4	44.5	81.9	83.6	78.0	75.0	78.9	71.7	64.7	56.1	159.0	800.8
1973	7.6	46.8	80.8	86.4	79.6	75.1	78.6	73.9	65.8	56.8	161.7	813.0
1974	7.7	49.4	79.2	88.4	81.9	75.4	77.8	75.8	67.0	57.8	164.4	824.7
1975	7.8	52.1	78.1	89.2	84.7	75.4	77.8	76.5	69.2	58.1	168.0	837.0
1976	7.9	53.2	84.9	87.6	85.0	75.9	77.9	77.1	71.8	59.4	170.3	850.8
1977	7.9	54.3	88.4	88.7	86.3	77.0	77.9	76.5	74.9	60.3	172.8	865.0
1978	7.8	55.3	92.8	87.4	89.1	78.6	78.0	76.2	77.2	61.3	175.6	879.5
1979	7.8	56.0	98.1	85.7	91.2	80.9	78.3	75.4	79.1	62.4	178.5	893.6
1980	7.6	57.0	103.4	84.6	92.1	83.6	78.3	75.4	79.9	64.5	181.7	908.2
1981	7.3	57.3	105.6	91.9	90.4	83.9	78.9	75.5	80.5	66.9	184.6	922.7
1982	6.9	57.3	107.8	95.8	91.5	85.2	80.0	75.5	79.8	69.8	187.3	937.1
1983	6.6	56.9	109.8	100.5	90.2	88.0	81.7	75.7	79.6	71.9	190.4	951.3
1984	6.3	56.6	111.3	106.2	88.5	90.1	84.1	76.0	78.7	73.7	193.6	965.0
1985	6.2	55.2	113.3	112.0	87.3	90.9	86.9	75.9	78.8	74.4	198.0	978.9

these figures are based upon an assumption of zero in-migration.

The totals show the nearly 26% increase in housing units (1970-85) necessary to accomodate the 1970 county population. These figures are conservative for 3 reasons: county residents tend to form households at greater rates than the national averages; 1970 household formation rates are used although the rates are expected to increase (and have done so), and this projection was made with the assumption of zero in-migration. Relaxing this assumption will, of course, increase the totals.

The above exercise serves to point out two important facts. Due mainly to the age structure bulge, new housing construction does not necessarily reflect or create increased population due to in-migration.* Second, those areas with little or no increase in the number of housing units may expect a decline in total population. As members of the age structure bulge move into the prime household formation years, they will wish to leave their parental households and form their own. These conclusions will not, of course, apply to all regions. For example, areas suffering from high unemployment may find that in the short run, an increase in housing units leads to higher vacancy rates rather than more people. However, for most areas the conclusions are probably accurate.

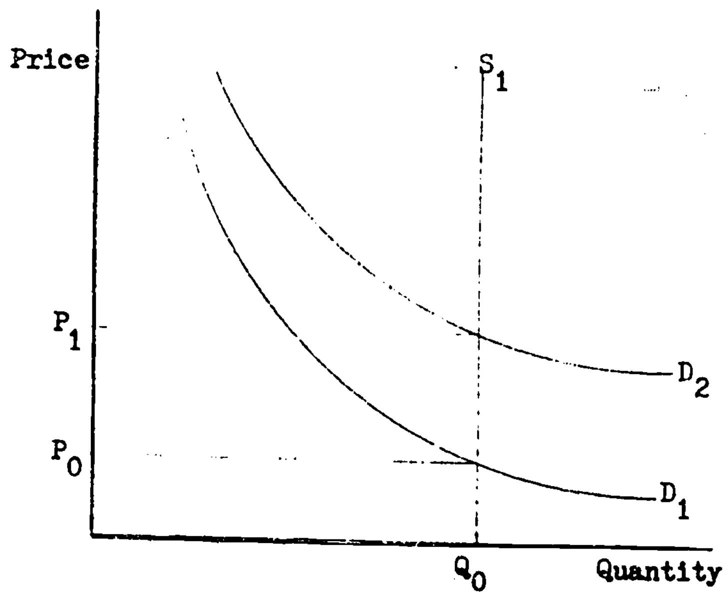
With this background in mind and using elementary economics, the

*This fact seems to have been neglected in many environmental impact reports (EIR's) and revenue-cost studies conducted on proposed housing developments. Often, these reports assume that new housing developments will increase a community's population. This increase is determined through multiplying a household size figure (often outdated and incorrect) by the number of proposed housing units. Unfortunately, these reports neglect the fact that due to the age structure bulge, a significant portion of the development's occupants may not come from out of the area, but rather will be present residents forming new households. Consequently, a number of the harmful environmental and fiscal costs will be eliminated.

analyst can list a few key consequences of a policy designed to limit or prohibit new housing construction. In Figure 16, curve D_1 and curve S_1 represent the present demand and supply for a given type of single-family dwelling. Assuming favorable economic conditions, as larger and larger numbers of individuals move into the above 30 age bracket, one can expect more of this type of housing to be demanded at all prices. Thus, the demand curve may shift out to D_2. Holding the supply constant, one can easily see that the equilibrium price must rise, and in this case, the price rises to P_1.

FIGURE 16

DEMAND AND SUPPLY FOR HOUSING



Such a price rise will effectively eliminate a number of people from this particular housing market. Or, sufficiently large price increases will encourage families to "double-up" and may induce some over crowding. As property values increase, property taxes will tend to

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rise, leading to financial pressure on those with fixed incomes. Undoubtedly, there will be political pressure to increase the amount and number of housing subsidies for low income families.

A similar type of exercise can be conducted for occupational opportunities. Using Bureau of Labor Statistics estimates and projections of national labor force participation rates for the fifteen year span (1970-1985), one can obtain an approximate idea of the number of new jobs required for Santa Barbara County's 1970 inhabitants. Once again assuming in-migration is zero, combining the program's age distribution projections with the appropriate labor force participation rates results in the probable number of jobs necessary to satisfy a relatively static population.* Table 18 shows the program computed labor force for 1975, 1980, and 1985. The 1985 total represents a 29% increase over the 1970 total and a nearly 20% increase over the 1975 level. If job opportunities are not forthcoming in the required levels, one may expect decreased in-migration levels if not significant out-migration. The local analyst should remember that employment requirements do not grow in relation to total population, but rather they grow in relation to that portion of the population entering the labor force. Due to the age structure bulge, the labor force will increase dramatically over the years 1970-85. If local decision makers attempt to eliminate new employment opportunities in an effort to control population growth, the region may actually experience a net out-migration.

Although there are numerous deficiencies with such a cursory analysis, the above background can provide clues as to the effect of a

*These estimates are also conservative.

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TABLE 18

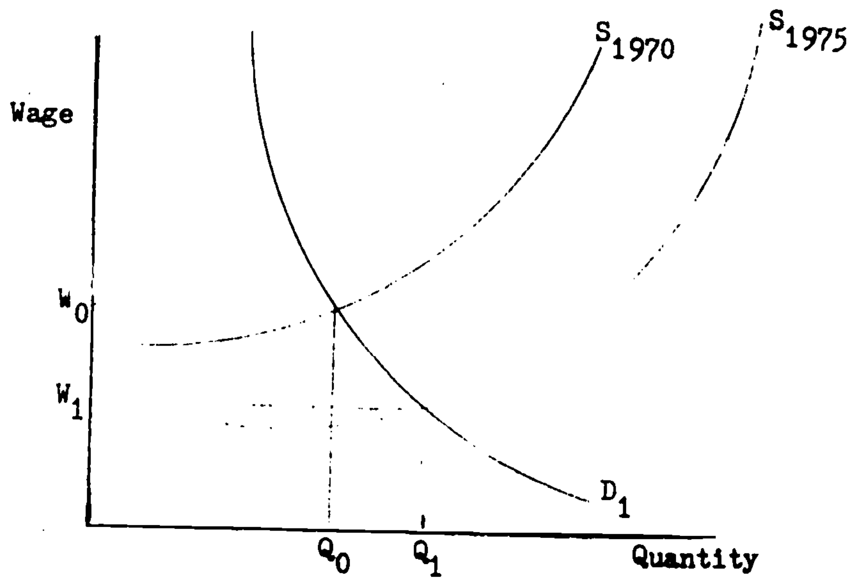
ESTIMATED TOTAL LABOR FORCE FOR SELECTED YEARS

	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	> 64	Total
1975	80.9	105.1	111.9	98.2	94.0	90.9	91.5	78.3	55.3	48.0	29.7	883.7
1980	79.3	148.4	133.9	103.2	112.8	98.8	90.5	86.0	71.7	58.8	34.8	1018.3
1985	63.1	141.0	146.5	133.3	105.1	112.0	97.9	88.2	68.2	66.4	36.3	1058.0

public policy which attempts to limit or curtail new job opportunities.** Figure 16 shows the typical market situation for a particular type of employment. For the purposes of this analysis, the curves represent the demand for and supply of unskilled and semi-skilled labor. As outlined above, the population wave will increase the supply of labor at all wages from the curve represented by S_{1970} to that represented by S_{1975}. If the demand for labor (job openings) does not rise quickly, we may expect

FIGURE 17

DEMAND AND SUPPLY FOR LABOR



significant downard pressure on wages. In fact, using the above static analysis, the equilibrium wage rate would fall from W_0 to W_1.

If wages are not allowed to drop to W_1, due to either legal or social restraints, one may expect the surplus labor to be allocated in a non-market manner. For example, the educational qualifications necessary to hold particular jobs could be increased. Such a situation, unless a strong affirmative action policy is pursued, may fall heavily on members

*One such objection might concern the existence of a significant out-migration of peak age groups. Recent driver license information does not support this objection. (See Table 4).

of the minority community. In addition, the drop in wages could adversely affect per capita incomes. Any drop in per capita incomes would have a negative impact on the fiscal situation of local government.

Conclusion

Population is an important aspect of regional or local decision making. The absolute level and the expected rate of change of a given population provides the impetus for action on the part of local governments. In most cases, the local analyst must rely on population estimates and projections produced by some higher level of government. This paper describes the manner by which such estimates and projections are made and suggests methods of improvement. In addition, the paper explains an often overlooked component of population analysis: the age structure. Hopefully, the reader now has the background and the tools to critically analyze and significantly improve local and regional analysis concerning population.

APPENDIX

POPULATION PROJECTION PROGRAM OPERATION

The computer program is written in Fortran IV for the IBM 360/75 computer at the University of California, Santa Barbara. The entire program is reprinted in Figure A-1. In addition to the actual program, numerous pieces of data are also supplied. Figure A-2 reprints this data in the order in which it occurs.

The information necessary from the user consists of 3 basic categories: assumptions, migration data, and age group base data. The assumption data card consists of 9 numbers. The explanation for the first 3 numbers is relatively straightforward. The user inputs

INFORMATION NECESSARY ON ASSUMPTION DATA CARD

Columns	Data Explanation
3-5	Ultimate fertility rate for white women.
8-10	Ultimate fertility rate for black women.
13-15	Ultimate fertility rate for Spanish surname women.
18-20	Choice of migration allocation.
21-25	Date of base data.
18-30	Choice of output.
33-35	Choice of age group allocation.
38-40	Number of projection years.
43-45	Choice of fertility trends.

fertility rates (i.e., 2.1) for each racial or ethnic group of interest.* Based on U.S. Bureau of the Census figures, the program will compute

*All numbers inserted into the assigned columns should include a decimal point and one place to the right of the decimal.

FIGURE A-1

POPULATION PROJECTION PROGRAM

```
C  THESE LINES WILL SPECIFY EACH VARIABLE
C    DATA=USER SPECIFIED ASSUMPTIONS
C    BAS=USER SPECIFIED 5 YEAR AGE GROUP POPULATION FIGURES
C    MI=USER SPECIFIED SINGLE MIGRATION ESTIMATE
C    MIG=USER SPECIFIED MIGRATION FIGURES BY SINGLE YEAR OF AGE
C    AGE=AGE DISTRIBUTION BY SINGLE YEAR OF AGE EITHER USER SPECIFIED OR PROGRA
C    COMPUTED
C    TREND=USER SPECIFIED INITIAL AND ENDING FERTILITY RATES( IF SO CHOSEN)
C  FER=CENSUS BUREAU AGE-SPECIFIC FERTILITY RATES FOR SERIES 1 PROJECTION
C  MORT=CONSTANT MORTALITY RATES
C  CAL=1970 CALIFORNIA POPULATION FIGURES BY SINGLE YEAR OF AGE
C  CATOT=1970 CALIFORNIA POPULATION 5 YEAR AGE GROUP TOALS
C  HOSH=PROGRAM SUPPLIED 1970 HOUSEHOLD FORMATION RATES
C  LABOR= PROGRAM SUPPLIED LABOR FORCE PARTICIPATION RATES FOR 1973,1980,1990
C  MIGR=COMPUTED MIGRATION FIGURES BY SINGLE YEAR OF AGE IF OPTION CHOSEN
C  FERT=PROGRAM COMPUTED AGE-SPECIFIC FERTILITY RATES
C  AGE5Y=PROGRAM COMPUTED AGE DISTRIBUTION BY 5 YEAR AGE GROUP
C  DEMO=PROGRAM COMPUTED DEMOGRAPHIC ESTIMATES FOR EACH YEAR
C  LFP=PROGRAM ESTIMATED LABOR FORCE
C  HH=PROGRAM ESTIMATED NUMBER OF HOUSEHOLDS
C
      REAL DATA(9),CAL(66),MIG(66),FER(36),MORT(2,66),CATOT(13),MIGR(3,
     167,21),AGE(15,67,21),FERT(3,36),AGE5Y(15,15,21)
      REAL DEMO(11,21),BAS(12,15),MI,TREND(6)
      INTEGER R,T,X,S,C(100)
      REAL HOSH(11),LABOR(2,11,3),LFP(3,12,3),HH(12,21)
      DATA HOSH,LABOR,LFP,HH/11*0.,66*0.,108*0.,252*0./
      DATA AGE,BAS,DEMO,MIG,AGE5Y,MIGR,TREND/21105*0.,180*0.,231*0.,66*0
     1.,4725*0.,16884*0.,6*0./
C
C  READ IN PROGRAM SUPPLIED INPUT DATA
C
      READ(5,1019) (FER(I),I=1,36)
      READ(5,1019) (MORT(1,J),J=1,66)
      READ(5,1019) (MORT(2,J),J=1,66)
 1019 FORMAT(16F5.4)
      READ(5,1029) (CATOT(I),I=1,13)
      READ(5,1029) (CAL(I),I=1,65)
 1029 FORMAT(13F6.1)
C
C     IF APPLICABLE, READ IN HOUSEHOLD FORMATION RATES(1970) AND LABOR
C     FORCE PARTICIPATION RATES FOR 1970,1980,1985
C
      READ(5,1019) (HOSH(I),I=1,11)
      DO 83 I=1,2
      DO 83 K=1,3
      READ(5,1019)  (LABOR(I,J,K),J=1,11)
   83 CONTINUE
C
C   READ USER INPUT DATA ACCORDING TO OPTION CHOSEN-ASSUMPTION CARD,
C     MIGRATION CARD(S), BASE AGE DISTRIBUTIONS
C
      READ(5,1021) (DATA(I),I=1,9)
 1021 FORMAT(4F5.1,F5.0,4F5.1)
      IF(DATA(9).EQ.0.) GO TO 505
      READ(5,1020) (TREND(I),I=1,6)
  505 IF(DATA(4).EQ.0.) GO TO 5000
      READ(5,1020) (MIG(I),I=1,66)
```

```
 1020 FORMAT(16F5.1)
      IF(DATA(4).EQ.1.) GO TO 4000
 5000 READ(5,1020) MI
 4000 IF(DATA(7).EQ.1.) GO TO 5001
      READ(5,1020) ((AGE(I,J,1),J=1,66),I=1,2)
      READ(5,1020) ((AGE(I,J,1),J=1,66),I=4,5)
      READ(5,1020) ((AGE(I,J,1),J=1,66),I=7,8)
      IF(DATA(7).EQ.0.) GO TO 4001
 5001 READ(5,1027) ((BAS(I,J),J=1,14),I=1,2)
      READ(5,1027) ((BAS(I,J),J=1,14),I=4,5)
      READ(5,1027) ((BAS(I,J),J=1,14),I=7,8)
 1027 FORMAT(14F5.1)
C
C     WRITE INPUT DATA- CENSUS BUREAU AGE-SPECIFIC FERTILITY RATES(SERIE
C     S 2.7), PROGRAM COMPUTED FERTILITY RATES, MORTALITY RATES
C
 4001 WRITE(6,1050)
      WRITE(6,1051) (FER(I),I=1,36)
      DO 31 K=1,2
      IF(K.EQ.1) WRITE(6,1056)
      IF(K.EQ.2) WRITE(6,1057)
      WRITE(6,1053) (MORT(K,I),I=1,66)
   31 CONTINUE
      WRITE(6,1054) (DATA(I),I=1,9)
      WRITE(6,1060)
      WRITE(6,1061) (CAL(I),I=1,65)
      WRITE(6,1062) (CATOT(I),I=1,13)
      R=DATA(8)
      X=R+1
      IF(DATA(7).EQ.0.) GO TO 5003
      M=1
      N=2
 5002 DO 3 I=M,N
      AGE(I,66,1)=BAS(I,14)
      L=1
      K=5
      DO 3 T=1,13
      DO 4 J=L,K
C
C    PERFORM BASE AGE DISTRIBUTION ALLOCATION IF SO CHOSEN
C
      AGE(I,J,1)=BAS(I,T)*CAL(J)/CATOT(T)
    4 CONTINUE
      L=K+1
      K=K+5
    3 CONTINUE
      IF(N.EQ.8) GO TO 5003
      M=N+2
      N=N+3
      GO TO 5002
 5003 DO 100 K=1,X
 9000 DO 5 I=1,8
      IF(I.EQ.3.OR.I.EQ.6) GO TO 5
      DO 6 J=1,66
      AGE(I,67,K)=AGE(I,67,K)+AGE(I,J,K)
    6 CONTINUE
    5 CONTINUE
C
C    TOTAL ETHNIC GROUP DISTRIBUTIONS AND COMPUTE MIGRATION ALLOCATION
C
```

```
      DO 7 J=1,67
      AGE(3,J,K)=AGE(1,J,K)+AGE(2,J,K)
      AGE(6,J,K)=AGE(4,J,K)+AGE(5,J,K)
      AGE(9,J,K)=AGE(7,J,K)+AGE(8,J,K)
      AGE(10,J,K)=AGE(1,J,K)+AGE(4,J,K)+AGE(7,J,K)
      AGE(11,J,K)=AGE(2,J,K)+AGE(5,J,K)+AGE(8,J,K)
      AGE(12,J,K)=AGE(10,J,K)+AGE(11,J,K)
    7 CONTINUE
C
C  COMPUTE APPROPRIATE AGE-SPECIFIC FERTILITY RATES ACCORDING TO OPTION CHOSEN
C
      IF(DATA(9).EQ.0.) GO TO 503
      DEMO(9,K)=TREND(1)-(((TREND(1)-TREND(2))/DATA(8))*(K-1))
      DEMO(10,K)=TREND(3)-(((TREND(3)-TREND(4))/DATA(8))*(K-1))
      DEMO(11,K)=TREND(5)-(((TREND(5)-TREND(6))/DATA(8))*(K-1))
      DO 40 M=9,11
      DO 40 J=1,36
      FERT(M-8,J)=(DEMO(M,K)/2.7)*FER(J)
   40 CONTINUE
      IF(DATA(9).EQ.1.) GO TO 506
  503 DO 1 I=1,3
      DO 1 M=1,36
      FERT(I,M)=(DATA(I)/2.7)*FER(M)
      DEMO(I+8,K)=DATA(I)
    1 CONTINUE
  506 IF(K.EQ.X) GO TO 8090
      DO 8 I=1,12
      DO 8 J=1,67
      IF(DATA(4).EQ.1.) GO TO 500
      MIGR(I,J,K)=MI*AGE(I,J,K)/AGE(12,67,K)
      IF(DATA(4).EQ.0.) GO TO 8
  500 MIGR(I,J,K)=MIG(J)*(AGE(I,J,K)/AGE(12,J,K))
    8 CONTINUE
      I=2
 8020 SUM1=0
      SUM2=0
      DO 9 J=15,50
      IF(I.EQ.2) M=1
      IF(I.EQ.5) M=2
      IF(I.EQ.8) M=3
C
C   ADVANCE EACH AGE GROUP BY 1 YEAR
C
      SUM1=SUM1+(AGE(I,J,K)*FERT(M,J-14)*.525)
      SUM2=SUM2+(AGE(I,J,K)*FERT(M,J-14)*.475)
    9 CONTINUE
      AGE(I-1,1,K+1)=SUM1+MIGR(I-1,1,K)
      AGE(I,1,K+1)=SUM2+MIGR(I,1,K)
      IF(I.EQ.8) GO TO 8000
      I=I+3
      GO TO 8020
 8000 DO 10 I=1,8
      IF(I.EQ.3.OR.I.EQ.6) GO TO 10
      IF(I.EQ.1.OR.I.EQ.4.OR.I.EQ.7) M=1
      IF(I.EQ.2.OR.I.EQ.5.OR.I.EQ.8) M=2
      DO 11 J=1,64
      AGE(I,J+1,K+1)=AGE(I,J,K)*MORT(M,J)+MIGR(I,J,K)
   11 CONTINUE
      AGE(I,66,K+1)=AGE(I,65,K)*MORT(M,65)+AGE(I,66,K)*MORT(M,66)+MIGR(I
     1,66,K)
```

```
   10 CONTINUE
  100 CONTINUE
 8090 DO 101 K=1,X
      DO 12 I=1,12
C
C  TOTAL AGE DISTRIBUTION BY 5 YEAR AGE GROUP
C
      AGE5Y(I,14,K)=AGE(I,66,K)
      J=1
      DO 12 M=1,13
      AGE5Y(I,M,K)=AGE(I,J,K)+AGE(I,J+1,K)+AGE(I,J+2,K)+AGE(I,J+3,K)+AGE
     1(I,J+4,K)
      J=J+5
   12 CONTINUE
      DO 14 I=1,12
      DO 14 M=1,14
      AGE5Y(I,15,K)=AGE5Y(I,15,K)+AGE5Y(I,M,K)
   14 CONTINUE
      DO 13 I=10,12
      DO 13 M=1,15
      AGE5Y(I+3,M,K)=AGE5Y(I,M,K)/AGE5Y(I,15,K)
   13 CONTINUE
  101 CONTINUE
      DO 102 K=1,X
C
C   COMPUTE DEMOGRAPHIC ESTIMATES
C
      DEMO(1,K+1)=AGE(12,67,K+1)-AGE(12,67,K)
      DO 84 I=10,11
      DO 84 J=1,66
      DEMO(3,K+1)=DEMO(3,K+1)+AGE(I,J,K)*(1.-MORT(I-9,J))
   84 CONTINUE
      DO 20 J=15,50
      DEMO(5,K)=DEMO(5,K)+AGE(11,J,K)
   20 CONTINUE
      DEMO(2,K+1)=AGE(12,1,K+1)-MIGR(12,1,K)
      DO 21 J=1,18
      DEMO(6,K)=DEMO(6,K)+AGE(12,J,K)
   21 CONTINUE
      DEMO(7,K)=AGE(12,67,K)-DEMO(6,K)
      SUM=0
      DO 22 J=1,66
      SUM=SUM+AGE(12,J,K)*(J-1)
   22 CONTINUE
      DEMO(8,K)=SUM/AGE(12,67,K)
      DEMO(4,K+1)=MIGR(1,67,K)+MIGR(2,67,K)+MIGR(4,67,K)+MIGR(5,67,K)+MI
     1GR(7,67,K)+MIGR(8,67,K)
  102 CONTINUE
      IF(DATA(6).EQ.1.) GO TO 6000
C
C  PRINT OUT DETAILED RESULTS
C
      DO 103 K=1,X
      S=DATA(3)+K-1.
      WRITE(6,1000) S
      WRITE(6,1001)
      WRITE(6,1002)
      DO 75 I=1,15
      IF(I.EQ.1) WRITE(6,2050)
      IF(I.EQ.4) WRITE(6,2051)
```

```
      IF(I.EQ.7) WRITE(6,2052)
      IF(I.EQ.10) WRITE(6,2055)
      IF(I.EQ.13) WRITE(6,2056)
      IF(I.EQ.1.OR.I.EQ.4.OR.I.EQ.7.OR.I.EQ.10) WRITE(6,2053) (AGE5Y(I,J,
     1K),J=1,15)
      IF(I.EQ.2.OR.I.EQ.5.OR.I.EQ.8.OR.I.EQ.11) WRITE(6,2054) (AGE5Y(I,J,
     1K),J=1,15)
      IF(I.EQ.3.OR.I.EQ.6.OR.I.EQ.9.OR.I.EQ.12) WRITE(6,2057) (AGE5Y(I,J,
     1K),J=1,15)
   75 CONTINUE
      WRITE(6,2058) (AGE5Y(13,J,K),J=1,15)
      WRITE(6,2059) (AGE5Y(14,J,K),J=1,15)
      WRITE(6,2060) (AGE5Y(15,J,K),J=1,15)
      WRITE(6,1010)
      WRITE(6,1011)
      WRITE(6,1012) (DEMC(I,K),I=1,11)
      WRITE(6,2020)
      WRITE(6,2022)
C
C  PRINT OUT BAR GRAPH OF AGE DISTRIBUTION
C
      DO 79 I=1,100
      C(I)=1
   79 CONTINUE
      DO 80 J=1,14
      L=(AGE5Y(15,J,K))*600
      WRITE(6,2021)J,(C(N),N=1,L)
   80 CONTINUE
      WRITE(6,2023)
      WRITE(6,2025)
 2020 FORMAT('1','-',30X,'GRAPHICAL REPRESENTATION OF AGE DISTRIBUTION')
 2021 FORMAT('0',10X,I2,3X,100I1)
 2022 FORMAT('-','AGE GROUPS')
 2023 FORMAT('-',26X,'2',11X,'4',11X,'6',11X,'8',11X,'10',11X,'12',11X,'
    114',11X,'16')
 2025 FORMAT('0',50X,'PERCENT OF TOTAL POPULATION')
  103 CONTINUE
 2050 FORMAT('-',13X,'WHITE')
 2051 FORMAT('-',13X,'BLACK')
 2052 FORMAT('-',8X,'SPAN. SUR.')
 2053 FORMAT(' ',14X,'MALE',7X,14F6.1,F10.1)
 2054 FORMAT(' ',12X,'FEMALE',7X,14F6.1,F10.1)
 2055 FORMAT('-',13X,'TOTAL')
 2056 FORMAT('-',11X,'PERCENT')
 2057 FORMAT('0',13X,'TOTAL',7X,14F6.1,F10.1)
 2058 FORMAT(' ',14X,'MALE',7X,14F6.3,F10.3)
 2059 FORMAT(' ',12X,'FEMALE',7X,14F6.3,F10.3)
 2060 FORMAT('0',13X,'TOTAL',7X,14F6.3,F10.3)
      WRITE(6,1014)
      WRITE(6,1002)
C
C  PRINT OUT SUMMARY RESULTS
C
 6000 DO 104 K=1,X
      S=DATA(5)+K-1.
      WRITE(6,1015)S,(AGE5Y(12,J,K),J=1,15)
  104 CONTINUE
C
C     COMPUTE HOUSEHOLD FORMATIONS AND LABOR FORCE PARTICIPATION
C
```

```
      DO 150 K=1,X
      DO 150 J=1,11
      HH(J,K)=AGE5Y(12,J+3,K)*HOSH(J)
      HH(12,K)=HH(12,K)+HH(J,K)
  150 CONTINUE
      DO 153 K=1,3
      IF(K.EQ.1)M=1
      IF(K.EQ.2)M=11
      IF(K.EQ.3)M=16
      DO 152 I=1,2
      LFP(I,1,K)=(AGE5Y(I,4,M)-AGE(I,16,M))*LABOR(I,1,K)
      DO 151 J=2,11
      LFP(I,J,K)=AGE5Y(I,J+3,M)*LABOR(I,J,K)
  151 CONTINUE
  152 CONTINUE
      DO 154 I=1,2
      DO 154 J=1,11
      LFP(I,12,K)=LFP(I,12,K)+LFP(I,J,K)
  154 CONTINUE
      DO 153 J=1,12
      LF (3,J,K)=LFP(1,J,K)+LFP(2,J,K)
  153 CONTINUE
C
C     WRITE ESTIMATED HOUSEHOLD FORMATIONS AND ESTIMATED LABOR FORCE
C     PARTICIPATION FOR SELECTED YEARS.
C
      WRITE(6,2005)
      WRITE(6,1002)
      DO 200 K=1,X
      S=DATA(5)+K-1
      A=0.
      WRITE(6,1015)S,A,A,A,(HH(J,K),J=1,12)
  200 CONTINUE
      WRITE(6,2006)
      WRITE(6,1002)
      WRITE(6,2007) ((LFP(3,J,K),J=1,12),K=1,3)
 2005 FORMAT('1','-',25X,'PROJECTED NUMBER OF HOUSEHOLDS BASED ON HOUSEH
     1OLD HEADSHIP RATES-1970')
 2006 FORMAT('1','-',40X,'ESTIMATED TOTAL LABOR FORCE FOR SELECTED YEARS
     1')
 2007 FORMAT('-',11X,'1975',28X,11F6.1,F10.1/'0',11X,'1980',28X,11F6.1,
     1F10.1/'0',11X,'1985',28X,11F6.1,F10.1)
 1014 FORMAT('1',57X,'SUMMARY TOTALS')
 1015 FORMAT('0',9X,I4,12X,14F6.1,F10.1)
 1000 FORMAT('1','-',40X,'AGE STRUCTURE BY 5 YEAR AGE GROUP FOR  ',I4)
 1001 FORMAT('-','-',10X,'CATEGORY',55X,'AGE GROUPS')
 1002 FORMAT('0',27X,'LT 5',3X,'5-9',1X,
     2 '10-14',1X,'15-19',1X,'20-24',1X,
     3'25-29',1X,'30-34',1X,'35-39',1X,'40-44',1X,'45-49',1X,'50-54',1X,
     4'55-59',1X,'60-64',1X,'GT 64',5X,'TOTAL')
 1010 FORMAT('-','-',48X,'DEMOGRAPHIC ESTIMATES')
 1012 FORMAT('-',11(F11.1))
 1011 FORMAT('-',49X,'CHILD-'/' ',48X,'BEARING',2(6X,'TOTAL'),4X,'AVERAG
     1E',9X,'FERTILITY RATES'/' ',3X,'INCREASE',5X,'BIRTHS',5X,'DEATHS',
     22X,'MIGRATION',4X,'FEMALES',3X,'JUVENILE',6X,'ADULT',8X,'AGE',6X,
     3'WHITE',6X,'BLACK',1X,'SPAN. SUR.')
 1050 FORMAT(40X,'INPUT DATA FOR POPULATION PROJECTION PROGRAM')
 1051 FORMAT(8X,'CENSUS BUREAU AGE-'/2X,'SPECIFIC FERTILITY RATES'/10X,
     1'BY AGE (14 - 49)',5X,14F7.4,2(/31X,14F7.4))
 1053 FORMAT(3X,'CENSUS BUREAU MORTALITY'/3X,'RATES BY AGE(0 - GT 65)',5
```

```
      1X,14F7.4,2(/31X,14F7.4))
 1054 FORMAT('-',6X,'DATA FROM ASSUMPTION'/23X,'CARD',4X,14F7.1)
 1057 FORMAT('-',19X,'FEMALE')
 1056 FORMAT('-',21X,'MALE')
 1060 FORMAT('-','-',25X,'EXTRANEOUS INPUT DATA FOR PROGRAM VALIDATION')
 1061 FORMAT('-',22X,'CAI',5X,14F7.1,5(/,31X,14F7.1))
 1062 FORMAT('-',20X,'CATCI',5X,14F7.1)
      STOP
      END
```

FIGURE A-2
PROGRAM SUPPLIED DATA

```
.4540.6490.5090.5090.5440.5440.5740.5740.4540.4540.0950
.4550.5340.5020.5020.5320.5320.5620.5620.4470.4470.0960
.4740.6100.4990.4990.5310.5310.5340.5340.4080.4080.0840
.5550.8240.9440.9440.9490.9490.9170.9170.7810.7810.2000
.5600.8300.9460.9460.9510.9510.9190.8190.7910.7910.2120
.6080.8560.9460.9460.9540.9540.9190.9190.7720.7720.2180
.0300.2200.4400.4800.5000.5000.5300.5300.5800.5800.6400
 213.5 203.6 202.4 201.8 193.8 187.3 178.6 171.8 174.6 157.7 154.2 144.1 140.1
 236.0 249.0 238.9 239.7 238.8 248.1 253.8 249.9 248.0 252.1 242.1 249.0 220.6
 305.6 310.6 275.9 261.6 264.1 247.8 241.8 232.0 233.8 234.3 224.3 228.7 226.
 388.5 385.1 377.1 368.2 366.2 354.9 351.0 359.8 349.6 365.8 370.5 295.2 304.
 340.5 386.2 313.7 323.4 338.9 362.2 379.5 387.0 391.6 397.7 406.1 388.9 395.0
1642. 71978.11968.61817.41740.91457.71219.51149.91808.51245.81083.8 933.9 770.8
.9856.95
.9955.9952.9948.9944.9989.9935.9830.9924.9912.9912.9905.9900.9888.9879.9871.9853
.9988.9987.9956.9985.9984.9983.9981.9979.9977.9975.9973.9970.9968.9965.9962.9959
.9994.9994.9993.9993.9993.9993.9993.9993.9993.9992.9992.9992.9991.9990.9990.9989
.9979.9991.9994.9995.9996.9995.9996.9997.9997.9997.9997.9997.9997.9996.9995.9995
.9707.94
.9933.9927.9919.9912.9903.9894.9884.9879.9362.9849.9836.9821.9805.9786.9770.9750
.9979.9979.9978.9977.9976.9975.9973.9970.9978.9965.9962.9948.9954.9950.9945.9929
.9990.9984.9983.9981.9980.9979.9978.9978.9979.9978.9980.9981.9981.9981.9980.9980
.9325.9972.9988.9993.9994.9995.9995.9999.9995.9996.9997.9997.9997.9996.9993.9990
.0005.0003.0001.0000
.1223.0977.0757.0577.0445.0343.0270.0216.0170.0131.0098.0068.0046.0030.0017.0009
.0018.0085.0256.0552.0891.1178.1437.1578.1903.2088.2178.2155.2079.1913.1723.1485
```

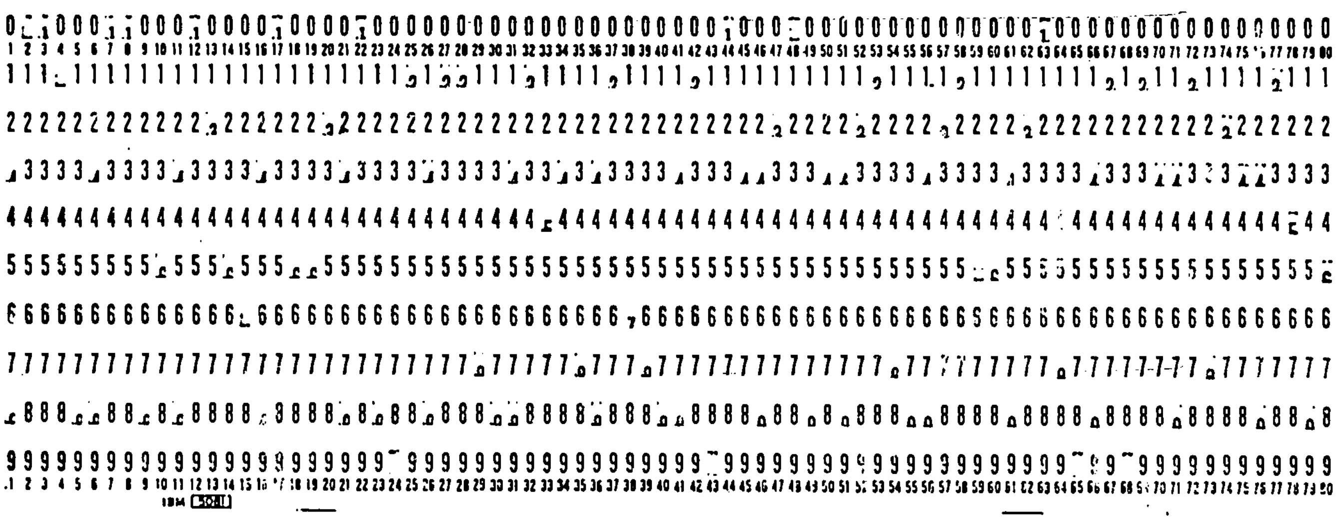


FIGURE A-2

PROGRAM SUPPLIED DATA (CONTINUED)

- Female labor force participation rates for 1985. - Male labor force participation rates for 1985. - Female labor force participation rates for 1980. - Male labor force participation rates for 1980. - Female labor force participation rates for 1975. - Male labor force participation rates for 1975.	By age groups 16-19, 20-24, 25-29, . . ., 60-64, and > 64.

- Household headship rates for 1970 (age groups 15-19, 20-24, . . ., 60-64, and > 64).

California population (1970) by single year of age < 65.

California population (1970) 5 year age group totals < 65.

Female survival rates by single year of age < 65 and 1 value for > 64.

Male survival rates by single year of age < 65 and 1 value for > 64.

Census Bureau age-specific fertility rates for the 2.7 ultimate fertility level.

age specific fertility rates for each race.*

There are a number of program options available to the user. For example, columns 18-20 allow the user to choose between two types of migration allocations. If a 0.0 is inserted in these columns, the user can specify one total migration figure. This total yearly figure is allocated by the program to each racial and age group according to its current share of the total population. If the user feels that certain age groups are over represented in net migration, he or she may insert a 1.0 in columns 18-20. If this is the case, the program will look for 66 migration values: 1, 1-64 by single years, and >64. These age group figures will be allocated among the various races according to their share of the total population.

Columns 21-25 require the date of the base data population figures by the user. For example, if population figures from the 1970 census are used, the correct number to be inserted would be 1970.

A choice of output form is also provided. If the user desires the detailed output shown in Tables 13-15 (pp. 58-60), a 0.0 is inserted into columns 28-30. A 1.0 in these columns reduces the output to that in Figure A-3.

As mentioned, the program requires base population data for 66 age groups: 1 year old, 1-64 by single year of age, and >64 years old. If this data is available, a 0.0 should be put in columns 33-35. Often for local areas, age data is available by 5 year age groups only. If this is the case, insert a 1.0 in columns 33-35 and 14 values for base population in the appropriate place. The 14 values should correspond

*The computation method is shown on page 55.

FIGURE A-3

SUMMARY OUTPUT

	< 5	5-9	10-16	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	> 64	Total
1970	207.3	253.6	261.7	238.1	178.9	187.3	170.9	152.7	149.7	178.9	125.0	107.5	94.1	241.0	2516.7
1971	211.0	245.0	264.3	244.5	195.3	184.7	172.4	154.6	150.7	150.8	130.4	110.4	95.7	246.0	2555.9
1972	213.7	235.1	265.6	251.0	204.6	188.1	176.0	157.7	151.5	150.4	136.8	112.8	97.7	251.0	2592.0
1973	214.7	224.5	265.4	256.9	215.9	186.5	182.8	161.7	152.6	150.7	141.7	115.3	99.5	256.7	2624.8
1974	211.1	216.2	265.0	261.7	229.3	183.7	188.1	167.3	154.0	149.9	146.0	118.0	101.7	262.3	2654.3
1975	203.0	211.7	259.8	267.8	242.9	182.3	190.8	173.9	154.7	150.6	148.2	122.5	102.9	269.3	2680.5

to the 13 five year age groups less than 65 years of age and the greater than 65 age group. The program will then take each five year block and allocate it to the individual years according to the proportions observed in the 1970 California census.*

In columns 38-40 the user inserts the number of years desired in the projection procedure. For example, if 20 years into the future is the desired number, then 20.0 is inserted in columns 38-40. Presently, the program is set up to handle a maximum of 20 years.

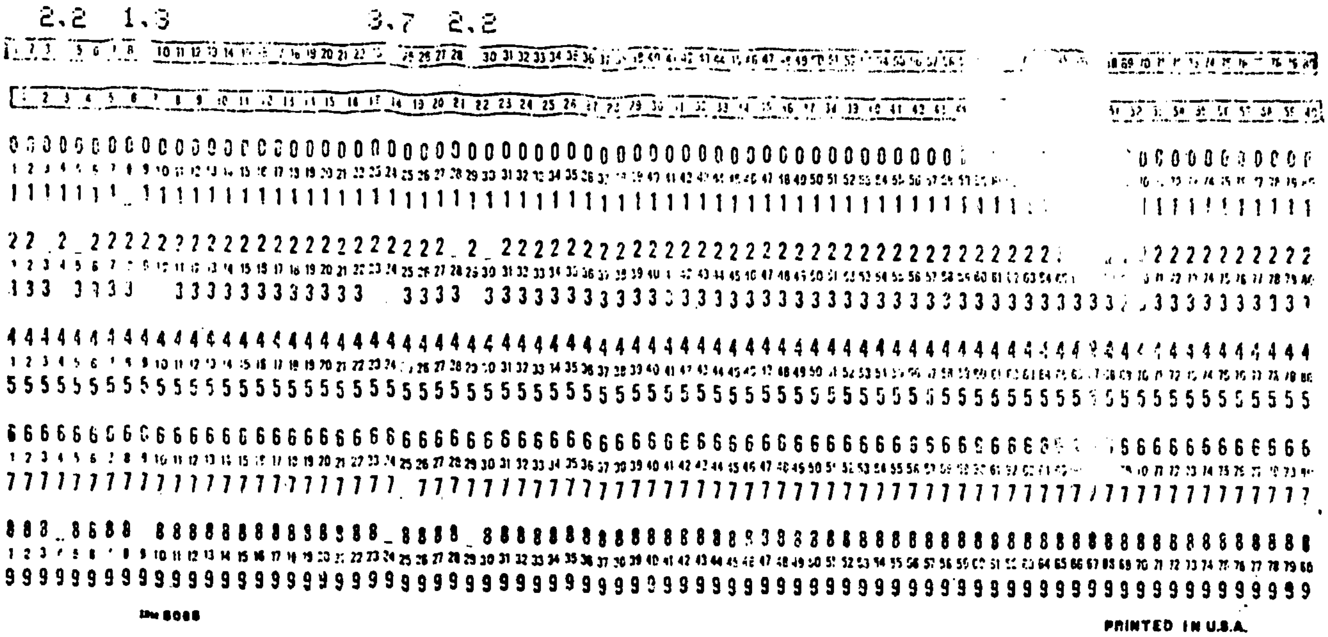
If the user prefers to utilize trended fertility rates (as was done for the Santa Barbara County lower bound projection), a 1.0 should be placed in columns 43-45. In this case, the computer will ignore any fertility rate information contained in the first 15 columns of the assumption data card. Instead, the computer will look for an additional data card (trend card) immediately following the assumption data card. This trend card contains the initial and ending fertility rates for each population group. Figure A-4 shows the trend card for the lower bound Santa Barbara County projection. This card tells the computer to allow the fertility rate for white women to fall, over the projection period, from 2.2 to 1.3.** Similarly, the fertility rate for Spanish surname women falls from 3.7 to 2.2 over the five year projection period. As the black population was not included in the projection, columns 11-20 are left blank. If the user prefers to ignore any trends in fertility rates, then a 0.0 should be placed in columns 43-45 and the trend card

*The allocation scheme has been previously described in the body of the report.

**Note that these fertility rates are also allocated 3 columns each, end on a column number divisible by 5, and have a decimal point in the middle of each 3 column block.

FIGURE A-4

FERTILITY RATE TREND CARD



should be ommitted., It is important to note the placement of each number.

The next set of card(s) provides the program with the necessary annual migration data. If there is a 0.0 in columns 18-20, then a total migration figure should be specified (right justified) in the first five columns of this card.* For example, the number 50.1 might represent an annual total migration of 50,100. This is the only migration card needed if a 0.0 is specified on the assumption card. On the other hand, if a 1.0 is specified in columns 18-20, then 66 specific migration values for each age <65 and one value for the population >64 must be printed on 5 data cards with 5 columns for each value.

The next set of data is the base population figures. If a 0.0 is in columns 33-35, the user must input 66 base population values for

*A decimal point must be included in column 4 of each 5 column block for both options and for both migration and base data figures.

each sexual and ethnic group. Each age group has 5 columns including 1 space to the right of the decimal point. For example, 14.8 in the first five column block of the first data card in this group will be read as the number of individuals less than 1 year of age for white males. In this case, the number might stand for 14,800.

If a 1.0 has been inserted into columns 33-35, the user need only supply 13 population values for the previously described five year age groups <65 and a value for the population >64. Each of these values are also allocated 5 columns with the decimal point in column 4 of each 5 column block.

In either of the above cases, base data should be supplied for each sex and racial group. If the analyst is not interested in disaggregating the racial groups, blank cards must be put in the data deck. For example, suppose the analyst is only interested in projecting the white and Spanish surname population and a 1.0 is specified in columns 33-35 of the assumption card. In this case, the sequence for the base population cards would be the following: two data cards, each with 14 values, corresponding to the white male and white female population distributions; two blank cards for the excluded black male and female distributions; and two final cards, with 14 values each, corresponding to the Spanish surname male and female population distributions.

Figure A-5 shows the user inserted data cards corresponding to the Santa Barbara County lower bound projection. Note carefully the placement and descriptions of all numbers. The above instructions should be sufficient to get the program working. However, any qualified programmer should be able to assist in technical or methodological problems.

FIGURE A-5

USER INSERTED DATA CARDS

```
24.5 32.0 27.9 24.6 19.9 16.9 15.4 12.4 13.6 10.1  9.5  6.6  5.0 13.2
25.4 28.9 29.6 24.9 17.5 16.7 15.5 14.4 12.8 11.8  7.9  5.8  5.1 11.8

77.8 92.3100.0 95.6 65.1 74.9 65.2 61.9 63.3 65.5 55.9 49.9 46.3129.5
79.6100.4104.2 93.0 76.4 78.8 63.5 64.1 60.0 61.5 52.7 45.2 37.7 86.5
13.5
 2.2  1.3            3.7  2.2
 1.8  0.    3.0  0. 1970.  0.   1.   5.   1.0
```

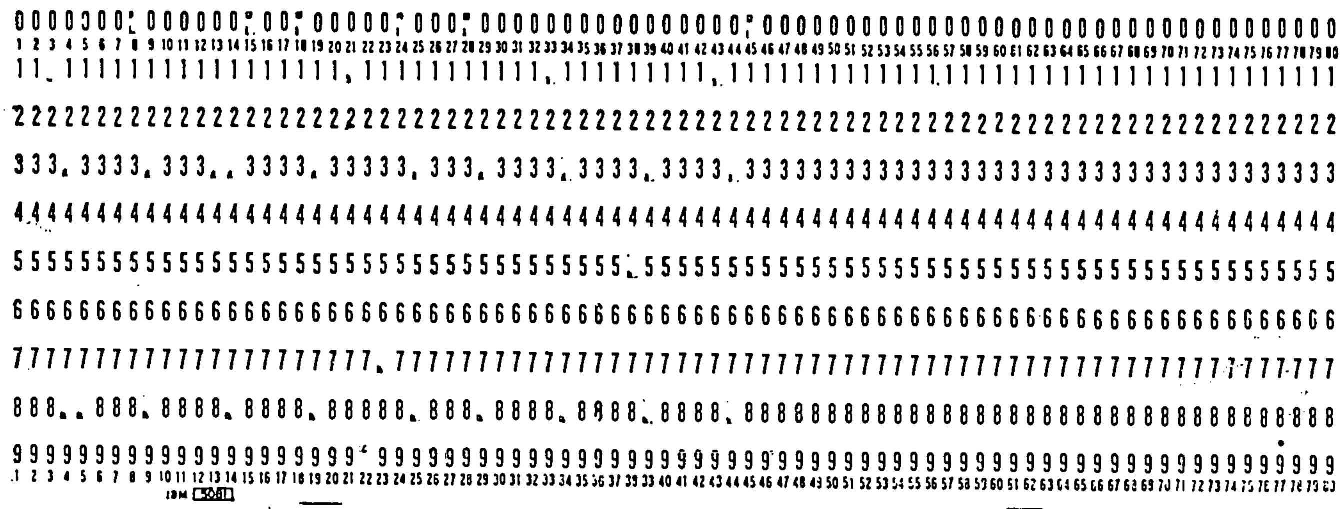


FIGURE A-5

USER INSERTED DATA CARDS (CONTINUED)

- Spanish surname female population by 5 year age groups < 65 and 1 value for > 64.
- Spanish surname male population by 5 year age groups < 65 and 1 value for > 64.
- Black female population by 5 year age groups < 65 and 1 value for > 64.
- Black male population by 5 year age groups < 65 and 1 value for > 64.
- White female population by 5 year age groups < 65 and 1 value for > 64.
- White male population by 5 year age groups < 65 and 1 value for > 64.
- Estimated total annual migration.
- Fertility rate trends: White women - 2.2 to 1.3 over projection period.
  Black women - ommitted.
  Spanish surname women - 3.7 to 2.2 over projection period.
- Assumption data card.
  - Ultimate fertility rate for White women.
  - Ultimate fertility rate for Black women.
  - Ultimate fertility rate for Spanish surname women.

  Ignored due to 1.0 in columns 43-45.
  - Migration allocation choice: 0.0 allows specification of a single migration value.
  - Date of base population data.
  - Choice of output: 0.0 produces detailed output.
  - Age group allocation: 1.0 allows base data to be specified by 5 year age groups < 65 and 1 value for > 64.
  - Number of projection years.
  - Fertility rate trends: 1.0 tells program to ignore columns 1-15 of assumption data card and instead look for a trend card to follow immediately.

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FOOTNOTES

1) U.S. Bureau of the Census, Current Population Reports, Series P-25, No. 601, "Projections of the Population of the United States: 1975 to 2050," Washington, D.C., 1975. p. 24.

2) Ibid., p.1.

3) U.S. Bureau of the Census, Current Population Reports, Series P-25, No. 614, "Estimates of the Population of the United States, by Age, Sex, and Race: 1970 to 1975," Washington, D.C., 1975. p. 4.

4) U.S. Bureau of the Census, Statistical Abstract of the U.S.: 1974, Washington, D.C., 1974.

5) Op. Cit., Current Population Reports, Series P-25, No. 601, p.23.

6) Ibid., p.22

7) Ibid., p.22.

8) H. Fox, Population Forecasts and their Implications for Public Policy, (General Research Corp.: 1974) p. 16.

9) Population Research Unit: California, Population Estimates for California Counties, Report 75 E-2. p. 1.

10) California Department of Finance, Population Projections for California Counties 1975-2020. Report 74 P-2. p.4.

11) Ibid., p. 3.

12) Op. Cit., Population Research Unit: California, p.1.

13) Ventura County Environmental Resource Agency, Population, No. 50 (1975) p.1.

14) U.S. Bureau of the Census, Current Population Reports, Series P-20, No. 277, "Fertility Expectations of American Women: June 1974," Washington, D.C., 1975.

15) Op. Cit., Population Research Unit: California, p.2.

16) Thomas Marcin, The Effects of Declining Population Growth on the Demand for Housing, U.S. Deparment of Agriculture (St. Paul, Minn., 1974) p.3.

17) H. Fox. Private correspondence to Santa Barbara County Supervisor R. Kallman.

18) Telephone call to San Bernadino County Planning Department.

19) U.S. Bureau of the Census, Current Population Reports, Series P-25, No. 614, "Estimates of the Population of the United States, by Age, Sex, and Race: 1970 to 1975", U.S. Government Printing Office, Washington, D.C., 1975. p.125.

20) Santa Barbara News-Press (Santa Barbara, Ca.) 25 January 1970, p. E-1.

21) Ibid., p. E-5.

22) Forecasting Occupational Opportunities: Quantitative Procedures and a Case Study of Santa Barbara County, General Research Corporation. (Santa Barbara, California), 1972.

23) Population Research Unit: California, Provisional Projections of California Counties to 2000, (Sept. 15, 1971).

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