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POPULATION GROWTH, COMPOSITION  
AND PROJECTIONS

MARICOPA COUNTY, ARIZONA

Prepared and Published by

THE MARICOPA COUNTY PLANNING AND ZONING DEPARTMENT  
111 South Third Avenue  
Phoenix, Arizona 85003

January 1972

Price: Two Dollars

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## PREFACE

Planning, in its many facets, is most often based upon the future size and composition of the population in a particular area. Past population growth in Maricopa County has resulted from such a number of variable factors as to warrant a special study of possible future growth. This report has been prepared and published as a guide for land use studies made by this Department and, it is hoped, it may be of value to other departments in Maricopa County in their planning activities.

The projections and text upon methodology were prepared by Lester J. Ringenberg of the Advance Planning Staff. In a study of this nature, continuing reanalysis must be made as new detailed information becomes available and new trends are observed. Supplements will be prepared as changing conditions may dictate.

DONALD W. HUTTON

## SUMMARY AND CONCLUSIONS

The factors involved in projecting population for a local area such as Maricopa County, Arizona, are sufficiently unique to warrant a detailed study. A summary of the factors involved and projections of future population growth are presented herein.

Maricopa County's population increased over 47 times during the present century, growing from approximately 20,000 persons in 1900 to over 968,000 persons in 1970. In comparison, the population of Arizona rose about 14 times while the nation as a whole increased 2.6 times during the same period. A period of high population growth began in the 1940's and has continued more or less steadily to the present time. During this period, most of the increase in Maricopa County occurred in the Phoenix urban area.

The basic components or factors of population growth are natural increase (births minus deaths) and net-migration (in-migrants minus out-migrants).

Birth rates in Arizona have paralleled national trends since 1930 but the rates in the State have been consistently higher. From a high rate of 29.1 births per 1,000 population in 1952, Arizona's rate dropped to 19.2 in 1968 (the last year of record). It is assumed that the birth rate in Maricopa County will approximate that of the State as a whole.

Death rates in Arizona have likewise paralleled those of the nation but have been consistently lower. From 1950 through 1968 the rate in the United States ranged from 9.4 to 9.7 deaths per 1,000 persons while the range in Arizona was from 7.5 to 8.4. In 1968, the death rate in Maricopa County was 8.0 as compared to 8.1 in the entire State.

Both Arizona and Maricopa County have had a net-migration with a positive value. There was a peak net-migration in the County in the year 1960 when there was an increase of slightly over 46,000 persons. A low of 7,500 net-migrants was recorded in 1965. As a proportion of total annual growth, net-migration was equivalent to the growth by natural increase during the five-year period from 1963 through 1968.

There are three methods, demographic in their logic in that all the components discussed above are used, which are generally considered to be most applicable for projections for an area such as Maricopa County. These methods are the component (basic and alternate), the cohort survival, and ratio. Based upon the present availability of information, the complexity of the calculations, and the time available for preparing the projections, it was determined that the basic component method was most reasonable and acceptable.

Projections of population for Maricopa County are made by five-year intervals to the year 2000. Three separate projections, using different values for the various components, are presented.

The basic component series is based on factor values observed, for the most part, within the last decade. It is assumed that the average birth rate of 19.47 as established in the 1966-68 period will continue at approximately the same level in the future. The most recently established death rate in Maricopa County of 8.0 deaths per 1,000 gross population is likewise used for projections in this basic series. Net-migration is expected to remain approximately equal to the amount of population increase resulting from births over deaths in each five-year interval.

Under the general definition of the U.S. Bureau of the Census, a second set of projections is made under Series B wherein a higher level of fertility is assumed. The average rate of 23.44 births per thousand population in the last decade of record in Arizona (1959 through 1968) has been used. The same factors for deaths and net-migration as employed in the basic series are also applied in Series B.

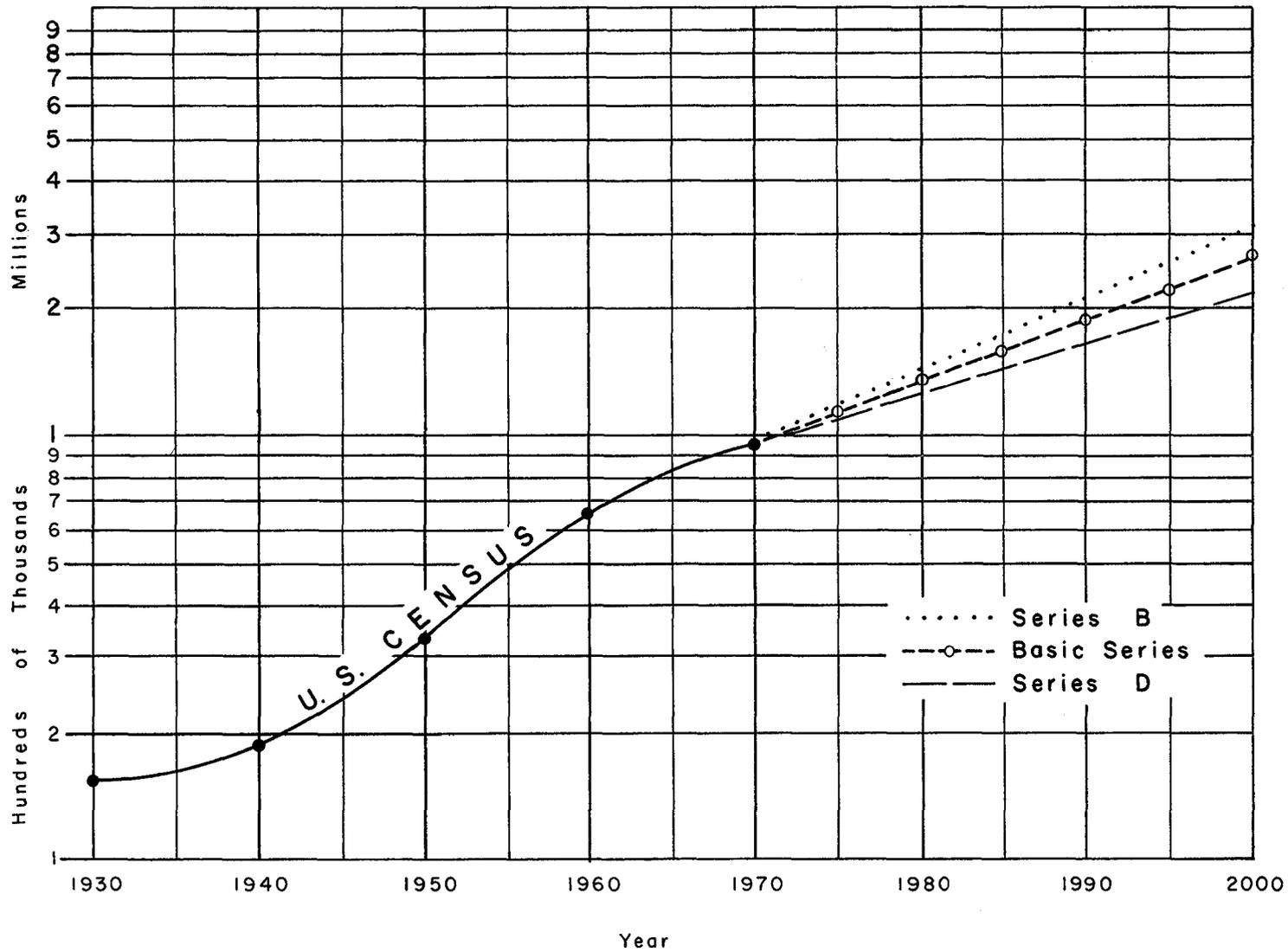
Series D assumes that the fertility rate in Arizona and Maricopa County will reach the low of 15.5 births per 1,000 persons as recorded in the nation in 1968. In addition, it is predicted in this series that net-migration will decline progressively in future five-year periods. The death rate of 8.0 per 1,000 persons is again used in this series.

Using the accepted methodology, Maricopa County's population as of the year 2000 was expected to be as follows:

Basic Series	2,682,000
Series B	3,349,000
Series D	2,141,000

Chart 1 shows graphically the comparative population projections for each of the three series described above. Although there is a difference of over 1,200,000 persons projected between the high and low series, the mean between the two is only 63,000 persons more than predicted under the basic series. Considering the variable factors in projection of this type, it appears that the basic component method is a reasonable approach. Significant future changes in component values would indicate the necessity for recalculation of the projections.

CHART I  
 MARICOPA COUNTY, ARIZONA  
 COMPARATIVE POPULATION PROJECTION - COMPONENT METHOD



## CHAPTER I

### INTRODUCTION

The demand for systematic and periodic population projections for local areas has been constantly increasing. Planning for the needs of people whether in government, business or private life most often cannot be done rationally without some indication of the future size and composition of the population.

The projections of future population must, by necessity, be based on the past history of population growth in the nation, in separate regions and in small local areas. Many factors are involved, and an analysis and comparison of these factors will initially be undertaken.

There are a number of methods which can be used to project population in local areas. There are three methods, however, which are demographic in their logic and technique and which are generally considered to be most useful in an area such as Maricopa County: the component method, the cohort-survival method, and the ratio method. Considering the availability of information, the time allotted for preparing the projections, and the expertise of the person doing the work, each method has its advantages and disadvantages.

Estimates and projections for the County, using the component method, for five-year intervals from 1960 to the year 2000 are presented. Sources of data and methodology are indicated in the body of the text or are indicated by parentheses ( ) and listed in the Bibliography.

## CHAPTER II

### POPULATION GROWTH AND GENERAL POPULATION CHARACTERISTICS

Local trends in population growth are usually evaluated in terms of their relationship to regional and national trends. Since the turn of the century, Maricopa County and the State of Arizona have had somewhat different rates of growth from that of the United States as a whole, and an examination of the probable factors accounting for this difference will be made.

In addition, an examination will be made of the basic components of population change as they affect growth in Maricopa County. These components include births, deaths and migration.

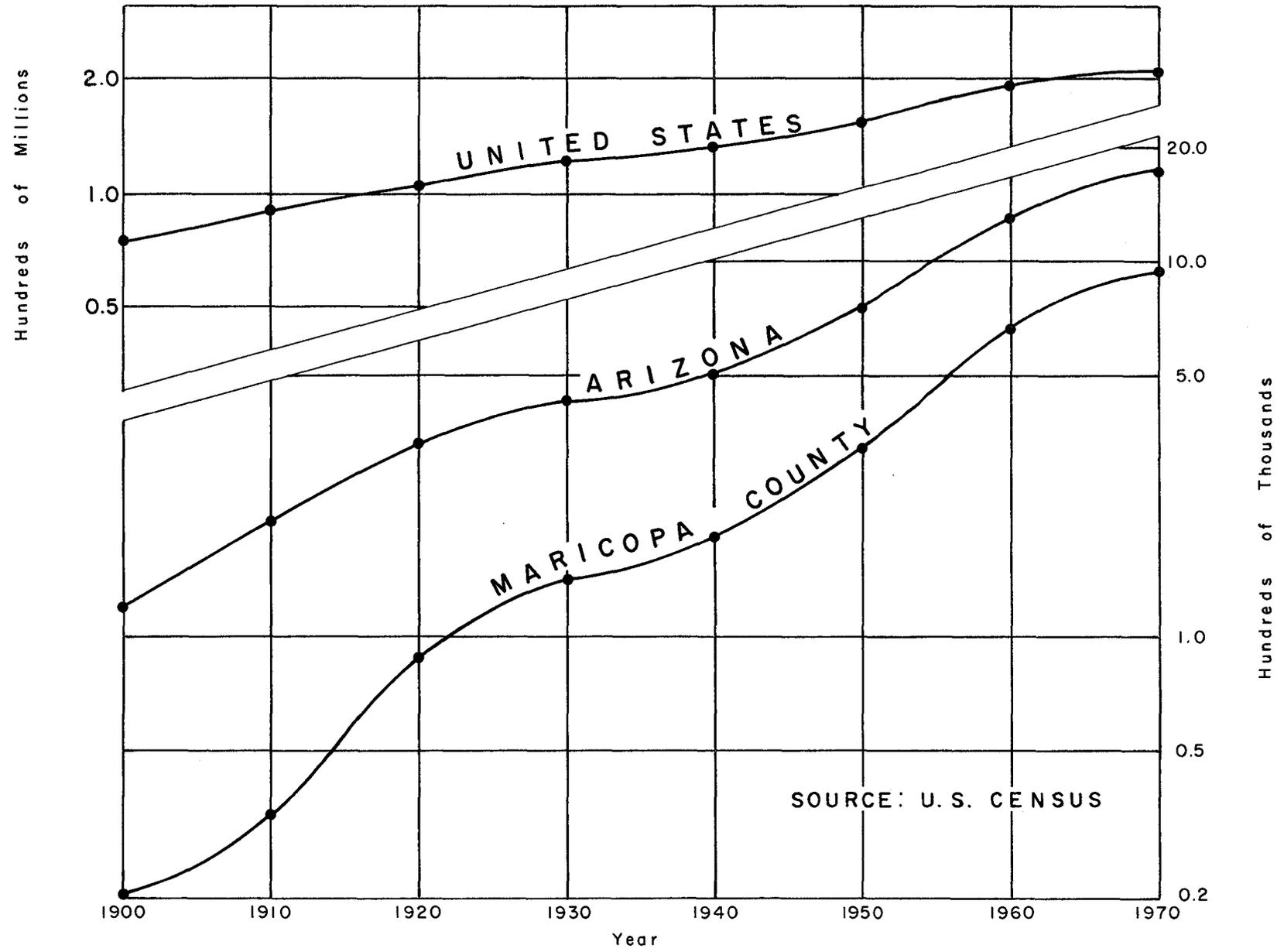
#### Population Growth

Chart 2 shows the growth of the population in the United States, the State of Arizona and Maricopa County from 1900 through 1970. This chart is based on the decennial population counts of the United States Bureau of the Census for the years indicated.

Reference to Chart 2 will show that generally the decennial rate of population change during the 70-year period has been considerably higher for Arizona and Maricopa County than for the country as a whole. For the United States, population rose from approximately 76,000,000 in 1900 to a total of slightly over 203,000,000 in 1970 - a 2.67 times increase over the period. During the same interval, Arizona's population rose from 123,000 in 1900 to 1,772,000 in 1970 for a 14.42 times increase, while Maricopa County increased 47.34 times from approximately 20,000 to 968,000 persons.

Two distinct periods mark the history of times of greatest population growth in Arizona and the County. The first period began about 1880 and continued through 1920. In Maricopa County, this era was essentially an agricultural settlement and coincides with the completion of the first detention dam on the Salt River which provided a dependable supply of irrigation water for farming purposes. The second period of rapid growth began in the 1940's, especially following World War II and has continued to the present. Basic factors contributing to this period of growth have been the development of high technology industries, retirement communities and tourism, all of which have resulted in a high rate of in-migration.

CHART 2  
 COMPARATIVE POPULATION GROWTH  
 1900 - 1970



SOURCE: U. S. CENSUS

During the second period of high population growth and especially in the last decade, there has also been a proportionate increase in persons in the urbanized areas. Table 1, "Maricopa County: Population and Area of Incorporated Places and Unincorporated Area for Recent Census Years", presents some comparative data for 1960 and 1970. In addition to several new incorporations, this decade witnessed some major land annexations by existing cities, especially Scottsdale, Phoenix, Glendale, Tempe and Mesa. From a total of approximately 240 square miles of incorporated area in Maricopa County in 1960, the figure rose to over 420 square miles in 1971. As a result the percentage of population living in unincorporated areas dropped from 15.2 percent in 1960 to 10.3 percent in 1970. From strictly an "urban" point of view, probably only about 5 percent of the population in Maricopa County now resides in definite rural areas.

As a result of annexations as well as the general population increase, a number of cities and towns have had spectacular growth during the last decade. Leading examples are Scottsdale which increased 576 percent, Paradise Valley 242 percent, and Tempe 155 percent.

#### Components of Growth

The basic components or factors of population growth are natural increase and net-migration. Natural increase refers to the number of births minus the number of deaths during a specific period of time, and the result is ordinarily a positive value. Since there are prevailing individual characteristics, birth and death rates are analyzed separately resulting in the rate or amount of natural increase.

Net-migration is the result of the number of people moving into an area (in-migrants) minus the number moving out (out-migrants) during a designated time interval. Since the turn of the century, this has resulted in a positive value in Maricopa County as well as Arizona as a whole. Unfortunately, there is not sufficient detailed information with which to analyze in- and out-migration separately. Therefore, the migration component will be discussed under the single heading of net-migration.

#### Birth Rates

Birth rates are primarily a natural function of rates of fertility, which is the quality of being capable of producing offspring. According to definitions of the U.S. Bureau of the Census<sup>(1)</sup>, measures of fertility may be grouped into two principal categories: period measures and cohort measures. Period measures of fertility refer to births occurring in a specified time interval, usually a calendar year. The simplest and most easily used of the period measures is the crude birth rate which is defined as the number of births per year per 1,000 population.

Table 1  
MARICOPA COUNTY

POPULATION AND AREA OF INCORPORATED PLACES AND UNINCORPORATED AREA FOR RECENT CENSUS YEARS

	1960		1970		Changes from 1960 to 1970		
	Population U.S. Census	Area (Sq. Mi) Jan. '60	Population U.S. Census	Area (Sq. Mi) April '71	Population	Percent Pop. Change	Area (Sq. Miles)
Avondale	6,151	1.22	6,626	2.47	475	7.72	1.25
Buckeye	2,286	.91	2,599	1.11	313	13.69	.20
Chandler	9,531	2.15	14,130	6.55	4,599	48.25	4.40
El Mirage	1,723	.24	3,258	2.15	1,535	89.09	1.91
Gila Bend <sup>(1)</sup>	1,813 <sup>(4)</sup>	2.82	1,795	2.82	-18	-0.99	0
Gilbert	1,833	1.03	1,971	1.03	138	7.53	0
Glendale	15,696	3.80	36,228	16.82	20,532	130.81	13.02
Goodyear	1,654	.39	2,140	.91	486	29.38	.52
Mesa	33,772	14.03	62,853	24.15	29,081	86.11	10.12
Paradise Valley <sup>(2)</sup>	2,091 <sup>(4)</sup>	2.76	7,155	13.29	5,064	242.18	10.53
Peoria	2,593	1.02	4,792	2.79	2,199	84.81	1.77
Phoenix	439,170	187.40	583,217	247.90	144,047	32.80	60.50
Scottsdale	10,026	3.80	67,823	67.30	57,797	576.47	63.50
Surprise <sup>(3)</sup>	1,574 <sup>(4)</sup>	1.00	2,427	1.00	853	54.19	0
Tempe	24,897	14.12	63,550	25.34	38,653	155.25	11.22
Tolleson	3,886	.43	3,881	.55	-5	-0.13	.12
Wickenburg <sup>(3)</sup>	2,445 <sup>(4)</sup>	1.37	2,698	3.46	253	10.35	2.09
Youngtown	1,559 <sup>(4)</sup>	.96	1,886	.96	327	20.97	0
TOTAL INCORPORATED AREA	<u>562,700</u> (84.8%)	<u>239.45</u> (2.6%)	<u>869,029</u> (89.7%)	<u>420.60</u> (4.6%)	<u>306,329</u>	<u>54.97</u>	<u>181.15</u>
UNINCORPORATED AREA	<u>100,810</u> (15.2%)	<u>8,986.55</u> (97.4%)	<u>99,458</u> (10.3%)	<u>8,805.40</u> (95.4%)	<u>-1,352</u>	<u>-1.34</u>	
TOTAL COUNTY	663,510 (100.0%)	9,226 (100.0%)	968,487 (100.0%)	9,226 (100.0%)	304,977	45.96	

(1) Incorporated July 2, 1962  
(2) Incorporated May 24, 1961

(3) Incorporated December, 1960  
(4) Unincorporated at time of Census

Cohort measures of fertility refer to the fertility histories of actual groups of women, where a cohort is defined by the occurrence of a specific event in a specific time period. For the determination of the general fertility rate, the Bureau of the Census defines the rate to be the number of births per year per 1,000 women 15 to 44 years of age inclusive. Additional detail can be obtained wherein the cohorts are broken down to include the fertility rates of women within five-year age groups.

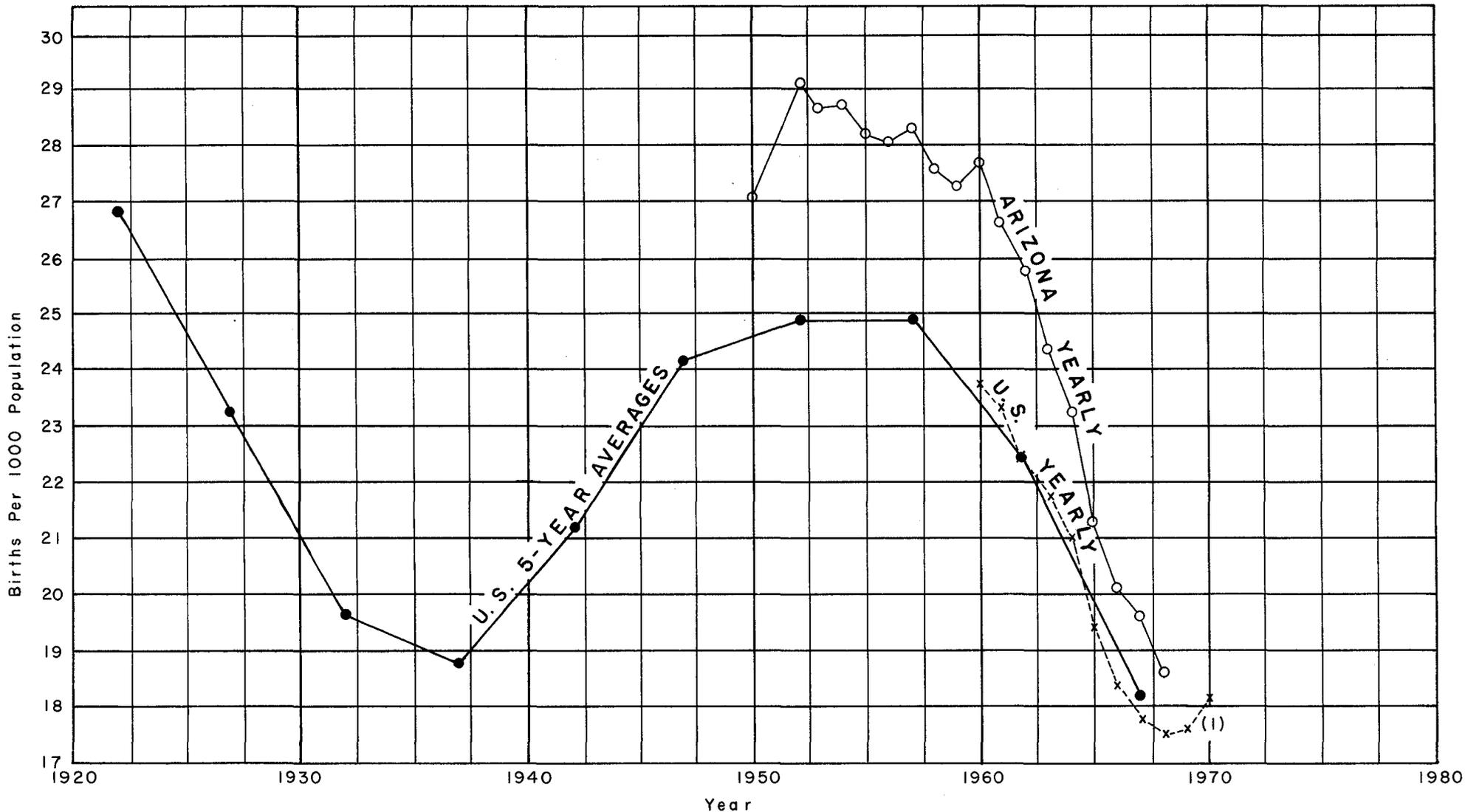
For the purposes of long range population projections for an area as large as Maricopa County, it is felt that the use of crude birth rates is sufficiently accurate. Therefore, in the following discussions, crude birth rates will be used for analytical purposes.

Chart 3 shows a comparison of crude birth rates in the United States and the State of Arizona for the years indicated. Sources of information are shown on the chart<sup>(1, 2)</sup>. The drop in the U.S. birth rate from 1920 to approximately 1940 was most unusual and has generally been attributed to results of the depression years. However, the decrease during the prosperity of the 1920's was greater than the decrease of the 1930's indicating that economic factors do not fully control the trends of the crude birth rate. The increase in the rate from 1940 to 1950 and the leveling-off at a high rate during most of the 1950's resulted from the 'marriage-boom' during and following World War II. After a sharp decline in crude birth rates during most of the 1960's, a slight reversal of the trend occurred in the nation in 1969 and 1970. This is probably due to the fact that women born in the mid 1940's began to reach child-bearing age.

Birth rate trends for Arizona have paralleled national trends since 1930. Reference to Chart 3 will show that the crude birth rate in the State for the period covered has consistently been above the national average. It is assumed that the rate in Maricopa County will approximate that of the State as a whole.

Because of the wide fluctuations in the past, the prediction of future crude birth rates in Arizona and Maricopa County is no easy task. One important guide, however, is the changing structure of age groups within the Arizona population. Chart 4 shows the percent of population by major age groups from 1900 to 1970 inclusive<sup>(3)</sup>. In the 0-14 year age group, although there has been some slight fluctuation, the overall percentage has been nearly constant. In the older age groups from 45 to 64 and 65 and over, however, the percentage has been consistently increasing during the seventy-year period. The result has been a decline in the percentage of population in the 15 to 44 year age group, which, of course, contains most of the women of child-bearing age. If this trend continues, a substantial increase in crude birth rates in Arizona is not likely.

CHART 3  
**CRUDE BIRTH RATES**  
 UNITED STATES AND STATE OF ARIZONA



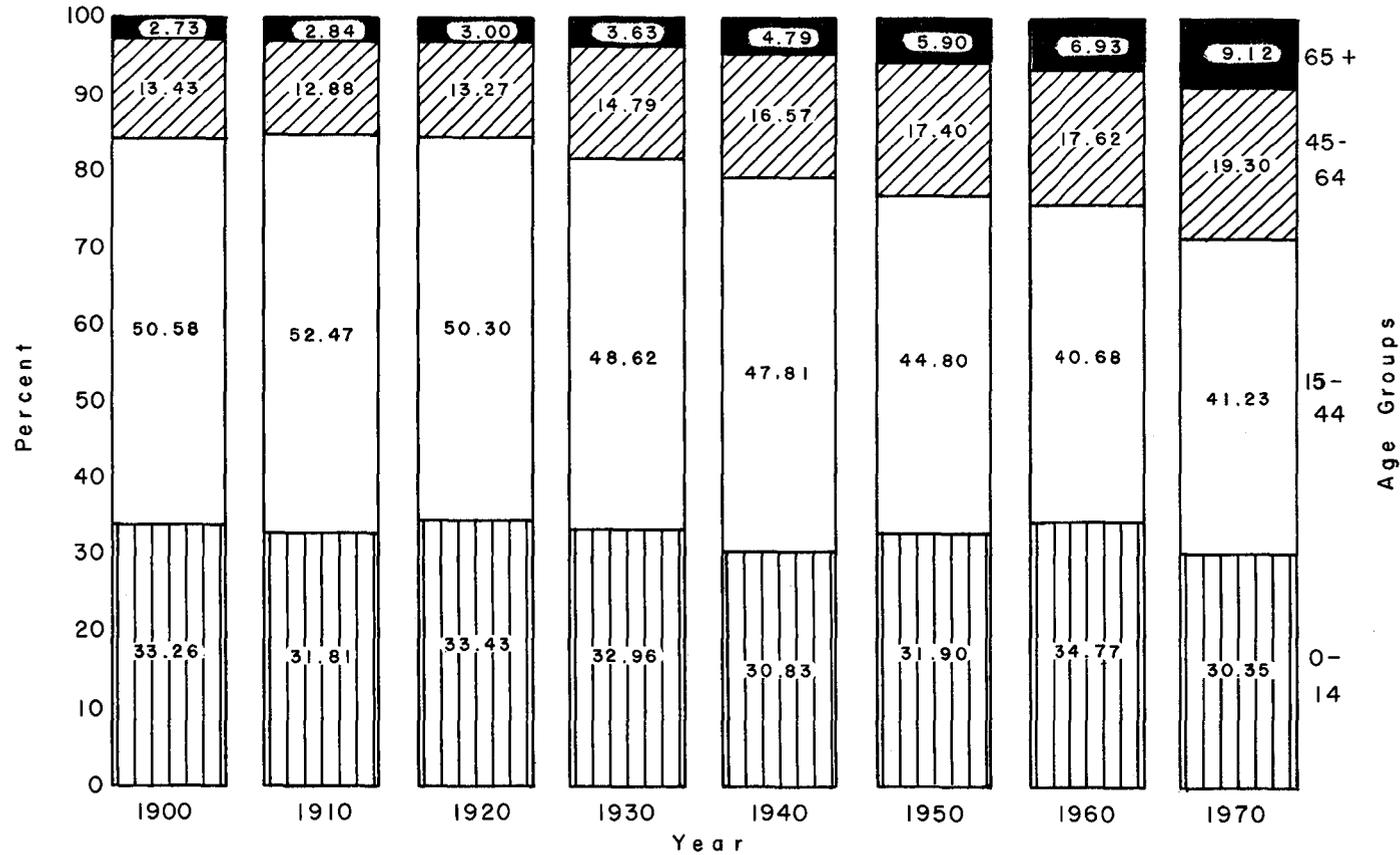
SOURCE: "CURRENT POPULATION REPORTS" Series P-23, No. 36, April 16, 1971 (pg.9) and "ARIZONA VITAL STATISTICS-1967 and 1968"

(1) Data for 1969 and 1970 are provisional

CHART 4

STATE OF ARIZONA

PERCENT OF POPULATION BY MAJOR AGE GROUPS  
1900 - 1970



SOURCE: "GENERAL POPULATION CHARACTERISTICS - ARIZONA"  
U. S. Department of Commerce, Bureau of the Census  
PC (1) - B4, July, 1971

### Death Rates

The death rate is the number of persons dying each year per 1,000 estimated midyear population. As with the crude birth rate, the death rate as defined is usable for general analytical purposes. For detailed projections, however, a breakdown of deaths by specified age groups is desirable.

The death rate of the United States declined steadily from 17.2 in 1900 to 9.6 in 1950<sup>(4)</sup>. Since 1950 through 1968, the rate leveled off, varying during the period from 9.4 to 9.7 deaths per 1,000 people.

Death rates in Arizona generally parallel that of the whole nation but have been consistently somewhat lower. According to the Arizona State Department of Health<sup>(2)</sup>, rates for the years indicated are as follows:

<u>Year</u>	<u>Death/1,000</u>
1950	8.4
1955	7.6
1960	7.6
1965	7.5
1966	7.9
1967	7.8
1968	8.1

The most significant change in the statistics given above is the increase in death rates in Arizona beginning in 1966. This increase is no doubt due to the increase in the percentage of people 45 years of age and older as depicted on the previously mentioned Chart 4.

The death rate in Maricopa County was 8.0 in 1968 as compared to 8.1 in the entire State. It is assumed that in the near future at least, the death rate in Maricopa County as well as Arizona as a whole will remain or may continue to rise slightly.

### Net-Migration

The third component, net-migration, is the most difficult of the three to determine and is an example of the arbitrary decisions that must be made in the process of doing projections. Each separate region in the United States has its own particular patterns of migration and even within regions, there have been wide fluctuations during various periods of time. Histories of migration in the nation and even in the states are seldom of much validity for analyses of smaller areas and this is especially true of Maricopa County.

Chart 5 shows the population growth in Maricopa County from 1950 through 1970 by the amount from natural increase and from net-migration. The data for this chart were specially prepared by the Employment Security Commission of Arizona.

Net-migration increased nearly uniformly from 1950, reaching a peak of 46,200 persons in 1960. There was a sharp decline from 1960 to 1965 when there was a net increase of only 7,500 persons in 1965. The upward trend noted since 1965 was reversed again in 1969. As shown on the chart, net-migration by averages over five year periods has shown a steady decline since 1959.

As a proportion of total annual growth, net-migrants reached a peak of 78.3 percent in 1951 and again in 1960. In contrast, net-migration accounted for only 41.7 percent of total population growth in 1965. The lowest net-migration for a five year period occurred from 1963 to 1968 when an average of 50.1 percent of growth was from this component. During this period, increase in population as a result of net-migration equaled the increase of births minus deaths (natural increase).

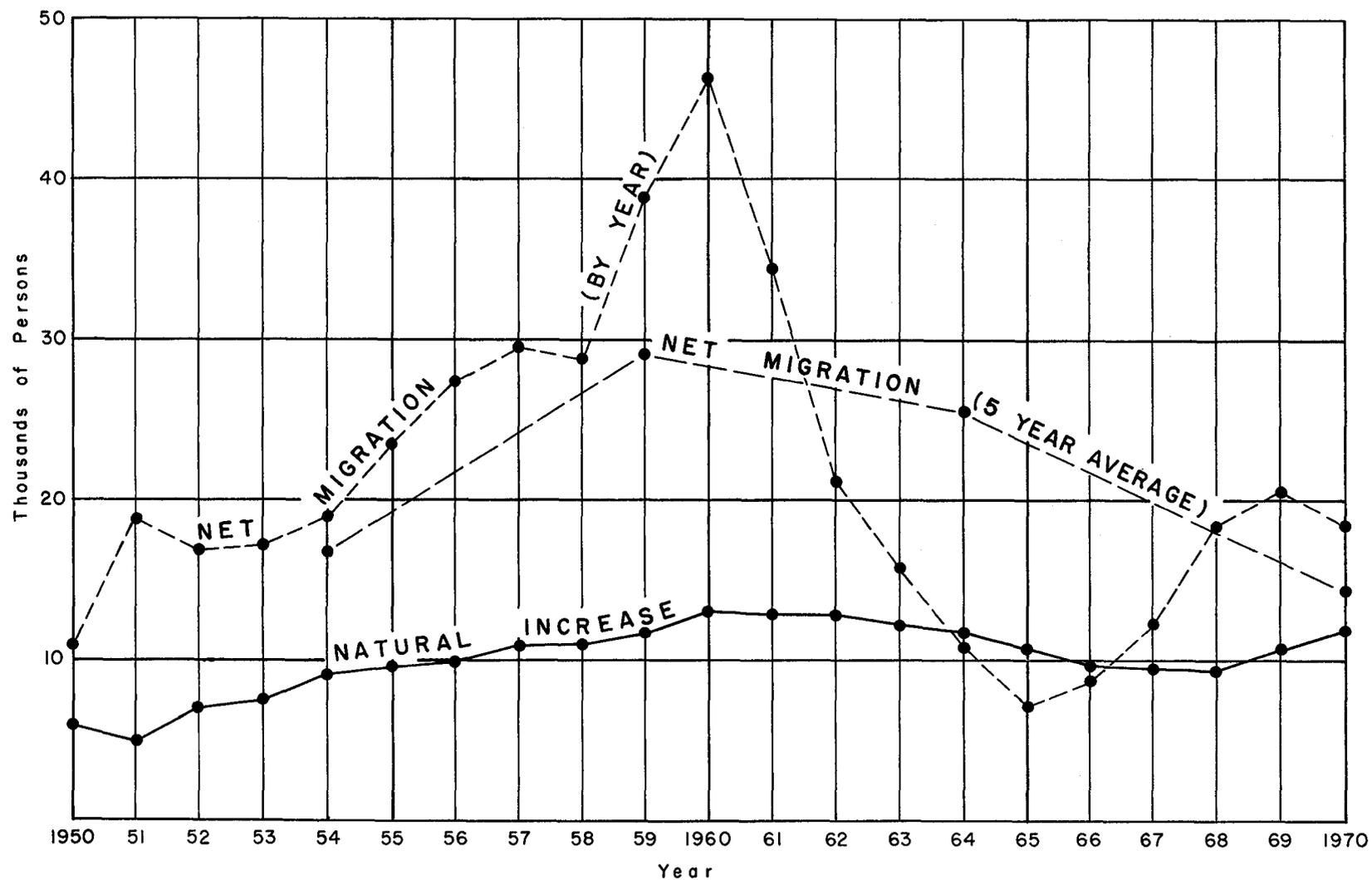
As has been previously noted, there are many variables which influence net-migration and the values to be assigned to each are difficult to determine. When the results of the 1970 census became available, most agencies making population projections for Maricopa County found that their projections during the past decade were somewhat on the high side. An over-estimate of net-migration probably accounted for a sizeable portion of this apparent error.

It is believed the Arizona economy in the future will not be able to continue to support high levels of in-migration of working-age people. Therefore, future population projections will be made on the basis that net-migration will be approximately equal to the expected natural increase within a given five-year period.

CHART 5

MARICOPA COUNTY, ARIZONA

COMPONENTS OF POPULATION GROWTH 1950-1970



SOURCE: Employment Security  
Commission of Arizona

## CHAPTER III

### PROJECTIONS BY THE COMPONENT METHOD

The term component applies to any method or technique which takes into account deaths, births and migration, and generally uses the total population to derive one or more of the component projections. A comprehensive study of this method, as well as several other methods, has been made by Robert C. Atchley of the Scripps Foundation in a report entitled "Population Projections and Estimates for Local Areas" and which was published in 1970<sup>(5)</sup>. The general methodology used in his study will be used in the estimates and projections for Maricopa County.

As a starting point, hypothetical projections will be made for the 1960-65 and 1965-70 periods. The results, in turn, will be compared to actual census counts in 1970.

#### Estimates for 1960 to 1965

Under the Atchley methodology, the first component to be calculated is the number of deaths in a given time interval. As described in Chapter II, deaths can be calculated by using a rate of the number of persons dying per 1,000 gross population. It seems more logical, however, to make use of the more detailed information available from the "Life Tables" of the U.S. Department of Health, Education and Welfare, which portray mortality by specific age groups<sup>(6)</sup>. Although such detailed information is not usually available for small local areas, it is generally agreed that the death rates in counties during the 1960's would not vary appreciably from the United States as a whole.

Table 2 is a data worksheet for the determination of the number of persons dying in Maricopa County from 1960 to 1965. The 1960 base population by five-year age groups was taken from the U.S. Bureau of the Census Reports<sup>(7)</sup>. The 22,112 total deaths in the five-year period is the sum of the deaths of each age interval.

To reasonably apply a crude birth rate to a five-year period, a mid-period (or average) population must be determined. This is calculated by taking the 1960 base population of 663,510 persons minus one-half of the deaths during the period, resulting in a mid-period population of 652,454 persons. In the Atchley report, the mid-period population was multiplied by the crude birth rate (in this case, 25 births per 1,000 population) and in turn the product was multiplied by five to obtain the amount of population resulting from natural increase during the five-year period.

Table 2

## DATA WORKSHEET FOR POPULATION PROJECTIONS

## COMPONENT METHOD

Maricopa County, Arizona: 1960-1965

<u>Age Group</u>	<u>1960 Base Population (1)</u>	<u>Proportion Dying (2)</u>	<u>Number Dying</u>
0-1	16,635	.0261	434
1-4	65,523	.0043	282
5-9	76,042	.0024	183
10-14	67,279	.0022	148
15-19	49,238	.0046	226
20-24	42,091	.0061	257
25-29	42,910	.0065	279
30-34	45,243	.0081	366
35-39	49,080	.0117	574
40-44	43,501	.0184	800
45-49	39,223	.0293	1,149
50-54	32,058	.0462	1,481
55-59	26,017	.0672	1,748
60-64	21,215	.1022	2,168
65-69	19,691	.1469	2,893
70-74	13,995	.2127	2,977
75-79	8,042	.3066	2,466
80-84	3,736	.4524	1,690
85 +	1,991	1.0000	1,991
Total	663,510		22,112

Sources: (1) U. S. Bureau of Census

(2) U. S. Department of Health, Education & Welfare,  
"Life Tables"

Since crude birth rates are available for Arizona by years since 1960, births for the 1960-65 period will be calculated by year. Using the mid-period population figure of 652,454 persons, population resulting from natural increase was as follows:

<u>Year</u>	<u>Birth/1,000 Population</u>	<u>Population Increase</u>
1961	26.6	17,355
1962	25.7	16,768
1963	24.3	15,855
1964	23.1	15,072
1965	<u>21.3</u>	<u>13,897</u>
Average	24.2	Total 78,947

The total population for the County, less net-migration, is indicated to have been 742,457 in 1965.

As pointed out in Chapter II, most population estimates made during the 1960's were discovered to be high when the results of the 1970 census became available, and most of this over-estimate is believed to have been in the evaluation of net-migration. Therefore, in using the component method in retrospect, net-migration is assumed to be approximately equal to the natural increase of the population in 1960-65. Adding 79,000 net-migrants, the total population at the end of the period was about 821,000 persons.

#### Estimates for 1965 to 1970

Essentially, the same methodology as explained in detail above, will be used to estimate the growth in the 1965-1970 period and a comparison of the results with the 1970 census facts will be made.

Since there is no breakdown of population in the County by five-year age groups for the 1965 base year, the proportion dying must be based on the overall death rate. Information on death rates is available for the years 1965 to 1968 inclusive. Since every year is not available, the average of the four years - 7.82 deaths per 1,000 population - will be used. On this basis, there were 32,120 total deaths in the 1965-1970 period. Deducting one half of the deaths from the 1965 base population of 821,457 persons a middle period population of 805,397 is obtained.

Crude birth rates in Arizona available for the years 1966-68 inclusive averaged 19.47 births per 1,000 gross population. Reference to previously mentioned Chart 2 will show that since there was a slight increase in birth rates in the nation as a whole in 1969 and 1970, a rate of 19.47 annually for the entire five-year period in Arizona appears to be a valid assumption. On this basis, there was a natural increase of 78,405 persons for a 1970 County population, less net migration, of 899,862 persons.

Assuming the increase in population by net-migration to be equal to that by natural increase, an estimate of a total population by 1970 of 977,862 persons is obtained. The 1970 final census of population for Maricopa County revealed a total of 968,487 persons, only 9,375 less than the estimate by the component method. These calculations reveal that net-migration during the ten-year period was actually 93.8 percent of the increase of births over deaths.

Although a control period of only ten years has been used, this methodology for the projection of population appears to be quite accurate, especially in view of the fact that there was less than one-percent error. Although additional assumptions must be made, this method will be used to project future Maricopa County population by five-year increments.

#### Basic Projections to the Year 2000

As a check on the death rate for future projections, the latest figures on the proportion dying by separated age groups have been taken from the 1968 "Life Tables"<sup>(6)</sup>. In the U.S. Bureau of the Census publication "General Characteristics of the Population: 1970", the breakdown of population by age groups is, in some cases, more consolidated than in the 1960 report. By proportion, however, the data was converted to the groups used in the previous discussions.

Table 3 is a data worksheet for the determination of the number of persons dying in Maricopa County as of 1970 based on the information from the reports cited above. In comparison to the 1960 "Life Tables", increased death rates are noted in the 15 through 44, 55 through 59, and 70 through 74-year age groups, while slight decreases occurred in the remaining groups. These changes in death rates reflect the changes in population characteristics as presented in the previous chapter. Changes of this nature will likely occur in the future, but there is no apparent method for predicting such changes. Therefore, the latest established death rate for Maricopa County of 8.0 deaths per 1,000 population annually will be used for basic future projections.

Table 3

## DATA WORKSHEET FOR POPULATION PROJECTIONS

## COMPONENT METHOD

Maricopa County, Arizona: 1970 to Future

<u>Age Group</u>	<u>1970 Base Population</u>	<u>Proportion Dying (1968)</u>	<u>Number Dying</u>
0-1	16,894	.0218	368
1-4	67,578	.0034	230
5-9	99,329	.0022	219
10-14	103,485	.0021	217
15-19	90,859	.0054	491
20-24	78,736	.0071	559
25-29	59,184	.0071	420
30-34	63,275	.0087	550
35-39	58,054	.0126	731
40-44	51,461	.0190	978
45-49	58,350	.0292	1,704
50-54	47,683	.0450	2,146
55-59	43,194	.0678	2,929
60-64	39,106	.1005	3,930
65-69	34,922	.1461	5,102
70-74	24,824	.2134	5,297
75-79	17,866	.2913	5,204
80-84	8,299	.4076	3,383
85 +	4,423	1.0000	4,423
Total	967,522 (968,487)*		38,881

\*Corrected total.

It is doubtful that future crude birth rates in Arizona will exceed the average established in the 1966-68 period. The rate of 19.47 births per 1,000 population will be used for five-year projections from 1970 to the year 2000. It will also be assumed in the basic projections that net-migration will continue to be approximately 94 percent of the natural increase of population in each five-year interval.

Table 4 shows basic population projections for Maricopa County and the table also includes the amount of change of each component. It should be remembered that these projections are based upon several constants as discussed above. Other projections will be made by methods including some variable factors.

#### High and Low Projection Series

As has been demonstrated, the basic inputs for regional population projections are the projections made for the United States as a whole. Because of the possible range of error, the U.S. Bureau of the Census provides more than one set of projections. Since birth rates have fluctuated widely over the past 50 years, this factor in prospective growth is the great unknown. To cover these variables, the Bureau of the Census has issued, and continues to issue, a number of "Current Population Reports: Population Estimates and Projections - Series P-25".

In issue number 381 dated December 18, 1967<sup>(8)</sup>, four different projections were made each using a different assumption about the level of fertility. The assumptions regarding the four series are briefly described as follows:

- Series A: Continues the high rates of fertility of the post-World War II years, particularly the rates of the mid-1950's.
- Series B: Moderately high series in that it presumes only a modest drop from the levels of fertility in the last decade.
- Series C: Based upon the assumption that fertility rates will drop to some levels observed during the 50 years preceding the large post-war rise in fertilities.
- Series D: Assumes a sharp decline in fertility (or, a continuation of the decline noted in 1968?).

Table 4

## MARICOPA COUNTY, ARIZONA

## Basic Population Projections by Component Method, 1960-2000

<u>Period</u>	<u>Base Population</u>	<u>Total Deaths</u>	<u>Births Over Deaths</u>	<u>Population by Natural Increase</u>	<u>Net-Migrants</u>	<u>End Period Population</u>
1960-1965	663,510 <sup>(1)</sup>	22,112	78,947	742,457	79,000	821,457
1965-1970	821,457	32,120	78,405	899,862	78,000 (68,625)	977,862 968,487 <sup>(1)</sup>
1970-1975	968,487	38,739	92,396	1,060,883	87,000	1,147,883
1975-1980	1,147,883	45,915	109,511	1,257,394	103,000	1,360,394
1980-1985	1,360,394	54,416	129,786	1,490,180	122,000	1,612,180
1985-1990	1,612,180	64,487	153,807	1,765,987	144,000	1,909,987
1990-1995	1,909,987	76,399	182,218	2,092,205	171,000	2,263,205
1995-2000	2,263,205	90,528	215,917	2,479,122	203,000	2,682,122

Notes: (1) Official Census for 1960 and 1970.

"Current Population Reports, Series P-25, No. 381" has been superseded by Number 448, dated August 6, 1970 (9). These projections represent an updating of the earlier set rather than a major revision. The highest series (Series A) has been dropped, but the fertility assumptions of the other three series (B, C and D) are unchanged from those described in Number 381. A new low series, Series E, has been added and is included for analytical purposes. The basic assumption of this series is that the fertility rate would be such that the population would exactly replace itself after the age structure had stabilized.

Series B

In order to be aware of possible extremes in future population growth, two additional projections will be made. The first will be under the general guidelines of Series B which has been described as a moderately high series. The last decade of record of fertility rates in Arizona is the period 1959 through 1968. The average rate in the period is 23.44 births per thousand gross population and this rate will be used in the present projection. It will also be assumed that net-migrants will equal population by natural increase. Since there is no further data upon which to predict future death rates, the rate of 8.0 per 1,000 persons per year as previously established will be used. Using these factors, projections of population for Maricopa County under Series B is as follows:

<u>Year</u>	<u>Population by Natural Increase</u>	<u>Net-Migration</u>	<u>Total</u>
1960			663,510*
1970			968,487*
1975	1,079,724	111,000	1,190,724
1980	1,327,486	137,000	1,464,486
1985	1,632,691	168,000	1,800,691
1990	2,007,511	207,000	2,214,511
1995	2,468,861	254,000	2,722,861
2000	3,035,598	313,000	3,348,598

\*U.S. Bureau of the Census.

Series D

This series assumes a sharp decline in fertility rates. As depicted on Chart 2, however, there has been a sharp decline since 1960 with a slight reversal of this trend noted in the last two years. It is likely that in Arizona, crude birth rates may reach the national low of 17.5 births per 1,000 persons and might level out at this rate. For a "low" projection, this rate will be used.

In the previous two projections, the increase in population in Maricopa County from net-migration has been assumed to be approximately equal to the amount by natural increase. Changes in economic conditions or limitations of natural resources, for example, may make moving to Maricopa County less desirable in the future than it has been in the past. For this reason, a declining net-migration will be assumed under Series D projections. A decrease of an additional 10 percent of increase of births over deaths for each five-year period for net-migration will be applied (for example, 90 percent for 1970-75, 80% for 1975-80, et cetera). Again using a death rate of 8.0 per 1,000 persons per year, projections of population for Maricopa County under Series D is as follows:

<u>Year</u>	<u>Population by Natural Increase</u>	<u>Net-Migration</u>	<u>Total</u>
1960			663,510*
1970			968,487*
1975	1,051,535	74,696	1,126,278
1980	1,222,856	77,248	1,300,118
1985	1,411,603	78,023	1,489,643
1990	1,617,380	76,625	1,694,022
1995	1,839,284	72,615	1,911,915
2000	2,075,862	65,563	2,141,141

\*U.S. Bureau of the Census.

#### Summary of Component Method

The basic projections developed in the earlier sections of this report fall within the general description of the Bureau of Census' Series C. Since fertility rates over a long period prior to World War II are not available for Arizona, more recent rates following the large post-war rise have been used. This "basic series" appears to provide projections that are most logical and reasonable for Maricopa County.

A summary comparison of population projections by the three series as described in the preceding paragraph is presented in Table 5. It should be noted that by the year 2000, there is a difference of approximately 1,207,000 persons between the high Series B and the low Series D. The mean between these two projections is 2,745,000, approximately 63,000 more than predicted under the basic series.

#### Comparison with Previous Projections

As a matter of interest, a comparison is made between the basic projection series as presented in this study with projections made in previous years for Maricopa County. Table 6 presents the figures from four separate reports, the titles of which are listed on the table.

Table 5

MARICOPA COUNTY, ARIZONA

Summary of Population Projections by Series

Using the Component Method

<u>Year</u>	<u>Series B</u>	<u>Basic Series</u>	<u>Series D</u>
1960	663,510*	663,510*	663,510*
1965		821,457	
1970	968,487*	968,487*	968,487*
1975	1,190,724	1,147,883	1,126,278
1980	1,464,486	1,360,394	1,300,118
1985	1,800,691	1,612,180	1,489,643
1990	2,214,511	1,909,987	1,694,022
1995	2,722,861	2,263,205	1,911,915
2000	3,348,598	2,682,122	2,141,141

\*Final Population Counts from U. S. Bureau of the Census.

Table 6

## MARICOPA COUNTY, ARIZONA

Comparison of Present and Past Population Projections

<u>Year</u>	<u>Basic Series</u>	<u>Task Force - '59</u> <sup>(1)</sup>	<u>Western Business</u> <sup>(2)</sup> <u>Consultants - '59</u>	<u>Western</u> <sup>(3)</sup> <u>Management - '65</u>	<u>Future</u> <sup>(4)</sup> <u>Land Use - '67</u>
1960	663,510*			663,510*	663,510*
1965	821,457	800,000			877,619
1970	968,487*	1,020,000		1,100,000	1,226,000
1975	1,147,883	1,230,000		1,350,000	1,501,000
1980	1,360,394	1,440,000	1,400,000	1,620,000	1,831,000
1985	1,612,180				2,229,000
1990	1,909,987				
1995	2,263,205				
2000	2,682,122				

- Notes: (1) "Population Growth of the Phoenix Urban Area", City of Phoenix and Maricopa County Advance Planning Task Force, April 1959  
(2) "Economic Analysis and Projection for Phoenix and Maricopa County", Western Business Consultants, Inc., November 1959  
(3) "The Economy of Maricopa County: 1965 to 1980", Western Management Consultants, Inc., April 1965  
(4) "A Report Upon Future Land Use for Maricopa County, Arizona", Maricopa County Planning Department, 1967

\*Final Population Counts from U. S. Bureau of the Census.

In the two projections made prior to the 1960 Census, it can be noted that the estimates for 1980 are quite close to that developed under the basic series. In the projections made in 1965 and 1967, however, the estimates were considerably higher. It is believed that the high rates of net-migration culminating in 1960 were an influencing consideration resulting in these higher projections.

## CHAPTER IV

### OTHER DEMOGRAPHIC METHODS

There are several advantages in the use of the component method for the projection of population for an area such as Maricopa County. First, this method requires relatively little data and most of this data, in sufficient detail, is available at the County level. Second, it is relatively simple to revise the projections when new facts on the various components become available. If only one component is changed, new totals may be derived without recalculating the other components.

Three additional methods of population projection for local areas were investigated in the Atchley study. These techniques are described as the Alternate Component (Component Method B), the Cohort-Survival and the Ratio Methods. A brief explanation and a summary of the advantages and disadvantages of each method will be made.

#### Alternate Component Method

The component method as employed in the preceding chapter is truly demographic in character since projections of all of the components of population change are required. However, one failure of the method is that it does not deal with migrants by age. When this information is included, the method tends to yield a more logical estimate for the expected mid-period population.

Unfortunately, such detail on migration is even more difficult to obtain than the data that has been used in the previous projections. The U.S. Bureau of the Census did issue a report in 1961 entitled "U.S. Census of Population: 1960. Mobility for States and State Economic Areas". Because of the changes in population characteristics and the drastic changes in net-migration in the past decade in Maricopa County, no attempt has been made to use this data.

A subject report upon migration is to be issued by the U.S. Bureau of the Census under the 1970 Population Series PC(2) sometime during 1972. If this report contains detailed information and cross-relationships at the County level, population projections for Maricopa County should be revised under the alternate component method.

#### Cohort-Survival

The cohort-survival method, like the component method, utilizes separate projections of births, deaths and migration to arrive at the projected population. In the case of the cohort-survival method, however, the popu-

lation is carried forward by age and sex to yield projections by age and sex. An important element of this method is the fact that births are derived by applying a set of age-specific birth rates to the female population in the child-bearing years.

This technique, because of the detail employed, has its chief advantage in its superior logic. The data required, however, are relatively detailed and are often not available for local areas. In addition, calculations involved in this method are voluminous and revisions of the projections when new facts become available would necessitate complete recalculation.

For general planning purposes in Maricopa County, the increased accuracy of the cohort-survival method is offset by the disadvantage of the great amount of time and information required for the projections. For specific problems, where projections by age and sex are required, the cohort-survival method is indicated.

#### The Ratio Method

Essentially, the ratio method is a projection of local area population based on the ratio of the local population to the population of some larger area for which acceptable projections are available. The ratios must be derived for several decades past, and extrapolated ratios must then be applied to the projected population for the larger area to yield the projected local area population.

The ratio method requires relatively little data, computation is simple and fast, and revision of ratio projections is comparatively easy. This technique, however, is not strictly demographic unless the projections for the larger areas are demographic in character. Projections made for the nation by the U.S. Bureau of the Census satisfy this requirement. As has been pointed out several times in this report, however, the great differences in population growth and characteristics between the entire United States and Maricopa County indicate that ratio projections would be unreliable.

Detailed demographic projections for a long period into the future are not generally available for the State of Arizona. Therefore it is concluded that, at this time, projections for Maricopa County by the ratio method would be inferior to the component method as employed in Chapter III.

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Acme Blueprint and Photo-Craft Co.  
Phoenix, Arizona