DESTINY

PLANNING AND FORECASTING SYSTEM

Module 1: Single-Country Programs

User's Manual

FORTRAN Version 1.0

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I. Overview

The DESTINY computer program package is designed to project populations and estimate quantities related to population. The estimated quantities may be occurrences of events, such as school enrollments or prison admissions or occurrences of diseases or accidents; or they may be special populations of interest, such as the population of students, of nursing home beds, or persons having certain disabling conditions.

An overall description of the DESTINY system and its uses is presented in a separate manual, DESTINY Planning and Forecasting System: Description of Capabilities (Reference 1). This User's Manual provides a detailed description of procedures for using the system.

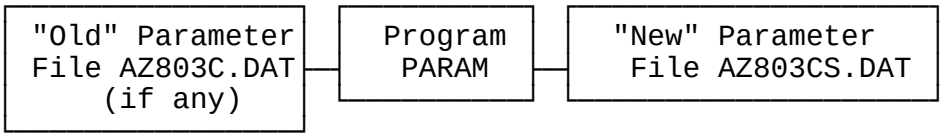
A primary objective of the DESTINY system is to enable the user to make population projections and population-related estimates using readily available demographic data about the general population and target or service populations of interest. In addition to describing how to use the DESTINY computer programs, much of the information presented in this manual is intended to identify sources for the needed program input data, or show how to obtain the needed data from related data, in cases where the exact data desired are not available.

The DESTINY computer program package consists of three computer programs, called PARAM, CHECK, and PROJ. Three separate programs are used instead of one in order to minimize the internal memory, direct-access (core) storage requirements of the package. The PARAM program sets up a parameter file, which contains demographic information about the population of interest, and programmatic information about the target populations and service system under study. The CHECK program is used to print out the contents of the parameter file, so that a "hard copy" printout of all parameters can be retained as documentation for the projection runs. This program is also used to make minor adjustments to some of the service-system parameters. The PROJ program operates on the data files created by PARAM and CHECK, and generates the desired population projections and forecasts of program-related quantities of interest, such as service requirements, resource utilization, and cost.

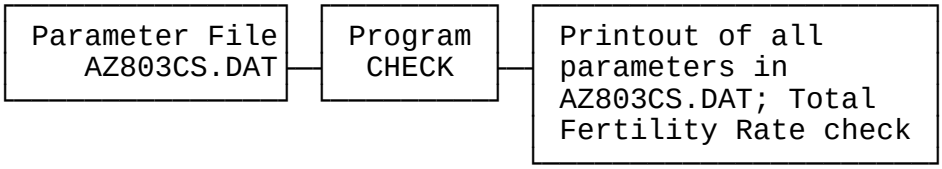
Figure 1, Major Components of the DESTINY System, illustrates the relationship of the three programs, PARAM, CHECK, and PROJ. In Figure 1, the data files created by PARAM, CHECK and PROJ are called AZ803.DAT and AZ803CS.DAT. (A recommended procedure for naming files is discussed later. With this procedure, each letter of the file name indicates something about the nature of the file. In the name AZ803CS.DAT, for example, AZ stands for Arizona, 80 for 1980, 3 for 3 races, C for geographic disaggregation by county, and S for social services.) In running the program, the user has the option of giving whatever names he desires to these files. The two data files AZ803C.DAT and AZ803CS.DAT are "parameter" files created by PARAM.

Figure 1. Major Components and Functions of the DESTINY System

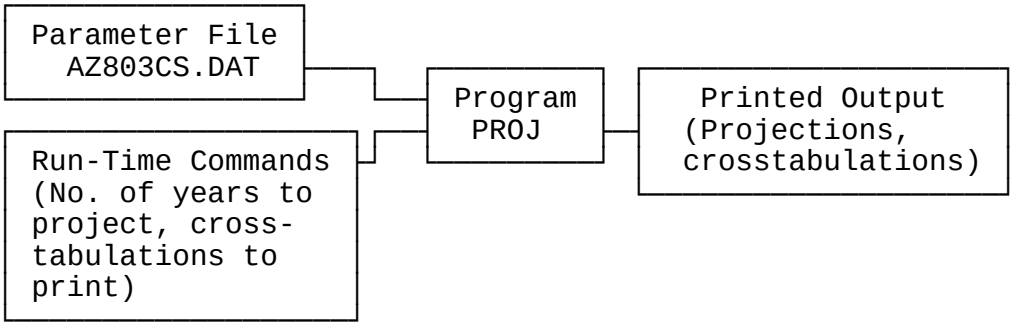
1. Program PARAM: Creation of Parameter File



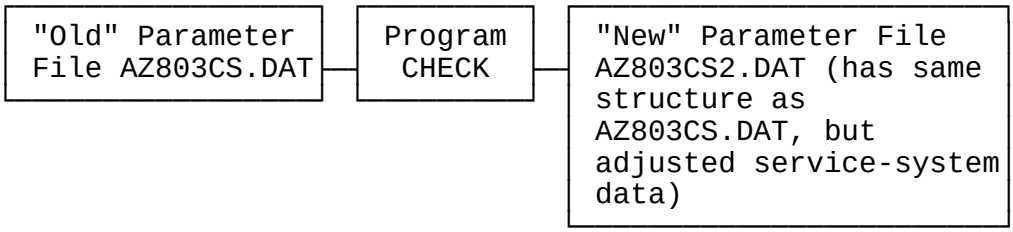
2. Program CHECK: Printout of Parameter File



3. Program PROJ: Computation of Projections



4. Program CHECK: Adjustment of Service-System Parameters (Optional)



The PARAM program is used to set up a parameter file, or to update a parameter file. The first time that PARAM is used, there is no "old" parameter file -- the program is used the first time to set up only a "new" parameter file, AZ803C.DAT, which is stored on the computer's disk. After this first parameter data file is created, it is then referred to as an "old" parameter file, and it may be modified (for example, by changing an infant mortality rate or a migration rate, or by adding service-system data.) These changes are incorporated into a "new" parameter file, AZ803CS.DAT, which is also stored on disk. The "old" parameter file, AZ803C.DAT, is unchanged -- it remains on the disk exactly the same as before.

After the parameter file (AZ803C.DAT the first time, AZ803CS.DAT in later runs) has been created, the program CHECK should be run. This program prints out all of the parameter values that are contained in AZ803CS.DAT. This printout is useful in two ways -- first, it facilitates a detailed review of all of the parameter values, which review should be conducted to be sure that all of the parameter values have been entered correctly; and second, it represents a permanent record of the parameter values stored in AZ803CS.DAT, which record would be retained as documentation for the projection runs produced by the PROJ program, using the parameter file AZ803CS.DAT.

In addition to producing a hard copy printout of the contents of the parameter file, CHECK also prints out information concerning the Total Fertility Rate specified in the parameter file. It estimates the Total Fertility Rate from the base-year crude birth rate and age/sex population distribution, so that the user may compare it to the value specified for the first five-year projection period. It also estimates the annual net migration for the past ten years.

If the user wishes to modify any of the data values in the data file, he may rerun the PARAM program to change them. If the user wishes only to make scaling adjustments to the values of service-system parameters (without changing the numbers of parameters in the file), this may be done more easily by rerunning the CHECK program (than by rerunning PARAM). This option is used after the user has made his first run of the projection program, PROJ, and may wish to modify some of the service-system parameters in order to "calibrate" the model to match certain known base-year quantities (such as total budgets.)

The PARAM program asks the user to enter the name of the old and new parameter files, and the values of the various parameters required to make projections. The CHECK program asks for the name of the parameter file, and, if it is being used to modify service-system parameters, for the values of the adjustment factors.

After the programs PARAM and CHECK have been run, the program PROJ is executed to construct the desired projections. The PROJ program asks the user for very little data -- the number of five-year periods to project, the kinds of crosstabulations that are desired, and whether single-year projections (between successive five-year intervals) are desired (and if so, for which years). The PROJ program reads the data file created by PARAM (and perhaps modified by CHECK).

The preceding paragraphs have described the overall way in which the DESTINY package works. The following chapters describe in detail how to use each of the three component programs, PARAM, CHECK, and PROJ.

II. How to Use the PARAM Program to Create Parameter Files

A. Overview

The PARAM program sets up a parameter data file containing the following categories of information:

- File Names; File Structure (Input Option) Parameters
- Demographic Parameters (one complete set of data is required for each race)
  - Total fertility Rate
  - Fertility Age Distribution
  - Infant Mortality Rates or Expectation of Life at Birth
  - Base-Year Population, Other Base-Year Data, and Data for the Ten-Year Period Prior to the Base Year
  - Regional Populations (if the model includes more than one region; for base year and ten years previous)
  - External Migration Parameters
  - Internal Migration Parameters (if the model includes more than one region)
- Service-System (Program-Related) Parameters (Optional)
  - Program Data Parameters
  - Target Population Incidences or Prevalences
  - Service Population Service Ratios
  - Service Unit Data
  - Resource Unit Data
  - Cost Data
- Names (Required)
  - Race/Ethnic Group Names
  - Region Names
  - Target Population Names
  - Service Population Names
  - Service Names
  - Resource Names
  - Cost Category Names

The sections that follow define each of the variables which characterize the above information categories, and describe in detail how to input them to the computer terminal. Appendix A indicates likely sources for the data required by PARAM. Appendix B contains data entry forms that can be used to record the data in an organized format, prior to entry into the computer. Appendix D includes some technical information concerning the analytical methodology used by the DESTINY package.

B. File Names; File Structure (Input Option) Parameters;

Names of Races and Regions

The PARAM program is executed by typing PARAM at the MS-DOS prompt. The first information required by the program is an Authorization Code -- an eight-digit code which must be input by the user before the program will work. The Authorization Code is recorded on the DESTINY Lease Agreement Form. The PARAM program prints the following line on the video monitor:

ENTER AUTHORIZATION CODE: .

If the Authorization Code were ABC123, for example, the user would type ABC123 on the keyboard (using capital letters), and then depress the ENTER key:

ABC123 (ENTER) .

(Note: the symbol (ENTER) indicates that the "ENTER" key on the keyboard is to be depressed.) No spaces should be typed before the code, or between any of its characters.

Next, the PARAM program states:

ENTER 0 TO MODIFY EXISTING FILE, 1 TO CREATE FILE FROM SCRATCH:

The first time the program is used, there is no existing file which can be modified, and the user must enter all of the data from scratch, i.e., a "1" should be entered:

1 (ENTER) .

For subsequent uses, the user will generally update an existing parameter file, and enter a "0". For example, the user will probably create a base-year population file containing only demographic information, and update this file on numerous occasions to create files that contain data on certain target populations. In such a case, all of the demographic data in the "demographic" file are simply copied into the new file without change, and the new target-population or service-system data are added to the file.

If the user inputs a "0" (to update an existing parameter file), the program reads through the file section by section, and shows the user what parameter values are stored in the existing file. The program then asks for each section whether to use the existing values, or whether different values are desired. If the user chooses to accept the existing values in a section, he types a "0" (or nothing), and depresses the ENTER key. If the user wishes to input different values in a section, he enters a "1" (i.e., types a "1" and depresses the ENTER key). Since the manner in which updated data are entered in each section is exactly the same as the manner in which new data are entered the first time PARAM is run, we shall discuss in this section only the latter case, in which a new parameter file is being

constructed from scratch. We assume that the user enters a "1" in response to the question:

ENTER 0 TO MODIFY EXISTING PARAMETER FILE, 1 TO CREATE FILE FROM SCRATCH: .

The next request printed by the program is:

ENTER NAME OF NEW PARAMETER FILE (12X): .

The notation (12X) in parentheses is a format descriptor. It indicates that up to 12 characters may be used in the file name. The user may input any valid MS-DOS file name (eight-digit alphanumeric name beginning with a letter, followed by a period, followed by three additional characters), such as US801.DAT or AZ803C.DAT. The use of easily-remembered mnemonics which suggest the contents of the file is recommended. It is suggested that the first two characters be used to denote the geographic region (e.g., US or AZ); the next two characters the last two digits of the base year (typically a census year, such as 80 or 90); the next character the number of races (or a letter denoting one of two races); and the next the type of region. The seventh character may describe the nature of a target population to be described by the file, e.g., S for social services. The eighth character may be used for any purpose, such as a file version number (e.g., 1, 2, a, b). The final three characters (the "file extension," following the period), may be any characters, such as DAT (for "data"), or DBF (for "data base file"). (It is best to use the same three-character extension for all data files, to facilitate copying of those files to a floppy disk by means of a command such as COPY *.DAT A:/V .)

For example, the mnemonic AZ803CS.DAT refers to a parameter file containing data for the state of Arizona (AZ); base year 1980, 3 races; countries; and social services to the elderly.

To input the file name, simply type it on the keyboard, using capital letters, and depress the ENTER key. For example,

AZ803C.DAT (ENTER) .

On later runs, the user will usually be updating an existing file, and will enter a "0" in response to the request concerning whether an existing parameter file is to be modified, or a new file created from scratch. The user would be instructed:

ENTER NAME OF OLD PARAMETER FILE: ,

to which request he might enter:

AZ803C.DAT (ENTER) .

The next command would then be:

ENTER NAME OF NEW PARAMETER FILE: ,

to which request he might respond with the entry:

AZ803CS.DAT (ENTER) .

The next information requested by the program is a "header" for the parameter file -- a descriptive title for the parameter file, consisting of up to 80 characters. The program prints out:

ENTER FILE HEADER. INCLUDE NAME OF GENERAL POPULATION; NATURE OF RACIAL/ETHNIC AND REGIONAL DISAGGREGATION: NATURE OF TARGET POPULATIONS AND SERVICE SYSTEM. FORMAT 80X.: .

The header would include the following information:

- Name of the general population being projected
- Nature of the racial/ethnic and regional disaggregation
- Nature of the target populations and service system.

For example, if the parameter file will refer to the resident population of the state of Arizona, will be disaggregated by three races (white, Indian, and other), will include 14 countries, and will include data concerning social services to the elderly population, then the user might enter the following header:

ARIZ RESIDENT POP, BY RACE (W/I/O) AND COUNTY: SOCIAL SERVICES TO THE ELDERLY .

After the header, the program prompts the user to enter the base year to which the population applies. This number is typically a decennial census year (for which much demographic data are available), such as 1980 or 1990. This number should be four digits long, e.g., 1980. The program requests:

INPUT BASE YEAR: ,

to which the user might respond, for example,

1980 (ENTER) .

After the file name(s), header, and base year have been entered, the next input parameters required by the PARAM program allow the user to specify which of a number of options he wishes to use, in constructing the parameter data file. These options indicate both the types of data to be specified by the user, and the level of detail of the data. The seven parameters (denoted by P1, P2,..., P7 in this document) are as follows:

P1: Number of Races (1-3)
P2: Number of Regions (1-14)
P3: Vital Statistics Parameter Option (1 or 2)
P4: Life Table Option (1 or 2)
P5: External Migration Parameter Option (0, 1, or 2)
P6: Internal Migration Parameter Option (0 or 1)
P7: Service System Option (0 or 1)

The significance of each parameter option is as follows.

P1: Number of Races (1-3)

The program requests:

ENTER NO OF RACIAL/ETHNIC GROUPS (1-3): .

The user specifies the number of races (from 1 to 3) for which he plans to enter a complete set of demographic data (fertility rates, migration rates, base year populations, and so forth). The user should enter the number of racial/ethnic groups for which he wants breakdowns of the data in the projections, or for which he wishes to specify different demographic or programmatic parameters. If projections are to be made for a state in which there are three major racial/ethnic groups, and projections are desired by race, then a "3" should be entered (by striking a "3" on the keyboard, followed by "ENTER"). Alternatively, if the user is not interested in projections broken down by race, he could specify a "1" for the number of races, in which case all subsequent demographic parameters entered to the program would refer to the entire state (i.e., the total population of all races combined).

It is emphasized that all of the demographic data items (described later) must be entered for each race specified.

P2: Number of Regions (1-14)

The program requests:

INPUT NO OF REGIONS (1-14): .

The user may specify up to fourteen geographic regions. If no regions are specified, the user enters a "1" (or a "0" or nothing). By specifying more than one region, the user may later request in a PROJ run that the projections be broken down by region. If two or more regions are specified, then the user must (at a later step) specify the population of each region, for each racial/ethnic group.

P3: Vital Statistics Parameter Option (1 or 2)

The program requests:

ENTER VITAL STATISTICS PARAMETER OPTION (1 OR 2): .

The Vital Statistics Parameter Option allows the user to specify that the following parameters:

- Total Fertility Rate
- Fertility Age Distribution
- Infant Mortality Rate
- Expectation of Life at Birth

are either the same for all future time (i.e., for all ten five-year projection periods), or are different for each of the ten five-year projection periods. The user enters a "1" for the former option

(parameter values the same for all the future) and a "2" for the latter option (different parameter values for each five-year period).

P4: Life Table Option (1 or 2)

The program requests:

ENTER LIFE TABLE OPTION (1 OR 2): .

The DESTINY package uses the Coale-Demeny "West" model life tables to determine the probability that an individual survives each five-year period of his life. These tables specify the survival probabilities either as a function of the infant mortality rate or as a function of the expectation of life at birth. The user indicates which table to use by specifying a value for either one of these two parameters. The Life Table Option parameter is set equal to "1" in order to use infant mortalities to determine the appropriate life table, and "2" to use expectations of life as the determining parameter. It is recommended that Option 1 be used for countries having high mortality rates (e.g., most developing countries) and Option 2 for countries having relatively low mortality rates (e.g., the US).

P5: External Migration Parameter Option (0, 1, or 2)

"External" migration refers to migration between the area under study and outside areas, e.g., migration into and out of a state or into and out of a country. "Internal" migration (the subject of Input Parameter P6) refers to population movements among the various subregions of the area under study, such as population movements among states, provinces, or regions in the case of a country, or movements among countries or other substate regions or districts in the case of a state.

The program requests:

ENTER EXTERNAL MIGRATION OPTION (0-2): .

The five options that are available for specifying external migration are as follows:

- Option 0. No net external migration, either into or out of the geographic area under study, is allowed, i.e., there is no net immigration ("in-migration") or emigration ("out-migration").

- Option 1. The same migration rate is used for all ten five-year projection periods (of the next fifty years), or the same migration amount, or number, is used for all ten five-year projection periods. (Note: Since all demographic parameters are specified separately for each race, a different rate or number may be specified for each race.)

- Option 2. A separate migration rate or migration number is specified for each of the ten five-year projection periods. (Note: These parameters may vary by race.)

A migration rate is the average proportion of the population moving out of the area each year; the rate is expressed in the net number of persons entering or leaving an area per 1,000 persons per year. A migration number is the average number of persons moving into or out of an area each year. The migration rate or the migration number are used to specify net immigration (in-migration). The user may specify either a migration rate or number, but a (negative) migration rate should be specified in cases of net population loss and a (positive) migration number should be used in cases of net population gain (although there is no requirement for this convention). Additional discussion of migration rates and numbers will be presented later.

Option 0 would be used in a run to determine the "rate of natural increase" -- i.e., the growth rate of a population due to births and deaths, ignoring changes due to migration.

P6: Internal Migration Parameter Option (0 or 1)

"Internal migration" refers to the redistribution of the population among the region to area under study, due to movements of the residents of one region to another region, to settlement of the external migrants (from outside the area), and to emigration of the residents of regions to places outside the area under study.

The program requests:

ENTER INTERNAL MIGRATION OPTION (1 or 2): .

Two options are available for specifying internal migration:

- Option 0. No internal migration.
- Option 1. For each region, the user must specify an annual growth rate or amount, net of births, deaths, and a proportional allocation of external migration to the regions. (Note: Different parameter values may be specified for each race.)

Since internal migration is an inter-regional phenomenon, the Internal Migration Option operates only if there is more than one region. If there are no regions specified, Option 0 is used.

The growth rate is the average rate of population change in a region per 1,000 population per year.

P7: Service System Option (0 or 1)

The program requests:

ENTER SERVICE SYSTEM OPTION (0 0R 1): .

The DESTINY package may be used solely to make projections of the general population, or to make projections of target populations (subpopulations of interest), program services, resources, and costs. To make only general population projections, enter a "0"; to use the

full capability of the program to forecast the program-related items as well, enter a "1".

After the demographic parameter options have been specified, the program asks for the names of the races (or ethnic groups) and regions (if any). The request is:

```
ENTER NAME FOR RACE NO i (8X): .
```

where i ranges from 1 to the number of races specified (i.e., 2 or 3). The user may specify any eight-character name for the race, such as WHITE, BLACK, OTHER, HISPANIC, or AMERIND.
The program next requests the user to input the names of the regions, if two or more regions are included in the model:

```
ENTER NAME FOR REGION NO i (8X): .
```

For a country, the regions might be states, provinces or major geographic regions. For a state or province, the regions might be districts or counties. For a local area such as a city, the regions might be the metropolitan and nonmetropolitan areas. If names such as "REGION 1" are used, a space may separate the word and the number, as long as the total number of characters, including blanks, is less than or equal to eight. Hence, "REGION 10" is not allowed -- if it were entered, the eleventh character (the "0") would be dropped.

If PARAM is being used to update an existing parameter file, the user will be asked whether he wishes to keep all of the Demographic Option Parameters the same as in the old file, or whether he wishes to change (all of) them. If he keeps them the same, PARAM simply reads them from the old file and writes them into the new file. If he wishes to change them, he must input the new values through the keyboard. This process (i.e., accept the old file values or enter new values) is used for all of the remaining parameter categories that follow.

C. Demographic Parameters and Data

A complete set of demographic parameters must be specified for each race represented in the parameter data set. When PARAM is used to construct a "new" parameter file from scratch (such as is the case the first time the DESTINY package is used), the program input section makes one complete input "cycle" for each race, and requests the user to enter values for all of the required demographic parameters. If program is used in the update mode (i.e., a new parameter file is being constructed by modifying an existing file), then the program input section cycles through each of the races in the old parameter file, each time asking whether the user wishes to save (i.e., write to the new file) or update the data for that race. Then, after all of the races of the old parameter file have been reviewed (and either saved or updated), the program recycles to permit entry of additional races. This process stops when demographic data have been modified or input anew for as many races

as were specified in the Input Option Parameter section. For each cycle, the following information is requested:

- Total Fertility Rate(s)
- Fertility Age Distribution(s)
- Infant Mortality Rate(s) or Expectation(s) of Life at Birth
- Base-Year Population
- External Migration Parameter(s)
- Regional Populations (if regions are included in the model; for the base year and ten years previous)
- Internal Migration Parameter(s) (entered if the model contains more than one region)

The paragraphs that follow describe the data entry procedure for each of the preceding information categories. The data entry is illustrated with sample values, without describing the source of those sample values. Later chapters will describe in detail the procedures for obtaining proper values for the model parameters.

Total Fertility Rate(s)

The total fertility rate is the average total number of live births per female in her lifetime. For the US population in 1975, this number was 1.799 (1.708 for white, 2.322 for black and other).

If Input Option Parameter P3 is a "1", then only one rate is required (per race), and this rate applies to all future time periods. In this case, the program requests:

```
ENTER 1 TOTAL FERTILITY RATE(S) (10X.XXX): ,
```

and the user must enter one decimal number. If Option P3 is specified as a "2", then the program requests:

```
ENTER 10 TOTAL FERTILITY RATE(S) (10X.XXX): ,
```

and the user must input ten decimal numbers. The rules for entry of these numbers will now be described.

The format X.XXX in the data entry request indicates that the Total Fertility Rate must be entered to the computer as a decimal number (e.g., 1.799), with no more than one digit before the decimal and no more than three digits after the decimal. If a rate of 2.0 were to be specified, it must be entered as "2.", or "2.0", or "2.00", or "2.000", with the decimal point, not as "2" with no decimal point. Each time PARAM requests one or more numerical values to be entered, it indicates the format of the number by means of an expression such as "X", "7X", "16XX.XX", or "8XXXXXXXXX.", where a digit is to be substituted for each "X" (or, in the case of names, any alphanumeric character is to be substituted for each "X".) The prefix number (7, 16, and 8 in the preceding examples) indicate how many values are to be specified (if available) before depressing the "ENTER" key. The

position of the decimal point does not matter, as long as it is present somewhere in the number. For example, if the user wanted to enter the following ten Total Fertility Rates (one for each of the ten five-year projection periods) according to the format 10X.XXX, then the following entry would be acceptable:

1.875,1.85,1.8,1.75,1.75,1.75,1.75,1.75,1.75,1.75 (ENTER).

Note that it is not necessary to have three digits following each decimal point, as suggested by the format. The numbers may not, however, have more than one digit before the decimal, nor more than three digits after the decimal. If the user violates these rules, the extra digits will be lost, and the wrong values entered into the parameter file.

The user has a choice of either following the specified format exactly, or separating each number by commas. For example, if the format were 3X.XXX, and the user wished to enter the numbers .75, 1.2, and .9, then either of the following entries would be acceptable:

0.75±1.2±±.9 (ENTER) ,

where ± represents a blank (obtained by depressing the space bar), or

.75,1.2,.9 (ENTER) .

If commas are not used, each number must utilize exactly the same number of positions (including digits, decimal point, minus sign, or blanks) as specified in the format descriptor. In the preceding example, each number of the entry must take up exactly five positions if no commas are used. In general, it is simpler to use commas to separate all decimal numbers, but to use no commas when entering small integer numbers. For example, if the user wished to enter the numbers 1,0,1,1,0,1,0,0,1 according to the format 9X, it is simpler to enter

101101001 (ENTER) ,

rather than

1,0,1,1,0,1,0,0,1 (ENTER) .

Fertility Age Distribution(s)

The Fertility Age Distribution indicates what proportion of a woman's children are born in each five-year period of life. For example, in the US in 1978, these proportions are as follows:

Age of Mother	Birth Rate (per 1000 women in specified age group)	Proportion
Under 20	53.6	.15
20-24	112.3	.31
25-29	112.0	.31
30-34	59.1	.17

35-39	18.9	.05
40+	4.1	.01
	360.0	1.00

Note that the Total Fertility Rate (1.799) is equal to the sum of the birth rates (360.0) divided by 1000 (the number of women) and multiplied by 5 (the number of years), i.e., 1.799 = 360.0 x 5.0 / 1000. (The arithmetic would actually produce 1.800, not 1.799; the value 1.799 published in vital statistics documents for 1978 is the result of more precise computations, which carried more decimal places in the birth rates.) Possible sources of demographic data such as the fertility age distribution are identified in Appendix A.

If Input Option Parameter P3 is a "1," the user need input but a single Fertility Age Distribution, consisting of six decimal numbers that total to 1.0. The program requests:

ENTER FERTILITY AGE DISTRIBUTION (6 ENTRIES, FORMAT 6X.XXX) FOR PERIOD NO 1: .

To enter the Fertility Age Distribution illustrated in the preceding example, the user would enter:

.15,.31,.31,.17,.05,.01 (ENTER) .

If Input Option Parameter P3 is a "2,, the user must enter ten such six-number distributions, one for each of the ten five-year projection periods.

Infant Mortality Rate(s)

The Infant Mortality Rate is the number of infant deaths per 1000 live births (where an "infant death" is the death of an infant under one year of age, excluding fetal deaths.) For the US in 1975, the infant mortality rate was 16.1. Note that the Infant Mortality Rate is specified to the PARAM program for both sexes combined, not separately for each sex.

The PARAM program will accept Infant Mortality Rates whose values lie between 11.25 and 530.76.

If Input Option Parameter P3 is a "1," the program requests:

ENTER 1 INFANT MORTALITY RATE(S) (10XX.XX): ,

to which the user might respond, for example,

13.8 (ENTER) .

If Input Option Parameter P3 is a "2," ten such numbers must be entered, one for each five-year period into the future.

Expectation of Life at Birth

The Expectation of Life at Birth is the average number of years to be lived by a newborn, assuming that the mortality rates for each age

group remain constant in the future. For persons born in the US in 1975, this number was 72.5. Note that the expectation of life at birth is specified to PARAM for both sexes combined, not separately for each sex.

PARAM will accept values of the expectation of life at birth between 19.02 and 75.70.

If Input Option Parameter P3 is a "1," the program requests:

ENTER 1 EXPECTATION(S) OF LIFE AT BIRTH (10XX.XX): ,

to which the user might respond

70.00 (ENTER) .

If Input Option Parameter P3 is a "2," then ten such numbers must be entered.

Note that, depending on the value of the Life Table Option Parameter P4, the user specifies either Infant Mortality Rates or Expectations of Life at Birth, but not both.

Base-Year Population, Other Base-Year Data, and Data for the Ten-Year Period Prior to the Base Year

Base-Year Population The program requests entry of the base-year population by thirty-two age x sex categories -- sixteen five-year intervals by two sexes. To illustrate, the following table presents the US resident population for 1980, categorized by these two variables:

Age	Male	Female
0-4	8,360,135	7,984,272
5-9	8,537,903	8,159,231
10-14	9,315,055	8,925,864
15-19	10,751,544	10,410,123
20-24	10,660,063	10,652,494
25-29	9,703,259	9,814,413
30-34	8,675,505	8,882,452
35-39	6,860,236	7,102,772
40-44	5,707,550	5,960,689
45-49	5,387,511	5,700,872
50-54	5,620,474	6,088,510
55-59	5,481,152	6,132,902
60-64	4,669,307	5,416,404
65-69	3,902,083	4,878,761
70-74	2,853,116	3,943,626
75+	3,547,402	6,419,145
Total	110,032,295	116,472,530
Grand Total	226,504,825	

Source: 1980 Census of Population, Supplementary Reports, PC80-S1-1, Age, Sex, Race, and Spanish Origin of the Population by Regions, Divisions, and States: 1980, Table 1. "Population of the United

States by Age, Sex, Race, and Spanish Origin, 1980, US Department of Commerce, Bureau of the Census (for sale by the Superintendent of Documents, Washington, DC 20402), issued May, 1991. This report presents resident population, i.e., excluding Armed Forces overseas.

The program requests:

ENTER BASE-YEAR POPULATION, BY AGE (16 ENTRIES, FORMAT 8XXXXXXXXX.) FOR SEX = i: ,

where i = MALE or FEMALE. The format 8XXXXXXXXX. indicates that these data are to be entered as decimal number of up to nine digits each (plus a decimal), eight at a time. In the preceding example, the data would be entered in four steps, as follows:

8360135.,8537903.,9315055.,10751044.,10660063.,9703259.,8675505.,6860236. (ENTER)
5707550.,5387511.,5620474.,5481152.,4669307.,3902083.,2853116.,3547402. (ENTER)
7984272.,8159231.,8925864.,10410123.,10652494.,9814413.,8882452.,7102772. (ENTER)
5960689.,5700872.,6088510.,6132902.,5416404.,4878761.,3943626.,6419145. (ENTER)

Each of the four sets of entered data should be typed on a single line, not on two lines as shown here. Note that commas may be used as delimiters between the data values, but they must not be used within each number.

Exactly eight population entries must be typed prior to each depression of the ENTER key. If fewer than eight entries are typed, the remaining entries (up to eight) will be recorded as zeros. If more than eight entries are typed, they will be lost.

Note that, just as is the case for all other demographic parameters, a separate set of base-year population figures is required for each race being considered. In the preceding example, no racial structure would have been specified for the model, and the population value for each age x sex category includes persons of all races.

Other Base-Year Data The following additional base-year data:

- o crude birth rate
- o crude death rate
- o infant mortality rate

are entered. The first two of these data elements are used, along with the base-year population, to determine an estimate of the Total Fertility Rate for the base year. This estimate may be used if reliable data on the Total Fertility Rate are not available from published sources. The last data item (infant mortality rate for the base-year period is not presently used in the model computations; it is entered for display purposes along with other demographic data.

The program makes the following three requests:

ENTER CRUDE BIRTH RATE (PER 1000) FOR BASE YEAR (FORMAT XXX.XX):

ENTER CRUDE DEATH RATE (PER 1000) FOR BASE YEAR (FORMAT XXX.XX):

ENTER INFANT MORTALITY RATE (PER 1000) FOR BASE YEAR (FORMAT XXX.XX):

to which the user might provide, for example, the values 15.90, 8.70, and 13.80.

Data for the Ten-Year Period Prior to the Base Year In order to estimate migration, the program uses the following data for the ten-year period preceding the base year:

- Population ten years prior to the base year
- Average crude birth rate for the ten-year period prior to the base year
- Average crude death rate for the ten-year period prior to the base year.

In addition, for display/comparison purposes, the following data element is requested:

- Average infant mortality rate for the ten-year period prior to the base year.

The program makes the following requests:

ENTER POPULATION TEN YEARS PRIOR TO BASE YEAR (FORMAT XXXXXXXXX.):

ENTER AVERAGE CRUDE BIRTH RATE (PER 1000) FOR PREVIOUS TEN YEARS (FORMAT XXX.XX):

ENTER AVERAGE CRUDE DEATH RATE (PER 1000) FOR PREVIOUS TEN YEARS (FORMAT XXX.XX):

ENTER AVERAGE INFANT MORTALITY RATE (PER 1000) FOR PREVIOUS TEN YEARS (FORMAT XXX.XX):

to which the user might provide, for example, the values 203302301., 15.90, 8.70, and 13.80.

External Migration (Total Net Migration for All Regions)

As mentioned earlier, the PARAM program allows five options for entry of migration information. The migration data describe the total migration for all regions. The manner in which the migration is associated with the various regions of the model (if the model

contains more than one region) is described in the following section (on internal migration).

The data entry for the five external migration options (0-2) are described below.

- o Option 0. No net external migration; no data entered.

- o Option 1. The user specifies (for each race) a single annual migration rate or a single annual migration number (amount), which apply to all future five-year projection periods. (In the model, the total number of net migrants (immigrants and emigrants) is allocated to each age x sex cohort (category) in proportion to the size (population) of each cohort.)

- o Option 2. The user specifies a separate migration rate or migration number for each of the ten five-year projection periods. (As with Option 1, the model allocates the total number of net migrants (immigrants or emigrants) to each age x sex cohort in proportion to its size.)

The migration rates and migration numbers are annual values, and the rates are per 1,000 persons. The migration rate is the average net number of immigrants (persons moving into the area) per 1,000 persons per year. The migration number is the average net number of immigrants per year. The term "net" refers to the difference between immigrants and emigrants. Net migration may be positive or negative.

Net migration rates and numbers may be either positive (net gain in population from immigration and emigration) or negative (net loss in population from immigration and emigration). For example, a migration rate of -1.0 represents a net emigration of one person per 1,000 population per year from an area. Similarly, a migration number of -7,000 represents a net emigration of 7,000 persons from an area.

Migration rates and numbers are intended to represent total net migration for the race under consideration, and typically only one of these two parameters is used. In (very) rare instances, however, the user might specify nonzero values for both parameters. One such instance is the testing of alternative models. In another instance, nonzero values might be used for both parameters in the situation in which accurate data were available separately for emigration and immigration. In this case, the emigration would be represented by a negative migration rate and the immigration would be represented by a positive migration number. In most situations, accurate data will not be available for emigration and immigration separately. Instead, estimates will be available for total net migration (immigrants less emigrants), and the total net migration may be expressed either as a net migration rate (if negative) or a net migration number (if positive).

Although migration rates and numbers may be positive or negative, it is highly recommended that positive net migrations be represented by (positive) values of the net migration number and that negative net migrations by represented by (negative) values of the net migration

rate. Because migration rates are typically used in cases in which an area is losing population, we shall sometimes refer to a migration rate as an emigration rate; similarly, because migration numbers are typically used in cases in which an area is gaining population, a migration number shall sometimes be referred to as an immigration number. This terminology may be confusing, however, since strictly speaking both the migration rate and the migration number measure immigration (migration into an area.

The rationale for the convention of using migration rates for negative migrations (net population losses) and numbers for positive migrations (net population gains) is both logical and practical. In the first instance, a country that is gaining population through immigration (such as the US) may enforce numerical limits on immigration, whereas population shrinkage due to emigration is less subject to control and more logically represented as a percentage of the country's remaining population. From a practical viewpoint, large net positive immigration levels should definitely not be used, since they quickly lead to absurdly high population projections. As a general rule, migration numbers should always be positive (representing net positive immigration) and migration rates should always be negative (representing net positive emigration).

Under External Migration Option 1, the program first requests:

```
ENTER 1 NET MIGRATION RATE(S) (ANNUAL, PER 1000,
     8XXXX.XXX): ,
```

(to which the user might respond, for example,

```
-8.3 (ENTER)  ),
```

and

```
ENTER 1 NET MIGRATION NUMBER(S) (ANNUAL, 8XXXXXXXXX.): ,
```

(to which the user might respond, for example,

```
500000. (ENTER)   ).
```

As discussed above, typically at most one of these two entries would be nonzero.

Under Option 2, the program requests ten migration rates and ten migration numbers. (Note: Since the format for the migration numbers is 8XXXXXXXXX., two data entries are required, the first line consisting of eight numbers and the second line consisting of two numbers.)

Note on Other Factors Included in External Migration

Changes in the size of a population of a specific race may result from factors other than births, deaths, and net external migration. Other factors that may contribute to changes in the size of a population of a specific race include changes in race declarations, changes in procedures, criteria, or categories used to collect race

data, and crossbreeding among races. Changes in the size of a population of a specific race beyond those associated with births, deaths, and external migration are referred to as "race transitioning."

In the DESTINY model, race transitioning is included in external migration. For example, if the net external migration of a population of a specific race over a particular time interval is 1,000, this could refer to 1,000 immigrants and no emigrants; or 4,000 immigrants and 3,000 emigrants; or no immigrants, no emigrants, and 1,000 births that are not classified as the race of the mother; or 1,000 individuals who declare their race differently at the end of the time interval from what it was at the beginning of the time interval.

Under the convention that external migration includes race transitioning, external migration may be defined simply as the total amount of population change (for a particular race) net of births and deaths. This convention not only simplifies the model specification, but more importantly it simplifies the problem of estimating values for the model input parameters. From available data, it is a simple matter to estimate the population change net of births and deaths -- the problem of attempting to decompose this quantity into a portion due to migration and a portion due to race transitioning is formidable.

It is noted that the population change that occurs over a time interval beyond that associated with specified birth and death rates (or, more properly, with specified fertility and mortality rates) is not limited to external migration and race transitioning. If the fertility or mortality rates change from the specified values, the size of the population will differ from the projected size associated with the specified values. While external migration may be a major factor explaining why a future population differs from that projected for a specified fertility and mortality rate, it is not the only factor.

Regional Populations

If the user entered "1" (or "0" or blank) for the number of regions, the program will not ask for regional populations. If any number greater than one were entered, then the user must enter the total population of each region. A separate set of regional populations is required for each race being entered into the parameter file.

If regional structure is being incorporated into the model, the program requests:

```
ENTER BASE-YEAR POP'N BY REGION (8XXXXXXXXX.): .
```

The regional populations are entered with the same format as the base-year populations by age and sex -- eight values per entry. Of course, if there are fewer than eight regions, then fewer than eight values will be typed. As an example, suppose that there are twelve regions. In this case, two entries will be required -- eight values for the first entry, and four entries for the second.

The sum of the regional populations must equal the sum of the base-year populations by age and sex. If they do not, the program rejects the entered regional populations, and requests the user to enter correct values.

The program then requests the regional populations for the year ten years previous to the base year (same format as above). The sum of these regional populations must equal the total population ten years prior to the base year. If they do not, they are rejected and correct values requested.

Internal Migration (Including Allocation of External Migration to Regions)

As remarked earlier, internal migration refers to the redistribution of the population among the regions of the area, due to movement of the residents from one region to another, to settlement of immigrants, and to emigration. Under Option 0, or if there are no regions in the model, there is no data entry.

If Internal Migration Option 0 is specified, the population change of each region from one projection period to the next (due to births, deaths, and external migration) is proportional to the current regional population (of a particular race), for every race. In this case, any differences in growth rates among the regions are solely due to differences in birth and death rates resulting from different racial compositions of the regions. Whatever external migration was specified in the preceding section is allocated to the regions of the model in proportion to their populations (of the race under consideration). (Under Option 0, if there were but a single race represented in the model, all regions would grow at the same rate.)

Under Option 1, the program represents internal migration as the population change (number or rate per 1,000) net of births, deaths, and external migration allocated proportional to the regional population (of the race under consideration). In other words, the internal migration parameters specify the average annual amount of change or rate of change (per 1,000 population) in the regional population beyond that attributable to births, deaths, and a proportional allocation of external migration to the regions. As used in the DESTINY system, the term "internal migration" hence includes not just interregional population movements but also nonproportional allocations of external migration to the regions.

If external migration is estimated as the population change net of births and deaths, the regional internal migration amounts will sum to zero over all regions (the regional internal migration rates do not necessarily sum to zero, except by coincidence). The sum of the regional population changes computed from the rates (by multiplying each regional rate by the regional population) is not necessarily zero, although it should be close to zero. The program resolves this inconsistency through the use of an adjustment procedure analogous to that discussed previously in the section on external migration (under the option that permits the entry of age/sex-specific external migration rates). With this procedure, changes in regional

populations due to internal migration are proportional to the user-specified regional growth parameters. If the sum of the regional population changes resulting from this procedure is not zero (so that the population total is changed), all populations are proportionally adjusted (scaled) to bring the total population back to the value prior to application of the internal migration process.

The user may specify an internal migration rate and/or an internal migration amount for each region. As usual, it is recommended that a rate be used if the parameter value is negative, and an amount be used if the parameter value is positive.

Unless accurate data on external migration are available and race transitioning is negligible, it is recommended that external migration be estimated as population change net of births and deaths, so that the sum of the internal migration amounts is zero.

Under Option 1, the program requests:

```
ENTER n REGIONAL INTERNAL MIGRATION RATES (ANNUAL, PER
 1000, 8XXXX.XXX): ,
```

where n denotes the number of regions. The user must specify one internal migration rate for each region. The rate for a region is the annual rate of population growth per 1,000 net of births, deaths, and proportional allocation of external migration to the regions. The format is 8XXXX.XXX, and at most fourteen regions are allowed, so that all numbers are to be entered as a single data entry.

The program then requests:

```
ENTER n REGIONAL INTERNAL MIGRATION AMOUNTS (ANNUAL,
 8XXXXXXXXX.): .
```

If more than eight entries are needed, more than one line will be required for data entry. The internal migration amount for a region is the average annual population change net of births, deaths, and proportional allocation of external migration to the regions.

If the convention of using rates for negative numbers and amounts for positive numbers is followed, the user will be required to enter rates for some regions and amounts for other regions, but only one of these parameters will be nonzero for each region.

With the completion of the internal migration input, the demographic data entry cycle is completed for one race, and the program recycles to request the demographic data entry for the next race (if any.)

D. Service-System (Program-Related) Parameters and Data

If the user indicated that no program-related data were to be entered (by entering a "0" for the service system option P7 in the Input

Option Parameter section, then this input section is skipped by the program. Otherwise, the data entry is as follows.

Service-System Parameters

There are five service-system parameters, corresponding to five subsections of the service-system data section of the PARAM program:

S1: Number of Target Populations (1-4)
S2: Service Population Option (0,1, or 2)
S3: Number of Services (0-10)
S4: Number of Resources (0-7)
S5: Number of Cost Categories (0-4).

The program requests entry of each of these service-system parameters by means of five separate requests, as follows:

ENTER NO OF TARGET POPULATIONS (1-4):

ENTER SERVICE POPULATION OPTION (0,1, OR 2):

ENTER NUMBER OF SERVICES (0-10):

ENTER NUMBER OF RESOURCES (0-7):

ENTER NUMBER OF COST CATEGORIES (0-4): .

After each of the preceding requests, the user types the appropriate number, and depresses the ENTER key. For all but the second parameter, the nature of the parameters is self-evident. For the second parameter, the options are as follows:

- o Option 0. There is no service population.

- o Option 1. The service population is identical to the target population.

- o Option 2. The service population is proportional to the target population. The factor of proportionality may be less than or greater than unity. That is, the size of the service population may be less than or greater than the target population.

The five parameters S1-S5 determine how much data entry follows. If any parameter is zero, the corresponding data entry section and all succeeding data entry sections of the service-system data section are skipped. For example, if the five entries were 1, 0, 1, 1, and 1, then only target population data would be accepted.

After the user enters the five service-system parameters, the program requests the user to enter names corresponding to all of the target populations, service populations, services, resources, and cost categories that have been specified. These requests are as follows:

ENTER NAME FOR TARGET POPULATION NO i (8X):

ENTER NAME FOR SERVICE POPULATION NO j (8X):

ENTER NAME FOR SERVICE NO k (8X):

ENTER NAME FOR RESOURCE NO m (8X):

ENTER NAME FOR COST CATEGORY NO n (8X): ,

where i varies from 1 to the number of target populations, j varies from 1 to the number of service populations, k varies from 1 to the number of services, m varies from 1 to the number of resources, and n varies from 1 to the number of cost categories.

Note that in ordinary speech the service population and the target population will often have the same name, e.g., the term "elderly" could refer either to "all elderly persons," or to "elderly persons served." In giving names to these two populations (the target population and the served population), however, it will avoid substantial confusion in the PROJ printout if different names are used. For example, the acronym ELDERLY could be used for the target population, and the acronym ELD(SV) could be used to denote the served elderly. Then, in the PROJ output, no confusion will arise -- for example, it will be clear that a crosstabulation labeled "DISTRIBUTION OF ELDERLY BY AGE AND SEX" refers to the total elderly population, not just the served elderly population.

Similarly, in naming services, resources, and costs, use different labels, e.g., COUNSLNG for counseling services, COUNSELR for a counselor (a resource), and COUNCOST or COUNSLR$ for the cost of counseling, so that the PROJ printouts are unambiguously labeled. If the single word COUNSELR were used for all three entities, the labels which PROJ prints out on the various tables would be confusing.

The name may consist of any eight characters, including blanks. For example, suppose that there are two cost categories -- direct costs and administrative costs. Names for these two cost categories could be as follows:

DIR COST and ADM COST ,

where the blank is typed using the space bar on the console keyboard.

Each of the five data subsections of the Service System Data section will now be described. The five subsections are discussed in the following order:

- Service Parameters
- Resource Parameters
- Cost Parameters
- Target Population Parameters
- Service Population Parameters.

Although specification of the target population and service population parameters would logically precede the specification of the other service-system parameters, they are entered last, in order to permit certain efficiencies in the program computer code.

Service Parameters

For each service population, the user must enter the average number of service units of each type expended per case served per year. By means of example, suppose that there are two target populations, two service populations, three services, and that the average numbers of service units are as follows.

Service Population	Service Type	Service Units /Case/Year
1. Child Abuse (CH ABUSE)	1. Counseling (COUNSLNG)	24.0 hrs.
	2. Physical Therapy (PHYSTHRP)	0.0 hrs.
	3. Day Care (DAY CARE)	200.0 hrs.
2. Disabled (DISABLED)	1. Counseling	12.0 hrs.
	2. Physical Therapy	80.0 hrs.
		0.0 hrs.

In this case, the program would request:

```
     SERVICE POPULATION = CH ABUSE
     ENTER AVERAGE NO OF SERVICE UNITS (XXXXX.XXXX) PER CASE
 SERVED, FOR SERVICE TYPE = COUNSELNG: .
```

The data entry in this case would be:

```
     24.  (ENTER) .
```

The program would then request:

```
     SERVICE POPULATION = CH ABUSE
     ENTER AVERAGE NO OF SERVICE UNITS (XXXXX.XXXXX) PER CASE
 SERVED, FOR SERVICE TYPE = PHYSTHRP: ,
```

to which the user would respond:

```
     0.  (ENTER) .
```

The program would repeat a similar request for service type Day Care, and then make three similar requests for the service population Disabled.

Note that the average number of service units requested by the program is the average over all served clients in the service population, over an entire year. It is not the conditional average, given that the client receives at least some of the service (this latter quantity would be much larger).

Resource Parameters

For each service, the user must enter the average number of resource units of each type required per service unit. It is emphasized that this parameter is the average per service unit, not per case. For example, suppose that there are two resource types (counselors and

contract services), and that the average number of resource units per service unit are as follows.

Service Type	Resource Type	Resource Unit /Service Unit
1. Counseling (COUNSLING)	1. Counselor (COUNSELR)	.0005 cnslrs/hrs
	2. Contract Service (CONT SVC)	0.0
2. Physical Therapy	1. Counselor	0.0
	2. Contract Service	25.0 cntrct svc units / hour
3. Day Care (DAY Care)	1. Counselor	0.0
	2. Contract Service	30.0 cntrct svc units / hour

In this example, it is assumed that the state does not employ physical therapists or provide day care services. Instead, both physical therapy and day care services are provided by outside contractors (service providers). In this case, the resource units are in fact dollars. It is assumed that each counselor works 2000 hours per year, so that the average number of counselors (the resource) per counselor hour (the service) is (1 counselor)/(2000 hours of service) = .0005 counselors per hour of counselor service.

The program first requests:

```
     SERVICE TYPE = COUNSLNG
     ENTER AVERAGE NO OF RESOURCE UNITS (XXXXX.XXXX) PER
 SERVICE UNIT, FOR RESOURCE TYPE = COUNSELR: ,
```

to which the user responds:

```
     .0005 (ENTER) .
```

The program next requests:

```
     SERVICE TYPE = COUNSLNG
     ENTER AVERAGE NO OF RESOURCE UNITS (XXXXX.XXXX) PER
 SERVICE UNIT, FOR RESOURCE TYPE = CONT SVC: ,
```

to which the user responds:

```
     0.0 (ENTER) .
```

The program then goes on to the next service type (Physical Therapy), and asks for the average number of units of each resource type. The same is then done for the third service type (Day Care), and the Resource Parameter section is finished.

Cost Parameters

For each resource, the user must specify the average cost (for up to four cost categories) per resource unit. It is emphasized that this is the average cost per resource unit, not per client or per service unit. For example, suppose that two cost categories are of interest

-- state personnel costs and contract services costs -- and that the average cost per resource unit are as follows:

Resource Type	Cost Category	Cost /Resource Unit
1. Counselor (COUNSELR)	1. State Personnel (DIR SV $)	$20,000.00/counselor
	2. Contract Service (PUR SV $)	0.00/counselor
2. Contract Svc (CONTR SV)	1. State Personnel	0.00/contract service unit
	2. Contract Service	$1.00/contract service unit

Since the contact service units are actually dollars, the number of dollars per contract service unit is 1.00.

The program requests:

```
     RESOURCE TYPE = COUNSELR
     ENTER AVERAGE COST (XXXXX.XXXX) PER RESOURCE UNIT, FOR
 COST CATEGORY = DIR SV $: ,
```

to which the user responds:

```
     25000. (ENTER) .
```

This question is repeated for the second cost category (Contract Services), to which the user responds with the entry 0.00. The question is then repeated two more times for the second resource type (Contract Services), completing the data entry for the cost parameters.

Note that in the preceding example, the resource associated with counseling services was defined to be a counselor, and the cost was $20,000.00 per counselor (one year's salary plus overhead). We might just as easily have defined the resource in this case to be a counselor-hour, in which case the cost would have been $20,000.00/2000 = $10/counselor-hour.

Target Population Parameters

The program requires a set of incidences (or prevalences, as the case may be) for each target population. Incidences (used in the case of the occurrence of acute medical conditions or events such as prison admissions) indicate the rate of occurrence of each type of condition in a single year (not in a five-year period). Prevalences (used in the case of chronic conditions) indicate the proportion of the population that has each condition at a point in time. Both rates (incidences or prevalences) refer to the population, e.g., an incidence of .01 signifies that 1% of the total population acquires the condition defining the target population at some time during the year, each year. Similarly, a prevalence of .01 signifies that 1% of the total population has the condition defining the target population

at any given point of time in the year. In the discussion that follows, we shall use the term "incidence" or "rate," rather than the more correct but cumbersome "incidence or prevalence." Note that incidences may exceed one in value (since the average number of occurrences of a condition might exceed one per person), but that prevalences (which refer to a subset of a population) are less than or equal to one.

There are ten different ways in which the user may enter incidences, depending on the level of detail desired. These ten ways are called "stratifications." They are defined as follows.

- ST1: A single rate is specified for the entire population. (Strictly speaking, this case corresponds to "no stratification.")
- ST2: A separate rate is specified for each age category.
- ST3: A separate rate is specified for each sex category.
- ST4: A separate rate is specified for each race.
- ST5: A separate rate is specified for each age x sex category.
- ST6: A separate rate is specified for each age x race category.
- ST7: A separate rate is specified for each sex x race category.
- ST8: A separate rate is specified for each age x sex x race category.
- ST9: A separate rate is specified for each region.
- ST10: A separate rate is specified for each race x region category.

Which level of detail, or stratification, is selected depends on two factors: what level of detail is present in available data, and what level of detail is desired in the cross- tabulations of the PROJ projections. For example, if the user wants breakdowns of the population by race, and there are differences in the incidence by race, then stratification option ST4 should be used.

Note that the level of detail of the crosstabulation projections should ordinarily not exceed the level of detail of the input data. For example, if a single incidence is specified for the entire population, then projection cross- tabulations should not be specified by age x sex x race, unless it is known that the incidence is in fact the same for all age x sex x race categories.

The user will usually be able to find reasonably good national-level data which indicates incidences for the general population, so that option ST1 may be used. Furthermore, for many target populations, incidences by age, by sex, by race, or by combinations (e.g., sex x race) are available. Incidences are generally not available by age x sex x race, except for conditions that have been studied rather extensively. If several low-dimensional crosstabulations are available (e.g., by age, by sex, and by race), procedures are available for statistically estimating a higher-dimensional crosstabulation (e.g., age x sex x race) from these lower-dimensional crosstabulations.

There are two different ways in which incidences are entered to the program. For options ST1, ST3, ST4, and ST7, the program instructs the user to enter incidences for each and every stratum "cell" (combination of levels of the variables of stratification), in a particular order specified by the program, and also specified on the data entry forms of Appendix B.

For example, suppose that the following incidence matrix applies:

		Race	
		W	O
Sex	M	.02	.04
	F	.03	.05

That is, the user wishes to specify incidences by sex and race (option ST7). In this case, the data entry is as follows.

First, the program prints out the following on the video screen:

```
THE FOLLOWING TYPES OF STRATIFICATION ARE AVAILABLE:
1: NONE
2: AGE
3: SEX
4: RACE
5: AGE X SEX
6: AGE X RACE
7: SEX X RACE
8: AGE X SEX X RACE
9: REGION
10: REGION X RACE
ENTER TYPE OF STRATIFICATION (1-10): .
```

Since stratification type 7 is desired, the user enters

```
7 (ENTER) .
```

The program then requests:

```
ENTER 4 INCIDENCE PREVALENCE RATES (8X.XXXXXXXX): .
```

In accordance with the sequence specified by the data entry form of Appendix B, the user must enter the four rates as follows:

```
.02,.03,.04,.05 (ENTER) .
```

The order in which the entries are made in the data entry forms is as follows:

Increment age, followed by sex, followed by race.

Hence, in the preceding example, two age values were input for the first race, followed by two values for the second race. Increment age in increasing order of age, sex by male followed by female, and races in the order in which they were entered in the PARAM data entry program (and are displayed by the CHECK program).

The preceding example illustrates the data entry procedure for options ST1, ST3, ST4, and ST7. For the other options, ST2, ST5, ST6, ST8, ST9, and ST10, the user must specify up to nine different rates, and then specify, for each stratum cell, which rate applies. (This approach is used for all stratification options in which the total number of stratum cells exceeds nine.) For example, suppose that the option ST2 is used, i.e., stratification is desired by age. Suppose that the incidences are as follows:

Age Category	Incidence
0-4	0.0
5-9	0.0
10-14	.01
15-19	.05
20-24	.02
25-29	0.0
30-34	0.0
35-39	0.0
40-44	0.0
45-49	0.0
50-54	0.0
55-59	0.0
60-64	0.0
65-69	0.0
70-74	0.0
75+	0.0

In this example, the program will request:

```
ENTER TYPE OF STRATIFICATION (1-10): ,
```

to which the user will respond:

```
2 (ENTER) .
```

The program will then request:

```
ENTER 9 INCIDENCE/PREVALENCE RATES (8X.XXXXXXXX):
```

to which the user will respond:

```
0.0,.01,.05,.02 (ENTER) .
```

The user enters four different rates, since there are only four different rates specified in the table shown above. There is no need to explicitly enter five additional zeros; by depressing the ENTER key after only four values, the next four values will automatically be taken as zeros. Since the program requires that nine values be entered, but the format only allows for the entry of eight values at a time, the ENTER key must be depressed a second time, to allow for the entry of the ninth value (a blank, in this example). In an example in which nine different values were entered, eight would be entered on the first line (followed by ENTER), and one would be entered on the second line (followed by ENTER.)

The program next requests:

ENTER 16 INDICES (ONE FOR EACH AGE COHORT), EACH OF VALUE 1-9 (16X): ,

to which the user may respond either with:

1,1,2,3,4,1,1,1,1,1,1,1,1,1,1,1 (ENTER) ,

or

1123411111111111 (ENTER) .

The i-th index number in this list indicates which of the four entered rates applies to the i-th age category. For example, the index "2" in the third position of the index list signifies that the second rate (.01) applies to the third age category (ages 10-14).

There are limits on the number of stratifications of each type (in addition to the overall limit of four target populations in all. The following table specifies the maximum number of stratifications of each type:

ST1	4
ST2	4
ST3	4
ST4	4
ST5	4
ST6	4
ST7	4
ST8	4
ST9	4
ST10	4

From this table, we see that the incidence rates for up to four target populations can be specified using stratification type ST2 (stratification by age), but only one target population can be specified using stratification type ST8 (stratification by age, sex, and race).

The user is requested by the program to enter incidences for each of the target populations specified.

Service Population Parameters

With regard to service populations, there are three different cases (corresponding to the three options of the Service-System Parameter S2). If a "0" is specified for the value of Service-System Parameter S2, then no service population data are requested, and the Service System Parameter section is skipped. If S2 = 1, then the total target population is taken as the service population, i.e., the service population is all of the persons in the target population. If S2 = 2, then the service population is a proportion of the target population. The factor of proportionality may be less than or greater than one. These factors, called service ratios, may vary by the same variables of stratification (age, sex, race, or region) as

were described for the incidences/prevalences of the Target Population Parameter section, and the procedure and formats for the data entry of the service ratios are exactly the same as for the Target Population Parameters.

For example, suppose that there is only one target population under study, and that a flat 10% of the target population is served, regardless of age, sex, or race, then the user would specify option ST1 (no stratification), and enter a "1" when requested to enter the type of stratification. The program would then prompt for the rate, which would be entered as ".1" (format X.XXXXXXXX).

Note that the services, resources, and costs do not vary by demographic characteristics of the served population. Any dependencies of service on age, sex, race, or region must be reflected in the definition of the target population or the service (served) population. Because of this restriction, it may be desirable (if services, resources, or costs vary by demographic characteristics of the person served) to define a service population as a number of person-years or a number of occurrences of a condition, rather than a number of individuals (subset of the target population).
This completes the data entry for the PARAM program.

A Note on Updating a Parameter File

When creating a new parameter file from an existing parameter file, it is often the case that the user retains much of the old data in the new file, without change. For example, the user may wish simply to append some target population data to an existing demographic-data parameter file. In this case, the program will prompt the user many times with a request such as:

```
ENTER 1 TO CHANGE DATA, 0 OTHERWISE: .
```

The response in most cases will be:

```
0 (ENTER) .
```

To save time, there is no need to actually enter the "0" -- the user may simply depress the ENTER key, and the program will automatically interpret that a "0" was entered. In this way, the user may very quickly run through those portions of the file which are not to be changed (such as the demographic parameters, in the example specified.)

III. How to Use the CHECK Program to Print a Parameter File

The CHECK program has two uses. Its main use, described in this chapter, is to print out the contents of a parameter file. A second use, to adjust the service parameters of a parameter file, is described in Chapter V.

After using the PARAM program to enter the parameters, it is important to review them with a CHECK run. It is easy to enter a wrong digit, or to invert two digits, in entering the data to PARAM. Also, if a string of data were entered using the wrong format, the data values will be recorded wrong in the parameter file. For example, suppose that a series of fourteen numbers were required for entry by PARAM, using format 8F10.0, but the user entered ten entries on the first line and four on the second line (instead of eight entries on the first line and six on the second line). In this case, the last two entries on the first line would be ignored by the program, resulting in an incorrect data entry. The user would not be aware of such an error until running the CHECK program, when it would be seen that two of the entries had been lost.

In addition to using CHECK to review new data input, it can be used to obtain a permanent hard-copy record of the contents of the parameter file. The reason for doing this is that the PROJ program does not print out any parameters -- it prints only projections (or summaries of the base-year data). A CHECK printout of the parameter file should be attached to the DEST printout, so that the analyst can be certain of the parameter values to which the PROJ run corresponds. The parameter file name is printed at the beginning of both the CHECK and PROJ printouts, for ready comparison.

The CHECK program is executed by typing CHECK at the MS-DOS prompt. The first request the CHECK program makes is:

```
     ENTER 0 TO PRINT EXISTING PARAMETER FILE, 1 TO INPUT NEW
 SERVICE-SYSTEM   PARAMETERS   FROM   SERVICE-SYSTEM   ADJUSTMENT
FACTORS: ,
```

to which the user responds:

```
     0 (ENTER) ,
```

in order to obtain the desired printout.

The program's next request is:

```
     ENTER NAME OF PARAMETER FILE (12X): .
```

The user should enter the name (a valid MS-DOS file name) exactly as he defined it in the PARAM run. For example, if the file name is AZ03CS.DAT, the user responds with:

```
     AZ03CS.DAT (ENTER) .
```

The program then prints the parameter file. The user may direct the output to the video monitor, the printer, or to a file named CHECKOUT.FIL .

IV. How to Use the PROJ Program to Make Projections

The PROJ program computes projections based on the parameter values in the parameter file. The PROJ program is executed by typing PROJ at the MS-DOS prompt. After the program begins execution, the user specifies the names of the parameter files, the number of five-year periods to project, and the amount of printed output desired.

After printing out a copyright notice on the video screen and on the line printer, the PROJ program's first request is:

```
ENTER NAME OF PARAMETER FILE (12X): ,
```

to which the user responds with entry of the name that was specified in the PARAM program run which created the parameter file, e.g., AZ803CS.DAT . The PROJ program prints out (on the line printer) the name of this file, the file header, and the base year.

The program then asks the number of five-year periods to project. This number must be between 0 and 10. If a zero is entered, the program will analyze the base-year data, but not construct any projections. The number of years to be projected is five times the entry, e.g., if a "3" is entered, then the program will project up to fifteen years into the future. The number specified by the user is printed by the line printer. The video request is:

```
ENTER NO OF FIVE-YEAR PERIODS TO PROJECT (0-10): .
```

(Note: If the user enters "1," after the number of periods to project, the program will print out all of the cohort-specific survival probabilities. Since these quantities are of limited interest in many applications, the program does not prompt the user concerning their printout. If three five-year periods are to be projected, and the survival probabilities are desired, the data entry is:

```
3,1 (ENTER) .)
```

Next, the program prints the following message:

```
THE FOLLOWING TABLES OR CROSSTABULATIONS ARE AVAILABLE:
1: TOTAL
2: AGE
3: SEX
4: RACE
5: AGE X SEX
6: AGE X RACE
7: SEX X RACE
8: AGE X SEX X RACE
9: REGION
10: REGION X RACE
SPECIFY CROSSTABS DESIRED (10 NOS, 0 OR 1, FORMAT 10X): .
```

This prompt allows the user to specify which crosstabulations he wants for the base year. The program will repeat this request for each five-year period, so that different crosstabulations may be specified for each five-year projection period.

The user answers this request by typing ten numbers, each 0 or 1. If the i-th number of this ten-tuple is a 1, then the i-th type of table or crosstab will be printed out. For example, if only a crosstab of sex x race is desired for the base year, the user would type:

0000001000 (ENTER) .

If a table by age is also desired, the user would type:

0100001000 (ENTER) .

If the user does not select any tables or crossbulations, then the analysis proceeds to the next projection period. Otherwise, the program next requests:

ENTER 1 TO SKIP SERVICE-SYSTEM ANALYSIS, 0 OTHERWISE: .

If the user enters a 1 in response, the program will print out only demographic information, and not any service-system-related information (on the target populations, service populations, services, resources, or costs). If a 0 is entered, a full printout (with both demographic and service-system data) will be done. After responding to this request, the line printer then prints out the crosstabulations that were requested by the user.

The program then prints the following information and request on the video screen:

PROJECTION PERIOD NO 1
YEARS: 19XX TO 19XX ,

and repeats the request for the user to specify which crosstabs are desired, for the first five-year projection period.

After the user specifies the desired crosstabs, the program then requests:

ENTER 1 TO SKIP SERVICE-SYSTEM ANALYSIS, 0 OTHERWISE,

to which the user responds 0 or 1, as desired. Next, the program requests:

ENTER 0 TO PRINT 5-YEAR PROJECTIONS, 1 TO PRINT 1-YEAR PROJECTIONS: .

If the user specifies a 0, the program will print out the projection for the fifth year out. If the user specifies a 1, the program will print intermediate years, and prompt the user to specify the intermediate years for which printouts are desired with the following request:

ENTER WHICH YEARS TO PROJECT (5 INTEGERS, 0 = NO, 1 = YES, FORMAT 5X): .

The user enters five numbers, each 0 or 1. If the i-th number is a 1, then a projection will be printed out for the i-th year. For example, if the user enters 11111, then the program will print out projections for all five years. These intermediate-year projections are computed by linear interpolation between the results for two adjacent five-year projection periods.

The program then proceeds to print out all the requested crosstabulations for the specified years. After completion of this printout, the program goes on to the next five-year period (if any), repeating the requests for the user input described above for each five-year period.

The user may direct the output to the video terminal, a printer, or a file named PROJOUT.FIL .

V. How to Use the CHECK Program to Adjust Service-System Parameters

The service, resource, and cost models which are incorporated into the PROJ program are very simple in concept -- they are linear models involving small numbers of parameters. Although these models are particularly well-suited to investigation of the impact of making marginal changes in a service system, it is unlikely that they will produce exactly the same estimates of service levels, resource levels, and cost levels, that are observed in real life -- the actual system will be far more complicated.

After the user has specified the target population, service population, service, resource, and cost models in terms of the parameters available in the PARAM program, the PROJ program should be run for the base year to see how closely the target population levels, service population levels, service levels, resource levels, and cost levels are to known, observable, base-year amounts. They will likely differ somewhat. If the differences are small, the user may proceed to make projections with PROJ. If some of the difference are substantial, however, the user should reexamine the parameter values to make certain that they are correct. Once any major discrepancies are resolved, and the user is satisfied that the parameter values are correct, there will still probably remain some minor discrepancies between the actual base-year amounts and the PROJ base-year amounts.

At this point, the user has a choice to make. If the differences are not significant from a substantive point of view, he may proceed directly to making PROJ runs. Alternatively, he may choose to adjust the parameter values so that the PROJ base-year levels of the target populations, service populations, services, resources, and costs match the actual base-year levels exactly. If the analyst is interested in estimating the cost or service changes that will occur if some change is made in the service system, then minor discrepancies (between PROJ base-year levels and actual base- year levels) in the absolute level are not important. In other situations, however, the user may be interested in estimating the actual level of some quantity (rather than a relative change). In such cases, it is best if the base-year levels computed by the PROJ program are exactly matched to the actual base-year values. This matching procedure is called model calibration. It is similar to the Deming-Stefan statistical adjustment procedure ("raking"), or the "ratio estimation" procedure of sample survey analysis. The user can accomplish this match by adjusting the various system parameters (target population incidences, service population, service ratios, service parameters, resource parameters, and cost parameters), and updating the parameter file with a PARAM run. Using PARAM solely to adjust service-system parameters is somewhat cumbersome, however, since the program first cycles through all of the demographic parameters and data, none of which changes. The CHECK program, on the other hand, can be used to quickly incorporate adjustments into the service-system model parameters, without having to run through all of the PARAM demographic parameter and data cycles.

The CHECK program allows the user to specify an adjustment factor, or adjustment ratio, for each target population, service population, service, resource, and cost total that the PROJ program computes and prints out. These adjustment factors are the ratio of the actual (observed) base-year level of each quantity to the base-year level estimated by PROJ. The CHECK program uses these adjustment factors to create a new parameter file containing all of the same demographic information as the original file, but corrected service-system parameters in place of the old service-system parameters.

Suppose, for example, that there is a single target population, service population, service, resource, and cost, and that the following actual-base-year and PROJ-base-year estimates are observed.

	Actual Base-Year Value	PROJ Base-Year Value	Ratio = Actual/PROJ
Target Population No. 1	5,362	4,897	1.095
Service Population No. 1	2,148	2,099	1.023
Service No. 1	317	246	1.289
Resource No. 1	117	122	.959
Cost No. 1	33,976	38,943	.872

The last column of the table contains the adjustment factor, which is the ratio of the actual base-year values to the values computed by PROJ for the base year. The CHECK program requests the user to enter these adjustment factors. These factors are used to modify the service-system parameters of the parameter file, such that when the next PROJ run is made, it will match the base-year values exactly. This parameter adjustment procedure is much faster than the procedure of adjusting the service-system parameters through another run of the PARAM program, which allows the user to modify all parameters, both demographic and service-system-related.

In order to use the CHECK program to adjust the service system parameters, the user proceeds as follows. As usual, the program is begun by typing CHECK at the MS-DOS prompt. In response to the first request made by CHECK,

ENTER 0 TO PRINT EXISTING PARAMETER FILE, 1 TO IMPUTE NEW SERVICE-SYSTEM PARAMETERS FROM SERVICE-SYSTEM ADJUSTMENT FACTORS: ,

the user responds with the entry:

1 (ENTER) .

The program then responds with:

ENTER NAME OF OLD PARAMETER FILE (12X): ,

to which prompt the user responds with the name of the existing parameter file, which contains the parameters to be adjusted, e.g.,

AZ803CS.DAT (ENTER) .

The program then request:

ENTER NAME OF NEW PARAMETER FILE (12X): ,

to which the user responds with the entry of a different (unused) file name, e.g.,

AZ03CTS2.DAT (ENTER) .

The program then instructs the user to enter one adjustment factor for each target population, service population, service, resource, and cost total. For example, for the target population totals, the program requests:

ADJUSTMENT FACTORS FOR TARG POP...
ENTER ADJUSTMENT FACTOR (X.XXX) FOR nnnnnnnn: ,

where nnnnnnnn denotes the name of the first target population (e.g., ELDERLY, or DISABLED). The user would respond with entry of the appropriate data. In the example presented in the above table, this would be:

1.095 (ENTER) .

In similar fashion ratios are entered for all of the target populations, service populations, services, resources, and costs included in the model. When used to adjust service-system parameters, the CHECK produces all of the same printout as when it is used simply to print out a parameter file. In addition, however, it also prints out the adjustment factors, and both the old and new values of the service-system parameters.

VI. Example 1: National Population Projection, Single-Race Model

A. Projection Objectives; Data Sources

Projection Objectives This and the next several chapters of this manual present a number of examples of applications of the DESTINY program package. The purpose of the examples are several -- to show in detail how to obtain the data required by the model, to illustrate how to use the model, and to provide an indication of the accuracy of the model projections. For the examples, the model will be set up with data from 1980 and before, and used to project up to 1990.

This chapter and the following one present examples which illustrate in detail the use of the DESTINY package to make projections of the US resident population from the base year of 1980. The examples identify the data sources that were used to construct the parameter (using the PARAM program), and describe the contents of the parameter file by means of a CHECK printout. The PROJ program is then run to produce a ten-year-out projection of the population.

This chapter addresses a "single-race" model, in which all races are combined. The following chapter addresses a three-race model.

DESTINY projections may be disaggregated to the same level of disaggregation as is represented in the population input data. In the present chapter, the population input data are disaggregated by age and sex, and the projections may be disaggregated by age and sex. In the following chapter, the population input data are disaggregated by age, sex, and race, and the projections may be disaggregated by any combination of those three variables. In addition to disaggregation by age, sex, and race, later chapters will illustrate disaggregation by region and by region and race.

In order to permit an assessment of the reliability of the DESTINY projections, the projections in this example will be based on demographic data for the base-year of 1980 that were available in 1982. The DESTINY projections for the year 1990 will be compared to US Census data for 1990.

Data Sources A primary objective of the DESTINY package is to enable projections to be made using readily accessible demographic data, available in many libraries. Examples of such sources are US Census publications (available decennially), the Statistical Abstract of the United States (available every year), the Vital Statistics of the United States (natality and mortality volumes available each year), and the County and City Data Book (supplement to the Statistical Abstract, various years). A major advantage of the Statistical Abstract is that it is published regularly and contains quite recent data. Similar publications are available for each state. All of the demographic data used in the examples presented in this document is available from such sources.

The demographic data required for the present example are available from the following three publications:

- CP80 Census of Population, Supplementary Report PC80-S1-1, Age, Sex, Race, and Spanish Origin of the Population by Regions, Divisions, and States: 1980. Bureau of the Census, US Department of Commerce (for sale by the Superintendent of Documents, Washington, DC 20402), issued May, 1981. (Data for other years are published in Current Population Reports, Series P-25.) This report presents resident population, i.e., excluding Armed Forces overseas.

- VS78: Vital Statistics of the United States, 1978. Volume I -- Natality, and Volume II -- Mortality, Part A. National Center for Health Statistics, US Department of Health and Human Services, Hyattsville, MD, 1982.

- SA81: Statistical Abstract of the United States, 1981. Bureau of the Census, for sale by the Superintendent of Documents, Washington, DC 20402, 1981.

These three publications will be referred to in the remainder of this chapter as CP80, VS78, and SA81, respectively. CP80 provides a crosstabulation of the population by age, sex, and race, where the age categories are in five-year intervals up to age 85, and 85+. VS78 provides vital statistics data (birth rates, death rates, infant mortality rates, total fertility rates, fertility age distributions, and life expectancy at birth), also by age, sex, and race. SA81 population data are not sufficiently detailed for use as DESTINY input, since the five-year categories go only to age 65, and 65+. (DESTINY requires population by five-year age intervals up to age 75, and 75+.)

All three publications present data not only for the United States as a whole (for use with the national-level model in the present chapter), but for regions of the US and for individual states (for use with the state-level models in later chapters). A problem with VS data is that, although the data are detailed, there is a four-year lag between the latest year documented and the year of publication (e.g., the data published in 1982 comprise the "1978" edition). SA81 provides selected vital statistics data on a more timely basis (e.g., a one- or two-year lag), but the data are generally not as disaggregated. For example, the fertility age distribution presented in SA81 is for the US as a whole; VS78 must be consulted to obtain the fertility age distribution by race. The SA81 does provide, however, total fertility rates and infant mortality rates by race.

Since the DESTINY package is concerned with population projections, the user should enter parameter values corresponding to his beliefs about the demographic situation in the future. It is not necessary that the demographic parameter values mirror the values experienced in recent history. Unless the user is performing a "what-if" exploratory analysis or sensitivity analysis, however, the input values would normally correspond to recent history. For this reason,

much of the discussion of this chapter is concerned with the identification of estimates derived from historical data. If the user believes that the future demographic situation will depart in some fashion from recent history, however, the input values will differ from the historical values.

When using historical values of parameters, the user should normally use parameter values corresponding to the base year, unless there is substantial year-to-year variability in the parameter values. In this case, the user should use an average, such as a five-year average value, as the specified value. If state or local-area data are suspect because of small sample sizes or rapidly changing demographic trends, it would probably be preferable to use more stable regional or national parameter values, rather than the state or local-area values.

The example presented here does not describe every line of input data entered into the PARAM, CHECK, and PROJ programs. Instead, the required data are described. The user can readily see the order of input of the parameters from the CHECK printout, which closely follows the data entry order of the PARAM program.

Note on Migration Data Prior to specifying the data for the desired run, it is necessary to make a few remarks about migration data. Published migration data refer to legal migration, and the actual migration in recent years in the US has been more than double the legal amounts. For this reason, SA81 is of little help in providing data for the DESTINY runs. The approach for obtaining reasonable migration data is to make a single-race projection (as in the present chapter), and use migration estimates produced by the CHECK program for input to the two-race projection (as in the following chapter).

It may be asked why the CHECK program cannot be used to provide migration estimates from the two-race data. The CHECK program estimates the difference after ten years between the total population and the population level associated with natural increase (population growth due to births and deaths, excluding migration). In a single-race model, this difference is a reasonable estimate of the amount of migration over the ten-year period. In a multi-race model, however, this difference is a poor estimate of migration (by race). There are two main reasons for this. First, race data are very subjective: they are based on the respondent's declaration of race. Ambiguous responses may be provided to race questions, or a respondent's race declaration may differ in time. In addition, the criteria and procedures for making race classifications have changed over the years. Second, over a period of years the racial composition of a multi-race population becomes intermixed, because of cross-breeding. A third source of error is associated with the fact that the DESTINY program estimates net migration. If the racial composition of emigrants and immigrants is different, the racial composition of the resident population will change over time even if there is no net migration.

B. PARAM Run Parameters

Input Option Parameters

In running the PARAM program, the name US801.DAT was given to the parameter file, and the base year was identified as 1980. The file header, "US Resident Population," was used. The seven Input Option Parameters were as follows:

P1: Number of races = 1
P2: Number of regions = 1
P3: Demographic Parameter Option = 1 (i.e., the demographic parameters are to be the same for all ten five-year projection periods)
P4: Life Table Option = 1 (i.e., the survival probabilities for the population will be determined by the Infant Mortality Rate, rather than by the Expectation of Life at Birth)
P5: External Migration Option = 1 (i.e., a single migration rate and/or migration number will be specified, to be used for all projection periods)
P6: Internal Migration Option = 0 (no regions are specified, so there is no internal migration)
P7: Service System Option = 0 (i.e., no service system parameters are included in the model).

The program next requests the names of the races. The name "All" was entered.

Since the present model includes but a single race, just one complete set of demographic data is required. These data are given in the paragraphs that follow.

An issue that arises immediately is how the values for the model parameters shall be determined. In some instances (e.g., base-year population), a base-year value is requested by the model. In other cases (e.g., infant mortality rate for the first projection period), it is not obvious what value should be used -- the base year value, the average value for the preceding five years, the average value for the preceding ten years, or the extrapolation of a trend of five-year averages. In general, the values specified for the first (or later) projection periods should be the values the user considers most likely for those periods, whether these are continuations of current values or the results of extrapolations. In general, it is better to use multi-year averages for estimates of the future values of parameters rather than the base-year value, because of the significant amount of variability in single-year values for many demographic parameters.

For the present example, we shall generally use the average value of a parameter for the five years preceding the base year, as the value for the first and later projection periods.

Total Fertility Rate

Total Fertility Rates for the US population are given on page 58 of SA81, in Table 84, entitled, "Total Fertility Rate and Intrinsic Rate of Natural Increase: 1940 to 1979." The average value for the years 1975-79 is 1.81. (Note that the table values are per 1000 women, and must be divided by 1000 to obtain the per-woman values required by PARAM.)

Total Fertility Rates (TFRs) are also presented on page I-9 of VS78, in Table I-6, entitled, "Total Fertility Rates and Birth Rates by Age of Mother and Race: United States, Specified Years 1940-55, and Each Year 1960-1978." The SA81 data are more recent than the VS78 data (i.e., for year 1979 vs. 1978).

Fertility Age Distribution

The Fertility Age Distribution for the total US population is found on page 59 of SA, in Table 85, entitled, "Births and Birth Rates: 1950 to 1979." The last part of the table provides the following data for the year 1979:

Age of Mother	Birth Rate per 1000 Women
10-14 years	1.2
15-19	53.4
20-24	115.7
25-29	115.6
30-34	61.8
35-39	19.4
40-44	3.9
45-49	.2
Total	371.2
TFR x 1000 (Tot x 5)	1856.

The Fertility Age Distribution data do not vary much from year to year, and so the single-year (1979) data were used rather than multi-year averages.

The PARAM program accepts a Fertility Age Distribution (FAD) for only six age categories, i.e., for ages 15-44, rather than for the eight categories presented above. Combining the two end age categories of the above table with the adjacent age group makes a very small difference in the FAD, and yields the following table:

Age of Mother	Birth Rate per 1000 Women	Percentage
15-19	54.6	.147
20-24	115.7	.312
25-29	115.6	.312
30-34	61.8	.166
35-39	19.4	.052
40-44	4.1	.011
Total	371.2	1.000
TFR x 1000 (Total x 5)	1856.	

Note that the value 371.2 (the sum of the birth rates) is equal to the Total Fertility Rate of all US persons for 1979 (1.856) multiplied by 1000 and divided by 5. The "percentage" is the percentage of total lifetime births occurring to females in each of the five-year age cohorts. The set of percentages comprise what will be referred to henceforth as the Fertility Age Distribution, or FAD.

The VS78 source (the same table in which the TFR is presented) provides the FAD for 1978 (a year older than the SA81 source).

Infant Mortality Rate

Infant Mortality Rates are found on page 73 of SA81, in Table 111, entitled, "Infant, Maternal, and Neonatal Mortality Rates, and Fetal Mortality Ratios, by Race: 1940 to 1978." The average of the values for years 1975-78 is 14.80. (Mortality data are also available from VS78 (Volume II, Part A), but the SA81 data are more recent.) (Had a "2" been specified for the Life Table Option parameter (Input Option Parameter P4), it would be necessary to enter the Expectation of Life at Birth instead of the Infant Mortality Rate to the PARAM program. These values are found on page 69 of SA81, in Table 105, entitled, "Expectation of Life at Birth: 1920 to 1979." The average of the values for years 1975-79 is 73.12. Life expectancy data are also available in VS (Volume II, Part A), in Table 5-1, entitled, "Abridged Life Tables by Color and Sex: United States, 1978.")

Base-Year Population by Age and Sex

Base-year population data by age and sex are published in CP80. SA81 also contains population data, but these data are not usable as DESTINY input since the age categories above age 65 are combined.

The 1980 resident population data published in CP80 are presented in the table which follows.

Age	Male	Female
0-4	8,360,135	7,984,272
5-9	8,537,903	8,159,231
10-14	9,315,055	8,925,864
15-19	10,751,544	10,410,123
20-24	10,660,063	10,652,494
25-29	9,703,259	9,814,413
30-34	8,675,505	8,882,452
35-39	6,860,236	7,102,772
40-44	5,707,550	5,960,689
45-49	5,387,511	5,700,872
50-54	5,620,474	6,088,510
55-59	5,481,152	6,132,902
60-64	4,669,307	5,416,404
65-69	3,902,083	4,878,761
70-74	2,853,116	3,943,626
75+	3,547,402	6,419,145
Total	110,032,295	116,472,530
Grand Total	226,504,825	

Crude Birth Rate for Base Year

From SA81, Table 85, the value for 1979 is seen to be 15.9. (Although 1979 is not the base year (1980), it is the latest year available, and is a suitable proxy for the 1980 value.)

Crude Death Rate for Base Year

From SA81, Table 108, the value for 1979 is seen to be 8.7.

Infant Mortality Rate for the Base Year

Table 111 of SA81 provides the value of 13.8 for 1978.

Population Ten Years Prior to Base Year

The next data element required is the population ten years prior to the base year. This data item is available from numerous tables of SA81, such as Table No. 29, page 26: "Resident Population, by Age, Sex, and Race: 1960 to 1980." The 1970 population is 203,302,031. (Note: The figure 203,302,031 is a revised figure, due to corrections for errors found after the tabulations of SA81 were done. The figure 203,235,000 appears in many of the tables of SA81.)

Average Crude Birth Rate for the Ten-Year Period Prior to Base Year

From SA81, Table 85, the average for years 1973-79 is seen to be 15.14.

Average Crude Death Rate for the Ten-Year Period Prior to Base Year

From SA81, Table 108, the average for years 1973-79 is seen to be 8.96.

Average Infant Mortality Rate for the Ten-Year Period Prior to Base Year

From SA81, Table 111, the average for years 1972-78 is seen to be 16.08.

External Migration

The final demographic data required by the program are migration parameters. Migration data for the US as a whole are found in SA81 Table 628, "Immigration, 1820 - 1979." The table shows an annual net migration of 2.0 per 1,000 for the period 1960 - 1979, and 1.7 per 1,000 for 1970 - 1979. These data are not satisfactory for use by the DESTINY program. The problem is that they reflect legal immigration, and illegal immigration, which is not reflected in these figures, may be substantial and even exceed legal immigration in magnitude.

Because of the problems inherent in published immigration figures, it is better to estimate net migration directly from available data on crude birth rates, crude death rates, and the population ten-year growth rate. The procedure is illustrated below.

First, we shall derive an estimate of the annual population change net of births and deaths. For a single-race model, the population change net of births and deaths is due to migration. There are two ways to proceed, depending on whether it is desired to represent migration as a rate or a number. As discussed earlier, if the net migration is positive (i.e., the number of immigrants into the country exceeds the number of emigrants out of the country), it is represented as a migration number, and if the net migration is negative, it is represented as a migration rate. The following will show the procedures for estimating migration both ways (as a rate and as a number), but the migration number will be used in the model specification, since the net migration is positive.

In terms of the annual birth rate, death rate, and migration number, an approximate expression for the population in year t+1 as a function of the population in year t is:

$$p_{t+1} = (1+b-d)p_t + M$$

where

p_t = population in year t

b = crude birth rate

d = crude death rate

M = annual (net) migration number,

and all of the parameter values represent average values over the ten-year period prior to the base year.

Solving this equation for M in terms of p_{10} and p_0 yields the following:

$$M = (p_{10} - p_0(1+b-d)^{10})(b-d)/((1+b-d)^{10}-1) .$$

Substituting b=.01514, d=.00896, p_0=203,302,031, and p_{10}=226,504,825 yields the estimate:

M = 1,000,075.

That is, the average net annual number of immigrants per year is estimated to be M = 1,000,075, which is about double the legal immigration published in SA81, Table 128.

This is about 5 per thousand population per year. This level is more than double the legal migration rate of 2 per thousand population per year. (The legal net migration rate would be even less.) (A certain amount of the net migration amount estimated above corresponds to a

decrease in the Census undercount from 1970 to 1980, and changes in racial classification procedures between 1970 and 1980.)

The estimated 1,000,075 is an estimate of migration (including race transition) under the assumption that the birth and death rates of the population are as specified.

The figure 1,000,075 may be entered to the PARAM program as the estimate of the annual migration number. The annual migration rate is entered as zero (since migration is specified either by the migration number or the migration rate, but not both).

As was mentioned, migration may be represented either as a number (as above) or as a rate. If migration is represented as a rate, the formula for the population at time t is:

$$p_{t+1} = (1+b-d+m)p_t \ ,$$

where all of the symbols introduced earlier are defined exactly as before, and

m = annual net migration rate.

Solving this equation for m in terms of p_{10} and p_0 yields:

$$m = (p10/p0)^{.1} - 1 - b + d.$$

Substituting b=.01514, d=.00896, p_0=203,302,031, and p_{10}=226,504,825 in this formula yields the estimate:

m = .004769,

or 4.686 per 1,000. (Note that this is just slightly different from the approximate value M/(average of populations for base year and ten years previous) = 1,000,075 /(.5(203,302,031+226,504,825) = 4.654 per 1,000.)

As discussed, since the net migration into the country is positive, the migration number, M = 1,000,075, will be entered into the PARAM program, and the migration rate will be specified as zero (<u>not</u> as 4.654).

The CHECK program performs the computations required to determine both M and m. As an alternative to performing the computations by hand, zeros may be specified initially as the values for the migration number and rate (in the PARAM input), and the CHECK program may be run to obtain the preceding estimates. The PARAM program may then be rerun to change the initial value of zero to the estimated value (the migration number, M, if the net migration is positive, or the migration rate, m, if the net migration is negative).

Note that the net migration estimate derived for use in the single-race model of this chapter will be used to derive net migration estimates for use in the multi-race model of the next chapter.

This completes the data specification for the construction of the file US801.DAT.

C. Results of CHECK Run

The output of a CHECK run of the file US801.DAT is shown in Listing 1 (in Appendix D). The program first prints out all of the input data. A review of Listing 1 reveals that all of these input data are as described above, with the exception of the population figures, which do not agree past the seventh digit. This minor discrepancy results from the fact that the computer on which the CHECK run was made is precise only to seven digits. After printing out the input data, the program then proceeds to print out additional information, which can help the user assess the validity of the input data.

The program prints out the expectation of life at birth (73.96 years) corresponding to the infant mortality rate specified for the first projection period (14.80 deaths per 1,000 live births). (Had the user specified a life expectancy at birth as the parameter for selecting the life table used by the model, the program would have printed out the corresponding infant mortality rate.)

In general, if the user enters the infant mortality rate to specify the life table (i.e., Life Table Option 1), he should examine the expectation of life at birth for reasonableness. Alternatively, if the expectation of life at birth is specified, (i.e., Life Table Option 2), he should examine the infant mortality rate for reasonableness.

If requested by the user (at the beginning of the CHECK run), the CHECK program prints out a table of survival probabilities by age and sex.

After printing out the input data, the program provides a number of additional estimates. The first is an estimate of the Total Fertility Rate estimated from the base-year birth rate and the base-year population distribution. This estimate, 1.833, is seen to be quite close to the value specified for the first projection period, 1.810.

The program estimates the general fertility rate (birth rate per 1,000 females of ages 15-44) as 68.18. This compares with the value of 68.5 found in Table 85 of SA81.

Next, the program estimates the net migration. As discussed above, the estimated annual net migration number is 1,000,075, and the corresponding annual net migration rate is 4.686 per 1,000.

The approximate projected population growth rate corresponding to the model parameters specified for the first projection period is 9.62 per 1,000. For the previous ten years, the population growth rate per 1,000 was 10.87.

The CHECK run reveals no unusual features in the data. The estimated base-year and projected total fertility rates are similar, and the projected annual growth rate is close to the historical growth rate.

A major purpose of the CHECK run is to enable the user to carefully examine the model input data, to make sure that no input errors have occurred.

D. Results of PROJ Run

Listing 2 illustrates a run of the PROJ program, which projects the population two five-year periods out, from the base year of 1980 to the year of 1990. From the base year of 1980, this run projects a resident US 1990 population of 250,026,462. The actual resident population in 1990 turned out to be 248,710,000 (Statistical Abstract of the United States 1992 (referred to henceforth as SA92), Table No. 16, "Resident Population, by Race and Hispanic Origin, 1980 and 1990," page 17. The projection for the total population is hence seen to be in error by only one-half of one percent.

Since the population data in the present model are disaggregated by age and sex, the projections may be disaggregated by these variables. Listing 2 includes projections for all possible disaggregations. (To conserve space, later projections will often project just a few of the possible tables and crosstabulations.) These projections may be compared in detail to data presented in the 1990 Census of Population, General Population Characteristics, United States (referred to henceforth as CP90), 1990 CP-1-1, US Department of Commerce, Bureau of the Census, issued November 1992 (available in most public libraries). For example, the number of male persons aged under five years in 1990 is 9,392,409, and the number projected by DESTINY is 9,229,281 (error of less than two percent).

In general, the relative (percentage) magnitude of the projections increases as the level of disaggregation increases. That is, projections for a particular category (e.g., males aged 0-5) are not as accurate in relative terms as more-highly-aggregated projections. Also, the magnitude of the errors increases with the distance (number of years out) of the projection.

The principal conclusions from the present example is that the data required for the US-population combined-race model are readily available, and that the DESTINY projections are of a high level of accuracy in this application.

The projection shown in Listing 2 prints the projection only for the tenth year out. The user may specify that the projection be printed in any future year, and a different selection of tables and crosstabulations may be selected for each year. For example, the user may request that the grand total be printed for every year, and detailed crosstabulations printed in the final projection year.

VII. Example 2: National Population Projection, Two-Race Model

A. Projection Objectives; Data Sources

Projection Objectives This chapter presents an example in which the DESTINY program package is used to make projections of the US resident population by race. The race categories used in this example are "white" and "other than white." As in the preceding chapter, the model will be constructed using data available prior to 1980, and used to make projections to the year 1990. Since the model input data are disaggregated by age, sex, and race, the projections may also be disaggregated by any combinations of those variables.

Data Sources The present example will use the same data sources as the preceding chapter, i.e., CP80, SA81, and VS78. The 1990 comparison data (for the projected populations) are found in CP90 and SA92.

Migration Data As discussed in the preceding chapter, one of the motivations for making the single-race projection of that chapter was to obtain an estimate of the total net migration. From the CHECK run of the preceding chapter, the value of 5,000,376 was obtained as an estimate of the five-year net migration for the US. This number will be used in determining the migration parameter values for the two-race model.

B. PARAM Run Parameters

Input Option Parameters

In running the PARAM program, the name US802.DAT was given to the parameter file, and the base year was identified as 1980. The file header, "US Resident Population by Race (W/O)," was used. The seven Input Option Parameters were as follows:

P1: Number of races = 2
P2: Number of regions = 1
P3: Demographic Parameter Option = 1 (i.e., the demographic parameters are to be the same for all ten five-year projection periods)
P4: Life Table Option = 1 (i.e., the survival probabilities for the population will be determined by the Infant Mortality Rate, rather than by the Expectation of Life at Birth)
P5: External Migration Option = 1 (i.e., a single emigration rate and/or migration number will be specified, to be used for all projection periods)

P6: Internal Migration Option = 0 (no regions are specified, so there is no internal migration)
P7: Service System Option = 0 (i.e., no service system parameters are included in the model).

The program next requests the names of the races. The names "White" and "Other" were entered.

The PARAM program requests entry of the demographic data race by race. In the present example, all of the required data are to be entered for the "white" race, followed by all of the required data for the "other" race. To facilitate the discussion in this chapter, however, the data shall be presented by demographic category. For example, the total fertility rate will be presented for both races, followed by the fertility age distribution for both races, and so on.

As in the preceding example, we shall generally use the average value of the parameter for the five years preceding the base year, as the value of parameters in the projection period.

Total Fertility Rates

The Total Fertility Rates for the two races included in this example (i.e., "white" and "other than white") are given on page 58 of SA81, in Table 84, entitled, "Total Fertility Rate and Intrinsic Rate of Natural Increase: 1940 to 1979." For whites, the value (average of data for 1975-79) is 1.717, and for black and other races, the value is 2.334.

Fertility Age Distribution

For the preceding example, the Fertility Age Distribution for the total US population were found on page 59 of SA81, in Table 85, entitled, "Births and Birth Rates: 1950 to 1979." While these data were appropriate for the combined-race model, they are not very suitable for a multi-race model, since fertility varies significantly from race to race.

Since the DESTINY package is to be used in the present example to make projections by race (white and other), it is desirable to specify FAD data for the two separate races. Better results are obtained by specifying race-specific data for the Fertility Age Distribution. Such a distribution is found in Table I-6 of VS78.

The following table is derived from Table I-6 of VS78:

Age of Mother	White Birth Rate per 1000 Women	Other Birth Rate per 1000 Women
10-14	.6	4.1
15-19	43.6	99.1
20-24	106.3	145.7
25-29	111.1	117.3
30-34	57.9	66.7
35-39	17.6	27.0

40-44	3.5	6.5
45-49	.2	.4

Combining the extreme age categories (to accommodate the DESTINY input categories), we obtain:

	White		Other	
	Birth Rate		Birth Rate	
Age of Mother	/1000 Women	Proportion	/1000 Women	Proportion
15-19	44.2	.130	103.2	.221
20-24	106.3	.312	145.7	.312
25-29	111.1	.326	117.3	.251
30-34	57.9	.170	66.7	.143
35-39	17.6	.051	27.0	.058
40-44	3.7	.011	6.9	.015
Total	340.8	1.000	466.8	1.000
TFR x 1000	1704.		2334.	

Note that the Total Fertility Rates (1.704 and 2.334) for 1978 are the sums of the birth rates by age of mother, multiplied by 5 and divided by 1,000.

It is seen from the preceding display that there is somewhat of a difference in the Fertility Age Distribution between the races, and it is hence preferable to use the race-specific data. (It is noted, however, that the value of the Total Fertility Rate has a much more pronounced effect on the birth rate than does the Fertility Age Distribution, and the difference in results introduced by using the combined Fertility Age Distribution in place of the separate ones would not have been very large.)

Infant Mortality Rate

Infant Mortality Rates for whites and black and other races are found on page 73 of SA81, in Table 111, entitled, "Infant, Material, and Neonatal Mortality Rates, and Fetal Mortality Ratios, by Race: 1940 to 1978." The rates (averages for 1975-78) are 12.95 for whites and 22.62 for black and other races.

Base-Year Population by Age, Sex, and Race

Base-year population data by age, sex, and race are published in CP80. The 1980 population data published in CP80 are presented in the table which follows. The data for the white race are presented explicitly in CP80. The data for the other race are obtained by subtracting the white amounts from the total amounts for all races.

	White		Other	
Age Category	Male	Female	Male	Female
0-4	6,482,766	6,148,431	1,877,369	1,835,841
5-9	6,684,406	6,346,611	1,853,497	1,812,620
10-14	7,407,610	7,052,673	1,907,445	1,873,191
15-19	8,631.389	8,326,152	2,120,155	2,083,971
20-24	8,680,290	8,603,095	1,979,773	2,049,399

25-29	8,004,161	7,978,484	1,699,098	1,835,929
30-34	7,298,603	7,344,080	1,376,902	1,538,372
35-39	5,830,238	5,928,994	1,029,998	1,173,778
40-44	4,849,123	4,976,012	858,427	984,677
45-49	4,638,090	4,817,869	749,421	883,003
50-54	4,918,050	5,238,845	702,424	849,665
55-59	4,852,081	5,384,727	629,071	748,175
60-64	4,172,521	4,801,456	496,786	614,948
65-69	3,841,097	4,329,974	420,986	548,787
70-74	2,551,944	3,542,234	301,172	401,392
75+	3,187,257	5,851,527	360,145	567,618
Sex Totals	91,669,626	96,671,164	18,362,669	19,801,366
Race Totals	188,340,790		38,164,035	
Grand Total		226,504,825		

Crude Birth Rate for Base Year

From SA81, Table 85, the value for 1979 is seen to be 14.8 for whites and 22.8 for others 1979.

Crude Death Rate for Base Year

From SA81, Table 108, the value for 1979 is seen to be 8.8 for whites and 7.8 for others.

Infant Mortality Rate for the Base Year

Table 111 of SA81 provides the value of 12.0 for whites and 21.1 for others for 1978.

Population Ten Years Prior to Base Year

From SA81 Table No. 29, page 26: "Resident Population, by Age, Sex, and Race: 1960 to 1980," the 1970 population is seen to be 178,098,000 for whites and (by subtraction from the total 203,235,000) 25,137,000 for others.

Average Crude Birth Rate for the Ten-Year Period Prior to Base Year

From SA81, Table 85, the average for years 1973-79 is seen to be 14.13 for whites and 21.77 for others.

Average Crude Death Rate for the Ten-Year Period Prior to Base Year

From SA81, Table 108, the average for years 1973-79 is seen to be 9.04 for whites and 8.33 for others.

Average Infant Mortality Rate for the Ten-Year Period Prior to Base Year

From SA81, Table 111, the average for years 1972-78 is seen to be 14.11 for whites and 24.19 for others.

External Migration

As discussed earlier, published data on immigration refers to legal immigration, and is not suitable for use in the DESTINY model. From the discussion of the single-race data in the preceding chapter, an estimate of 1,000,075 was obtained for the annual total net migration number. The problem remains as to how to apportion this total net migration number among the two races of the present model.

Migration numbers and rates vary considerably by race, and so it is not satisfactory simply to allocate the total in proportion to the US population race totals. One indication of the relative racial composition of immigrants is provided in SA81 Table 131, entitled, "Immigrants, by Country of Birth: 1951 to 1979." The data of this table may be used to determine an approximation of the number of white and other immigrants.

The following data are extracted from SA81 Table 131:

Region	Immigrants, 1975-79
Europe	350.4
Asia	879.2
North America	854.7
South America	155.8
Africa	48.8
Australia	6.9
New Zealand	2.6
Other	10.5
Total	2,308.8

This table shows that the legal immigration from Europe, America, Australia, and New Zealand for the years 1975-79 was 1,368,400. To estimate immigration by race, the legal immigrants from these countries will be classified as white, and all other immigrants (legal or otherwise) will be classified as other. The five-year figure of 1,368,400 corresponds to an annual number of 273,680. Subtracting this figure from the DESTINY estimate of 1,000075 total immigrants (legal or otherwise) per five years, this yields 726,395 as the estimate of immigrants for the other race category.

These two immigration estimates are very approximate, since some legal immigrants from Europe, America, Australia, and New Zealand are surely nonwhite, some legal immigrants from other countries are surely white, and some illegal immigrants (from any countries) are surely white. Also, emigration from the US has been ignored. From readily available published sources, however, little information is available on total immigration (legal and illegal) by race. The estimate for whites is an approximate lower limit and the estimate for others is an approximate upper limit (since all illegal immigrants are classified as other). What this means with respect to population projections is that the projections for whites are likely to be low, and the projections for others are likely to be high.

Another limitation of the preceding estimates is that they do not account for population changes associated with race transitioning

(which is included in the external migration parameters of the DESTINY model).

In summary, published data on migration are of limited value for use in the DESTINY system. Because of the unavailability of satisfactory published data on migration by race, migration parameters will be estimated as the population change (rate per 1,000 or amount) net of births and deaths, as was done in the case of the all-races-combined model. As has been discussed earlier, this estimate includes population changes associated with race transitioning (changes in race declarations, changes in race classification procedures, intermarriages) as well as with migration. Since the two-race model is a different parametric specification of the population, the sum of the external migration estimates for the two races may differ a little from the external migration estimate calculated for the two races combined.

The formulas for estimating net external migration, either as a rate or an amount, were given earlier. The formula for the amount is as follows:

$$M = (p_{10} - p_0(1+b-d)^{10})(b-d)/((1+b-d)^{10}-1) ,$$

where the symbols are defined as before.

Substituting b=.01413, d=.00904, p_0=178,098,000, and p_{10}=188,340,790 for the white race yields the estimate:

$$M = 94,517.$$

Substituting b=.02177, d=.00833, p_0=25,137,000, and p_{10}=38,164,035 for the other race yields the estimate:

$$M = 888,003.$$

The sum of these two estimates is 982,520, which differs somewhat from the estimate of 1,000,075 for both races combined. These estimates are somewhat different from the rough migration estimates presented above of 273,680 for whites and 726,395 for others (exclusive of race transitioning). At this point, a decision must be made concerning whether to use these estimates, derived from the data for the ten-year-period preceding the base year, as the parameter values for the projection period, or whether some other values, considered more likely to apply in the projection period, should be used. The primary factor is whether it is expected that the migration rates during the projection period will be similar to those for the preceding ten-year period. Another factor to consider is whether the amount of race transitioning for the projection period is expected to be similar to that in the past. Since the figure of 273,680 was considered to be an approximate lower bound for white migration (exclusive of race transitioning), the estimate of 94,517 net external white migration may be somewhat low for the projection period. If changes in race classification procedures caused relatively fewer people to be classified as white in 1970 than in 1980, and if this trend was not expected to continue, a higher figure should be used for the projection period.

The goal of the present example is to project the population from the base year of 1980, using data that were readily available in 1980. To keep the example as simple as possible, the estimated population change net of births and deaths (94,517 and 888,083) will be used for the values of the external migration parameters, but in should be understood that other values may be used. For example, if it is believed that illegal immigration will increase, higher values would be indicated. Or, it may be desired to construct several alternative projections under different assumptions about external migration levels.

This completes the data specification for the construction of the file US802.DAT.

C. Results of CHECK Run

The output of a CHECK run of the file US802.DAT is shown in Listing 3. For each race, the program first prints out all of the input data. No discrepancies are observed from the data presented above.

The estimated Total Fertility Rates for the two races are 1.748 and 2.335, which are in close agreement with the rates specified for the first projection period (1.717 and 2.334, respectively). The race transition parameter values as calculated by the program are identical to the values calculated manually above.

D. Results of PROJ Run

Listing 4 illustrates a run of the PROJ program, which projects the population two five-year periods out, from the base year of 1980 to the year of 1990. Since the input population data are disaggregated by age, sex, and race, the projections may be also. The total projected population for 1990 is 250,738,546, which corresponds to the actual value for 1990 of 248,710,000 (SA92, Table No. 18, "Resident Population, by Age, Race, and Hispanic Origin: 1980 and 1990"). This is an error of 1%. The projected population for this example differs from the projected population for the previous (combined-race) model since the demographic specification is different -- more detailed (two races vs. one) -- and the projection model is nonlinear.

The projection yields values of 197,443,844 for white and 53,294,702 for other. These correspond to the actual 1990 values of 199,686,000 for white and (by subtraction from the total 248,710,000) 49,024,000 for other (SA92, Table No. 18). These race-specific projections are in error by -1.1% and 8.7%, respectively. The white race projection is slightly low and the other race projection is somewhat too high. Since the Total Fertility Rate for black and other races was steadily increasing over the period 1980-1990, the reason for the overshot is that the migration number specified for the black and other races for

the projection period was too large. This is a not unexpected result, in view of the fact that the value used for the external migration number (888,003) for others exceeded the approximate upper limit (726,395) for other migration. (Based on this result, the migration numbers could be revised to obtain more accurate projections from a later base year, such as 1990. It is noted that if the values 273,680 and 726,395 are used for the migration amounts, the 1990 projection is 199,252,780 whites and 51,620,900 others, both of which are somewhat closer to the actual 1990 values.)

VIII. Example 3: State Population Projection, Single-Race Model

A. Projection Objectives; Data Sources

This chapter presents an example illustrating the use of the DESTINY package to make a projection of the population of the state of Arizona from the base year of 1980. The purpose of this example is primarily to obtain a migration estimate for the three-race model presented in the following chapter.

In addition to the national demographic data sources cited earlier, the following state data sources were used:

- CPAZ80: 1980 Census of Population, Volume 1, Characteristics of the Population, Chapter B, General Population Characteristics, Part 4, Arizona, PC80-1-B4), issued April 1982, Bureau of the Census, US Department of Commerce, Washington, DC.

- VSAZ80: 1980 Arizona Vital Health Statistics, Arizona Department of Health Services, Phoenix, Arizona

These two publications will be referred to in the remainder of this chapter as CPAZ80 and VSAZ80, respectively. CPAZ80 includes data on the state population by age, sex, and race. VSAZ80 includes data on birth and death rates.

Another source of demographic data for Arizona is the Arizona Statistical Abstract: A 1990 Data Handbook published by the College of Business and Public Administration of the University of Arizona, Tucson, Arizona.

For comparing DESTINY projections for 1990 to actual 1990 values, the 1990 Census of Population, General Population Characteristics, United States, 1990 CP-1-1 ("CPUS90"), contains data by age, sex, and race for each state. Data on county by race (including white, black, Indian, and Hispanic status) are presented in the County and City Data Book 1994 ("CCDB94"), and also in 1990 Census of Population, General Population Characteristics, Arizona, 1990 ("CPAZ90").

The example presented in this chapter is particularly illustrative of a state-level application of the DESTINY package, since it reveals the difficulties in obtaining accurate state-level data, and shows how these difficulties are overcome.

As in the preceding examples, we will generally use, if available, the average for the five years preceding the base year as the value of parameters in the projection period.

B. PARAM Run Parameters

The example presented here includes a single racial group and region, representing the total population of the state.

In the run of the PARAM program, the name AZ801.DAT was given to the parameter file, and the base year was stated as 1980. (In the file name, AZ stands for Arizona, 0 stands for 1980, and 1 is the number of races.

P1: Number of races = 1
P2: Number of regions = 1
P3: Demographic Parameter Option = 1 (i.e., the demo- graphic parameters are to be the same for all ten five-year projection periods)
P4: Life Table Option = 1 (i.e., the survival prob- abilities will be determined by the Infant Mortality Rate, rather than by the Life Expectancy at Birth)
P5: External Migration Option = 1 (i.e., a single migration rate and/or migration number will be specified, to be used for all projection periods)
P6: Internal Migration Option = 0 (no regions are specified, so there is no internal migration)
P7: Service System Option = 0 (i.e., no service system parameters are included in the model)

The following paragraphs describe the demographic data input to the PARAM program.

Fertility Age Distribution; Total Fertility Rate

Total Fertility Rates are not available for Arizona from published state vital statistics sources. VSAZ80 presents crude birth rates (CBRs), but not Total Fertility Rates (TFRs). The TFR will be hence be estimated from the CBR and base-year population data.

The following formula relates TFR to CBR and the base-year population:

$$TFR = .005*CBR*POPT/BFAC$$

where

TFR = total fertility rate

CBR = crude birth rate

POPT = total population

$$BFAC = ' FAD_i*FPOP_i$$

and

FAD_i = the "fertility age distribution," i.e., the

percentage of total lifetime births occurring to females in the i-th five-year age cohort

$FPOP_i$ = female population in the i-th five-year age cohort.

All of the preceding parameters refer to the base year.

The crude birth rate for Arizona for 1979 is given in on page 60 of SA81, Table No. 71, "Live Births -- Number and Rate, by States, 1960 to 1979": 19.1. Note that this differs somewhat from the 1979 rate presented in VSAZ80, which is 17.7 (the state 1980 value is 18.4). Since the state value is more recent (i.e., for 1980 rather than 1979), we shall use it (i.e., 18.4).

The total population for the base year is 2,718,215 (from CPAZ80).

Since no state-specific data are available on the fertility age distribution, the national (all-race) data are used. These data, from SA81 Table No. 85, were presented on the chapter dealing with the US single-race model, and are presented below, along with the female population for the relevant age cohorts (the full base-year population distribution by age and sex, from CPAZ80, is presented later):

Age of Mother	Fertility Age Distribution, FAD_i	Female Population, $FPOP_i$
15-19	.147	123,734
20-24	.312	130,297
25-29	.312	116,911
30-34	.166	102,909
35-39	.052	82,540
40-44	.011	68,279
Total	1.000	

Substituting in the formula presented above, we obtain

$$BFAC = .147(123,734) + .312(130,297) + .312(116,911) + .166(102,909) + .052(82,540) + .011(68,279)$$

$$= 117,443.837$$

and so

$$TFR = .005(18.4)(2,718,215)/117,443.837$$

$$= 2.129 .$$

Infant Mortality Rate

Data on infant mortality for Arizona are found in SA81, VS78, and VSAZ80. SA81 presents IMRs for whites and blacks, but not for all races combined (later editions of the SA also report for the total). VS78 reports IMRs for white and other races, but the data are for 1978, not for 1980. The most recent source is VSAZ80. VSAZ80

reports (Table 3.11) the infant mortality rate for 1980 as 12.4. The average for years 1975-80 is 13.56; this value will be used for the first projection period.

Base-Year Population by Age and Sex

Population data by age and sex are presented for the year 1980 in CPAZ80. These data are as follows.

Age	Male	Female
0-4	109,075	104,808
5-9	107,650	103,417
10-14	111,583	107,990
15-19	128,283	123,734
20-24	133,486	130,297
25-29	119,140	116,911
30-34	104,855	102,909
35-39	80,333	82,540
40-44	66,836	68,279
45-49	61,538	63,533
50-54	60,295	66,454
55-59	61,155	71,352
60-64	57,682	66,718
65-69	53,009	61,835
70-74	39,867	47,409
75+	43,155	62,087
Total	1,337,942	1,380,273
Grand Total	2,718,215	

Crude Birth Rate for Base Year

In VSAZ80, Table 2.8, the crude birth rate for Arizona for 1980 is reported as 18.4.

Crude Death Rate for Base Year

In VSAZ80, Table 3.3, the crude death rate for 1980 is reported as 7.8.

Infant Mortality Rate for the Base Year

In VSAZ80, Table 3.13, the infant mortality rate for 1980 is reported as 12.4.

Population Ten Years Prior to Base Year

Numerous tables in SA81, such as Table No. 8, page 9 ("Resident Population -- States 1970 to 1980") report the 1970 resident population of Arizona as 1,775,000.

Note that CPAZ80 reports (Table 20) a slightly different figure -- 1,770,900. The 1,775,000 figure is cited more frequently, and appears in later editions of SA. For use in the multi-race model of the next chapter, however, the 1970 population is needed disaggregated by race. Since these data are presented in CPAZ80

(Table 17) but not in SA81, the CPAZ80 data (i.e., the value 1,770,900) will be used, solely for the sake of consistency.

Average Crude Birth Rate for the Ten-Year Period Prior to Base Year

From VSAZ80, Table 2.8, the average for years 1971-80 is seen to be 18.32.

Average Crude Death Rate for the Ten-Year Period Prior to Base Year

From VSAZ80, Table 3.3, the average for years 1971-80 is seen to be 7.71.

Average Infant Mortality Rate for the Ten-Year Period Prior to Base Year

From VSAZ80, Table 3.11, the average for years 1971-80 is seen to be 14.94.

External Migration

As was done before, the annual migration amount will be estimated as the average annual population change net of births and deaths, which is:

$$p_{t+1} = (1+b-d)p_t + M$$

where

p_t = population in year t

b = crude birth rate

d = crude death rate

M = annual (net) migration number,

and all of the parameter values represent average values over the ten-year period prior to the base year.

Solving this equation for M in terms of p_{10} and p_0 yields the following:

$$M = (p_{10} - p_0(1+b-d)^{10})(b-d)/((1+b-d)^{10}-1) .$$

Substituting b=.01832, d=.00771, p_0=1,770,900, and p_{10}=2,718,215 yields the estimate:

M = 71,507.

This completes the data specification for the construction of the file AZ801.DAT.

C. Results of CHECK Run

The output of a CHECK run of the file AZ801.DAT is shown in Listing 5. The printout reveals no errors in the data entry.

The run shows that the manual computations of the Total Fertility Rate (2.129) and the annual net migration number (71,507) were correct.

D. Results of PROJ Run

Listing 6 illustrates a run of the PROJ program, which projects the population two five-year periods out, from the base year of 1980 to the year of 1990. Since the input population data are disaggregated by age and sex, the projections may be also. The projected total population for 1990 is 3,694,625, which corresponds to the actual value for 1990 of 3,665,000 (SA92, Table No. 25, "Resident Population -- States: 1970 to 1991"). This is an error of less than 1%.

IX. Example 4: State Population Projection, Three-Race, 14-Region Model

A. Projection Objectives; Data Sources

This chapter presents an example illustrating the use of the DESTINY package to make a multi-race, multi-region projection of the population of the state of Arizona from the base year of 1980. The races are white, American Indian, and other. The regions are the 14 counties of Arizona.

In the following chapter, the DESTINY package will be used to project social services to the elderly. That projection will use the population model constructed in this chapter.

The data sources used for this example are the same as those of the preceding chapter. A minor problem that arose in the present example in that population data were not immediately available by county and race for 1970 (i.e., 10 years prior to the base year). In order not to delay preparation of the projections, the 1970 county-by-race data were estimated. Later, the actual (1970 Census) county-by-race data were obtained. In order to illustrate the procedure for estimating ten-year-prior region-by-race data (for applications in which the ten-year-prior region-by-race data are unavailable), the estimation procedure will be illustrated, and the estimates will be compared to the actual values. The estimates will be used in this example, rather than the actual values; in a real application, the projection would be redone using the 1970 actual race-by-county values.

The special features illustrated in this example are the estimation of net migration numbers by race, and the procedure for estimating regional growth rates and migration.

B. PARAM Run Parameters

The example presented here includes three racial groups (white, American Indian, and other) and fourteen regions (the fourteen counties of Arizona in 1980). (Note: In 1983, Yuma County was split to form the two counties of Yuma and La Paz. The Yuma County of the example presented here refers to the union of the present Yuma and La Paz Counties.) In the run of the PARAM program, the name AZ803C.DAT was given to the parameter file, and the base year was stated as 1980. (In the file name, AZ stands for Arizona, 80 stands for 1980, 3 is the number of races, and C stands for county.) The seven Input Option Parameters were as follows:

P1: Number of races = 3
P2: Number of regions = 14

P3: Demographic Parameter Option = 1 (i.e., the demo- graphic parameters are to be the same for all ten five-year projection periods)
P4: Life Table Option = 1 (i.e., the survival prob- abilities will be determined by the Infant Mortality Rate, rather than by the Life Expectancy at Birth)
P5: External Migration Option = 1 (i.e., a single migration rate and/or migration number will be specified, to be used for all projection periods)
P6: Internal Migration Option = 1 (i.e., internal migra- tion among the counties will be specified)
P7: Service System Option = 0 (i.e., no service system parameters are included in the model)

The following paragraphs describe the demographic data input to the PARAM program. As in the previous chapter, the data are presented demographic-category-by-demographic-category, rather than race-by-race (the order requested by the PARAM program.)

Total Fertility Rates; Fertility Age Distributions

Total Fertility Rates are not available by race for Arizona from published state vital statistics sources, and they are not available by state in VS78. Hence, the TFRs will be estimated, using the formula

TFR = .005*CBR*POPT/BFAC

given earlier. In order to use this formula, data are required, by race, for crude birth rates for the base year, for the total population in the base year, for the fertility age distribution, and for the female populations in the child-bearing age categories.

The required population data are available from CPAZ80 (Table 17, "Race by Sex: 1900 to 1980"). The total populations for 1980 for the three races of the model are 2,240,761 for whites, 152,498 for American Indians, and 324,956 for others.

Obtaining data on crude birth rates for 1980 is problematic. VS78 presents crude birth rates by state or by race, but not by race for each state. Although data on births are available by race from VSAZ80, the racial classification used for these data do not correspond to the racial classifications used for the population figures available from the Census. For this reason, it is not possible to construct rates directly from the birth-by-race data presented in the Arizona vital statistics report (VSAZ80).

The following table presents the 1980 US Census data on the Arizona population by race (CPAZ80, Table 17. "Race by Sex: 1900 to 1980"), and the 1980 Arizona vital statistics data on Arizona births by race (VSAZ80, Table 2.12).

Race	Arizona 1980 Population (CPAZ80)	Percent	Race of Child	Arizona 1980 Births (VSAZ80)	Percent	Crude Birth Rate

White	2,240,761	82.4	White	42,308	84.6	18.9
Indian	152,498	5.6	Indian	5,061	10.1	33.2
Black	74,977	2.8	Black	2,062	4.1	27.5
Other	249,979	9.2	Asian	618	1.2	
Total	2,718,215	100.0	Total	50,049	100.0	

The problem is apparent: the Asian birth category of VSAZ80 does not correspond to the Other population category of CP80. Evidently, many births that would be classified as "other" using US Census race classification criteria are included in other categories in the state birth counts. Birth rates estimated from the preceding data would be seriously biased (low) for the "other" race category (nonwhite, nonIndian) of the model.

Note that since the model will be projecting the populations obtained from the CP80 source, it is the birth rates that must correspond to those population categories, and not vice versa.

To overcome the comparability problem, crude birth rates will be estimated for the white and Indian categories from the VSAZ80 data, but the US crude birth rate will be used for the other category. This approach produces 18.9 for the white crude birth rate (VSAZ80, Table 2.12), 33.2 for the Indian crude birth rate (also Table 2.12), and 22.8 for the other crude birth rate (SA81, Table 85).

The remaining data required by the TFR estimation formula are the fertility age distributions and the populations of females in the fertile age categories.

For the fertility age distributions, the national-level data presented in VS78 will be used (no state-level FAD data are available from VSAZ80). These data are available for total, white, all other, and black races. The data for the "all other" race category will be used for the Indians and other race category of the model. These data were presented earlier in the chapter dealing with the US two-race model, and are presented in the following table.

	Fertility Age Distribution		
Age	White	Indian	Other
15-19	.130	.221	.221
20-24	.312	.312	.312
25-29	.326	.251	.251
30-34	.170	.143	.143
35-39	.051	.058	.058
40-44	.011	.015	.015
Total	1.000	1.000	1.000

The final data required are the numbers of females in the fertile age cohorts. These counts are available from Table 20 of CPAZ80, and are presented in the following table (the complete population distributions are presented later).

	Female Population		
Age	White	Indian	Other

15-19	95,899	9,973	17,862
20-24	104,137	7,979	18,181
25-29	95,364	6,237	15,310
30-34	85,981	4,988	11,940
35-39	69,718	4,054	8,768
40-44	57,394	3,522	7,363

With the preceding data, the TFR estimates may now be calculated for the three race categories.

For whites, we have:

$$BFAC = .130(95,899) + .312(104,137) + .326(95,364) + .170(85,981) + .051(69,718) + .011(57,394)$$

$$= 94,850.00$$

and

$$TFR = .005*18.9*2,240,761/94,850.00 = 2.232.$$

For Indians, we have:

$$BFAC = .221(9,973) + .312(7,979) + .251(6,237) + .143(4,988) + .058(4,054) + .015(3,522)$$

$$= 7,260.214$$

and

$$TFR = .005*33.2*152,498/7,260.214 = 3.487.$$

For others, we have:

$$BFAC = .221(17,862) + .312(18,181) + .251(15,310) + .143(11,940) + .058(8,768) + .015(7,363)$$

$$= 15,789.193$$

and

$$TFR = .005*22.8*324,956/15,789.193 = 2.346.$$

Infant Mortality Rates

Infant Mortality Rates are available from VS78 by state, for the race categories total, white and all other (Table 2-6, "Infant Mortality Rates by Color: United States, Each Division and State, 1974-78"). (Later editions of VS also present data for the black race category.) SA81 presents IMR data by state for white and black races. VSAZ80 presents birth and infant death data for white, Indian, black, and Asian races.

Estimation of the Infant Mortality Rate (IMR) for Arizona faces similar problems to those encountered in estimation of the Total

Fertility Rates, namely the incomparability of the Arizona vital statistics race categories with the Census population race categories (which are used for the model population categories). The data presented in VSAZ80 for births (Table 2.12) and infant deaths (Table 3.12) are as follows:

Race of Child	Arizona 1980 Births (VSAZ80)	Percent	Race of Child	Arizona 1980 Infant Deaths (VSAZ80)	Percent	Infant Mortality Rate
White	42,308	84.6	White	497	80.3	11.7
Indian	5,061	10.1	Indian	82	13.2	16.2
Black	2,062	4.1	Black	40	6.5	19.4
Asian	618	1.2	Asian	0	0.0	0.0
Total	50,049	100.0	Total	619	100.0	12.4

We shall use the IMRs calculated from the VSAZ80 state data for whites (11.7) and Indians (16.2), but use the SA81 national data for black and other races (21.1 for 1978, from Table No. 111) for the other race category.

Base-Year Population by Age, Sex, and Race

Base-year population data by age, sex, and race are presented in CPAZ80 (Table 20, "Age by Race and Sex: 1910 to 1980"). Unfortunately, these data are presented for white and black (and, by subtraction, for other than white or black), but not for white, Indian, and other than white or Indian. The Indian population is presented by age and sex for all counties except Greenlee and Santa Cruz. For these two counties, the population is presented by age and sex, but only the total Indian population is specified. The Indian population by age and sex for these counties was estimated by multiplying the age-sex distribution of the county by the proportion Indian in each county (.0200772 for Greenlee and .0027861 for Santa Cruz.) The age x sex Indian population distribution was added for all counties to obtain the age x sex Indian population distribution for the entire state.

The age by sex population distribution for Arizona for 1980 for the three racial groups of interest is as follows:

	White		Indian		Other	
Category	Male	Female	Male	Female	Male	Female
0-4	79,351	76,208	9,853	9,732	19,871	18,868
5-9	80,415	76,578	9,288	9,237	17,947	17,602
10-14	85,306	82,032	9,575	9,465	16,702	16,493
15-19	99,026	95,899	9,931	9,973	19,326	17,862
20-24	106,315	104,137	7,250	7,979	19,921	18,181
25-29	96,311	95,364	5,681	6,237	17,148	15,310
30-34	87,382	85,981	4,817	4,988	12,656	11,940
35-39	68,203	69,718	3,524	4,054	8,606	8,768
40-44	56,493	57,374	3,120	3,522	7,223	7,363
45-49	52,916	54,059	2,532	3,103	6,090	6,371

50-54	53,052	58,170	2,123	2,579	5,120	5,705
55-59	55,155	64,721	1,758	2,122	4,242	4,509
60-64	53,162	61,749	1,362	1,555	3,158	3,414
65-69	49,283	57,527	1,154	1,382	2,572	2,926
70-74	37,022	44,379	928	916	1,917	2,114
75+	39,590	57,863	1,349	1,409	2,216	2,815
Sex Tot.	1,098,982	1,141,779	74,245	78,253	164,715	160,241
Race Totals	2,240,761		152,498		324,956	
Grand Total			2,718,215			

Crude Birth Rate for Base Year

As discussed earlier, we shall use the birth rates derived from VSAZ80 (births) and CPAZ80 (population) for the white and Indian races, and the SA81 data for the other race category. These values are 18.9 for whites, 33.2 for Indians, and 22.8 for others.

Crude Death Rate for Base Year

Crude death rates are available by race or by state from SA81 and VS78, but not by state and race. Data on deaths by race are available from VSAZ80. As was the case with the VSAZ80 data on births, these data are not comparable with the CPAZ80 population data. The following table presents the death data from VSAZ80 (Table 3.5).

Race	Arizona 1980 Population (CPAZ80)	Percent	Race of Child	Arizona 1980 Deaths (VSAZ80)	Percent	Crude Death Rate
White	2,240,761	82.4	White	19,631	92.4	8.8
Indian	152,498	5.6	Indian	988	4.7	6.5
Black	74,977	2.8	Black	552	2.6	7.4
Other	249,979	9.2	Asian	55	0.3	
Total	2,718,215	100.0	Total	21,226	100.0	

We shall use the crude death rate from the VSAZ80 data for whites and Indians (8.8 and 6.5 respectively), but the national-level data from SA81 for the other race category (7.8 for 1979, Table 108).

Infant Mortality Rate for the Base Year

As discussed earlier, we shall use IMR data derived from VSAZ80 for the white and Indian races, but national-level data presented in SA81 for the other race category. These rates are 11.7 for whites, 16.2 for Indians, and 21.1 for other.

In VSAZ80, Table 3.13, the infant mortality rate for 1980 is reported as 12.4.

Population Ten Years Prior to Base Year

Data for the 1970 population by race are available from CPAZ80 (Table 17, "Race by Sex: 1900 to 1980"). These data are as follows:

1,604,948 for whites, 95,812 for Indians, and (by subtraction from the total of 1,770,900) 70,140 for others.

Average Crude Birth Rate for the Ten-Year Period Prior to Base Year

Data on birth rates by race for the entire ten-year period prior to the base year are available from past editions of the Arizona Vital Health Statistics, but these data are not readily available. For this reason, the base-year data presented above shall be used (18.9 for whites, 33.2 for Indians, and 22.8 for others).

Average Crude Death Rate for the Ten-Year Period Prior to Base Year

For the same reason given in the preceding paragraph on crude birth rates, the base-year data presented above will be used (8.8 for whites, 6.5 for Indians, and 7.8 for others).

Average Infant Mortality Rate for the Ten-Year Period Prior to Base Year

For the same reason given above, the base-year data presented above will be used (11.7 for whites, 16.2 for Indians, and 21.1 for others).

Base-Year Population by Region (County)

CPAZ80 presents the population of each county, by race. The data are presented in the table which follows:

	Population by Race (Base Year, 1980)			
County	White	Indian	Other	Total
Apache	11,902	39,024	1,182	52,108
Cochise	73,261	489	11,936	85,686
Coconino	49,235	20,904	4,869	75,008
Gila	30,147	5,083	1,850	37,080
Graham	17,085	2,740	3,037	22,862
Greenlee	9,357	229	1,820	11,406
Maricopa	1,307,455	22,788	178,809	1,509,052
Mohave	53,477	1,462	926	55,865
Navajo	32,543	32,122	2,964	67,629
Pima	442,888	14,880	73,675	531,443
Pinal	61,849	8,487	20,582	90,918
Santa Cruz	16,515	57	3,887	20,459
Yavapai	65,322	997	1,826	68,145
Yuma	69,725	3,236	17,593	90,554
Total	2,240,761	152,498	324,956	2,718,215

External Migration

External migration will be estimated, as before, as the change in population net of births and deaths. Using the same formula ($M = (p_{10} - p_0(1+b-d)^{10})(b-d)/((1+b-d)^{10}-1)$) as before, the estimates 44,535 for whites, 2,462 for Indians, and 22,756 for others are obtained. These estimates are considered "rough," since the data on fertility rates by race were approximate, especially for the other race category.

Errors in the fertility rate will affect the migration estimate (since this estimate is the population net of estimated births and deaths, and the estimated births is uncertain), but these errors tend to compensate (i.e., if the TFR for others is too low, the external migration estimate will be too high, and vice versa).

Regional Populations Ten Years Prior to Base Year

As mentioned earlier, county-by-race data were not immediately available (from the US Bureau of the Census) for the year 1970, and so these data were estimated. Later, the actual 1970 data were received. The following paragraphs illustrate a procedure for estimating region-by-race data for a ten-year-earlier year, using base-year region-by-race data.

The data that were initially available for 1970 were the population totals for the three races and the population totals for the 14 counties (i.e., the "marginal" totals are available for race and county). For 1980, the data were available for county-by-race. These data may be used to compute estimates of the proportion of population in each race-by-county category. What is desired is to determine an allocation of the 1970 population over the various race-by-county categories that matches the marginal race and county totals, for which the race-by-county proportions are "close" to the 1980 values.

The problem of determining a set of race-by-county category counts that matches the specified marginal totals and is close to the specified cell proportions is called "statistical adjustment of data." The recommended procedure for solving this problem is to determine the adjustments by the method of least-squares, using a procedure known as "Deming-Stefan raking." To avoid the complexity of this (iterative) method, we shall use a simpler procedure.

The procedure we shall use involves two steps. First, we shall apportion the total 1970 population for each race to the counties in proportion to the 1980 county populations for the race. The problem that arises is that the county populations (summed over all races) obtained in this way may not match the known 1970 totals. To address this problem, the population values for the white race (usually the largest in every county) will be adjusted (in each county) to force the county total to match the known 1970 county total.

The result of applying the first step produces the following table:

Population by Race (Estimated, 1970, Unadjusted)

County	White	Indian	Other	Unadjusted Total	1970 Total
Apache	8,525	24,518	255	33,298	32,298
Cochise	52,473	307	2,576	55,356	61,910
Coconino	35,265	13,134	1,051	49,450	48,326
Gila	21,593	3,194	399	25,186	29,255
Graham	12,237	1,721	656	14,614	16,578
Greenlee	6,702	144	393	7,239	10,330
Maricopa	936,466	14,317	38,595	989,378	967,522

Mohave	38,303	919	200	39,422	25,857
Navajo	23,309	20,182	640	44,131	47,715
Pima	317,219	9,349	15,902	342,470	351,667
Pinal	44,299	5,332	4,443	54,074	67,916
Santa Cruz	11,829	36	839	12,704	13,966
Yavapai	46,787	626	394	47,807	36,733
Yuma	49,941	2,033	3,797	55,771	60,827
Total	1,604,948	95,812	70,140	1,770,900	1,770,900

The result of adjusting the white county amounts so that the three races sum to the correct county totals (by adding the 1970 total less the unadjusted total to each white amount) is as follows:

Population by Race (Estimated, 1970)

County	White	Indian	Other	1970 Total
Apache	7,525	24,518	255	32,298
Cochise	59,027	307	2,576	61,910
Coconino	34,141	13,134	1,051	48,326
Gila	25,662	3,194	399	29,255
Graham	14,201	1,721	656	16,578
Greenlee	9,793	144	393	10,330
Maricopa	914,610	14,317	38,595	967,522
Mohave	24,738	919	200	25,857
Navajo	26,893	20,182	640	47,715
Pima	326,416	9,349	15,902	351,667
Pinal	58,141	5,332	4,443	67,916
Santa Cruz	13,091	36	839	13,966
Yavapai	35,713	626	394	36,733
Yuma	54,997	2,033	3,797	60,827
Total	1,604,948	95,812	70,140	1,770,900

The entries of this table are entered into to program as the regional populations ten years prior to the base year.

The following table shows the actual 1970 region-by-race values, for comparison to the estimated values. (The source of the data is 1970 Census of Population, Volume 1, Characteristics of the Population, Part 4: Arizona, US Department of Commerce, Bureau of the Census, Washington, DC 1972. The other values are obtained by subtraction of the white and Indian values from the total.)

Population by Race (Actual 1970)

County	White	Indian	Other	1970 Total
Apache	7,734	23,994	570	32,298
Cochise	59,250	152	2,508	61,910
Coconino	34,512	11,996	1,818	48,326
Gila	24,409	4,591	255	29,255
Graham	14,124	1,682	772	16,578
Greenlee	10,099	124	107	10,330
Maricopa	914,464	11,159	41,899	967,522
Mohave	24,850	869	138	25,857
Navajo	23,425	23,023	1,267	47,715
Pima	329,278	8,837	13,552	351,667

Pinal	57,516	6,405	3,995	67,916
Santa Cruz	13,740	22	204	13,966
Yavapai	35,754	686	293	36,733
Yuma	55,793	2,033	3,001	60,827
Total	1,604,948	95,812	70,140	1,770,900

In general, the estimated values are close to the actual values. Large relative errors occur for some of the counties having very small numbers of Indian and other races. Except for these instances, using the estimated values instead of the actual values will have a negligible impact on the projection results.

Internal Migration

As discussed earlier, the parameters used to determine internal migration are the amount (or rate) of population change net of births, deaths, and net external migration allocated proportional to region (county) population size.

The formulas for estimating the internal migration parameter values are similar to those used for estimating external migration parameters.

The formulas for the internal migration amount (N) and the internal migration rate (n) are:

$$N = (p_{10} - p_0(1+b-d+m)^{10})(b-d+m)/((1+b-d+m)^{10}-1) - M$$

and

$$n = ((p_{10}-MC)/p_0)^{.1} -1 - b + d - m,$$

where

$$C = ' (1+b-d+m+r)^{i} ,$$

the sum is from 1 to 9, and the other symbols are as previously defined. In this case, however, p_{10} refers to a county population of a particular race in the base year, and p_0 refers to the county population of a particular race ten years previous. Also, the value of M for each county is the total external migration for the race times the proportion of the race in that county, where the external migration is estimated (as above) as the population change net of births and deaths.

The formula for the amount is a closed-form expression, whereas the formula for the rate is not (i.e., n occurs on both sides of the equation and it is not possible to obtain a closed-form expression for n). The CHECK program evaluates both of these expressions (using an iterative method for the rate), and so it is not necessary to perform the computations by hand.

As an approximation for the rate, the amount divided by the population, times 1,000, may be used.

The following table presents the values of the internal migration amounts and rates (per 1,000) for the three races, as determined by the preceding formula for N and n. As discussed earlier, the amount will be used (entered to the PARAM program) if the estimate is positive (or zero), and the rate will be used otherwise.

Internal Migration Amounts and Rates

	White		Indian		Other	
County	Amount	Rate	Amount	Rate	Amount	Rate
Apache	106	11.257	0	.001	0	.021
Cochise	-692	-10.599	0	.070	0	.005
Coconino	119	2.290	0	-.003	0	-.002
Gila	-430	-15.539	0	-.013	0	.033
Graham	-207	-13.399	0	.027	0	-.031
Greenlee	-327	-34.043	0	-.079	0	-.018
Maricopa	2,309	2.130	0	.002	0	.000
Mohave	1,433	39.480	0	-.045	0	-.027
Navajo	-379	-12.877	0	-.001	0	-.016
Pima	-972	-2.576	0	-.001	0	.001
Pinal	-1,462	-24.442	0	.004	0	-.005
Santa Cruz	-133	-9.132	0	-.486	0	-.001
Yavapai	1,170	24.387	0	.059	0	.014
Yuma	-534	-8.687	0	.006	0	.004
Total	0		0		0	

The internal migration amounts for Indians and others are zeros for all counties because the populations for 1970 for those races were estimated for each county as proportional to the 1980 populations.

Some of the internal migration rates are so large that it is difficult to imagine that they would continue for very long. The value 39.480 for the white race in Mohave County, for example, corresponds to a migration of about 4% per year, net of births, deaths, and proportional allocation of external migration. Although the estimated values will be used for this example, in a real application consideration would be given to reducing the magnitudes of migration parameters that are very large (since continuation of high rates for many years is unlikely).

This completes the data specification for the construction of the file AZ803.DAT.

C. Results of CHECK Run

The output of a CHECK run of the file AZ803C.DAT is shown in Listing 7. The printout reveals no errors in the data entry.

The run shows that the manual computations of the Total Fertility Rates (2.232, 3.487, and 2.346) were correct.

D. Results of PROJ Run

Listing 8 illustrates a run of the PROJ program, which projects the population two five-year periods out, from the base year of 1980 to the year of 1990. Since the input population data are disaggregated by age, sex, race, and region, the projections may be also. The total projected population for 1990 is 3,735,219, which corresponds to the actual value for 1990 of 3,665,000 (SA92, Table No. 25, "Resident Population -- States: 1970 to 1991"). This is an error of 1.9%.

Note that the 1990 total-population projection of this model differs slightly from the 1990 total-population projection of the single-race model of the preceding chapter (3,694,625). It is not quite as accurate, probably a result of the difficulty of estimating net migration by race.

The projections for 1990 by race are 2,886,323 for whites, 228,240 for Indians, and 620,656 for others. These may be compared to the actual 1990 figures available from the 1990 Census (1990 Census of Population, General Population Characteristics, United States, 1990 CP-1-1, issued November, 1992, US Department of Commerce, Bureau of the Census, Washington, DC (henceforth referred to as CP90), Table 262, "Age and Sex by Race and Hispanic Origin: 1990"): 3,665,228 total, 2,963,186 for whites, 203,527 for Indians, and (by subtraction) 498,515 for others. The errors in these race-by-race projections are -2.6% for whites, 12.1% for Indians, and 24.5% for others. These results are displayed in the following table.

Race	1990 Projected Population	1990 Actual Population	Percentage Error
White	2,886,323	2,963,186	-2.6
Indian	228,240	203,527	12.1
Other	620,656	498,515	24.5
Total	3,735,219	3,665,228	1.9

The projection for the other race is poor. The reason for this is that the explosive growth in this racial group from 1970 to 1980 (70,140 to 324,956, or an average annual rate of 16.6% dropped dramatically for the 1980-1990 decade (from 324,956 to 498,515, or an average annual rate of only 4.4%). It is not known whether this dramatic drop in the growth rate of the other race category is the result of substantial changes in race classification procedures, racial mixing, or a real drop in the number of other-race persons migrating to Arizona.

The projections for 1990 by county may be compared to the 1990 actual values, available from the County and City Data Book, 1994, US Department of Commerce, Bureau of the Census, Washington, DC. The following table compares the 1990 county projections and the 1990 actual values.

County	1990 Projected Population	1990 Actual Population	Percentage Error

Apache	72,497	61,591	17.7
Cochise	97,683	97,624	.1
Coconino	97,171	96,591	.6
Gila	40,759	40,216	1.4
Graham	26,383	26,554	-.6
Greenlee	11,039	8,008	37.8
La Paz	*	13,884	*
Maricopa	1,893,992	2,122,101	-10.7
Mohave	83,827	93,497	-10.3
Navajo	84,127	77,658	8.3
Pima	649,633	666,880	-2.6
Pinal	101,590	116,379	-12.7
Santa Cruz	24,075	29,676	-18.9
Yavapai	95,609	107,714	-11.2
Yuma	108,068	106,895	-10.5*
Total	3,735,219	3,665,228	1.9

No projection is available for La Paz County, since that county was created in 1983, and was not included in the model. Since that county was created from Yuma County, the sum of the 1990 actual populations for La Paz and Yuma Counties (120,779) should be compared to the projection for Yuma County (108,068). The error in this projection is -10.5%. The largest projection error is for Greenlee County, for which the population decreased from 11,406 to 8,008 between 1980 and 1990.

The average absolute projection error for the county projections is 10.4%. For 10-year-out projections for highly disaggregated local areas in a state in which the population is growing rapidly because of migration, errors of this magnitude are considered very reasonable. The magnitude of the errors for nearer-term projections would be less.

The following table shows the 1990 projections by race and county and compares them to the 1990 actual values. The actual values are from CCDB94, with the "other" race obtained by subtracting the white and Indian amounts from the county totals.

1990 Population by Race and County

	White		Indian		Other	
County	Projected	Actual	Projected	Actual	Projected	Actual
Apache	15,397	12,456	55,256	47,803	1,844	1,332
Cochise	78,373	79,724	692	790	18,618	17,110
Coconino	59,977	61,836	29,599	28,233	7,595	6,522
Gila	30,676	30,776	7,197	5,238	2,886	4,202
Graham	17,766	20,603	3,880	3,951	4,737	2,000
Greenlee	7,876	6,835	324	183	2,839	990
La Paz	*	10,335	*	2,402	*	1,107
Maricopa	1,582,814	1,799,420	32,267	38,017	278,911	284,664
Mohave	80,313	88,834	2,070	2,145	1,444	2,518
Navajo	34,020	34,205	45,483	40,417	4,623	3,036
Pima	513,643	524,976	21,069	20,330	114,920	121,574
Pinal	57,469	87,219	12,017	10,785	32,104	18,375
Sta Cruz	17,931	22,159	81	64	6,063	7,453
Yavapai	91,349	103,106	1,412	1,740	2,848	2,868

Yuma	76,044*	80,702*	4,582*	1,429*	27,442*	24,764*
Total	2,886,323	2,963,186	228,240	203,527	620,656	498,515

Even though the level of disaggregation is quite high and the number of years out is far (10 years), the projections are reasonably close to the actual values in magnitude in most cases. Substantial relative errors may occur for counties having small populations of the other race category. The relative projection error may be reduced by combining (adding together) counties having small populations of the other races.

Recall that the actual totals for La Paz and Yuma Counties is to be compared to the projected for Yuma County.

X. Example 5: Projection of the Hispanic Population

A. Projection Objectives; Data Sources

This chapter presents an example illustrating the use of the DESTINY package to project the Hispanic population of the state of Arizona. The model is a "two-race" one, in which the two "race" categories are Hispanic and other (non-Hispanic). The model includes representation of the 14 Arizona counties of 1980.

Any racial, ethnic, or other classification of a population may be represented as a "race" in the DESTINY model. The classification Hispanic/other is not a racial one, the model treats this classification in the same fashion as it does actual races. To maintain parallelism of the presentation of this chapter with that of previous chapters, the discussion of this chapter will refer to the two categories of the Hispanic/other classification as "races" of the model, even though they are not races in the ethnic sense.

There is the likelihood of some confusion in the descriptors used for the racial categories of this model, when references are being made to some of the other multi-race models. The problem is that the term "other" becomes ambiguous when several different multi-race models are under discussion. It may refer to "other than white," or "other than white and Indian," or "other than Hispanic." To avoid confusion, and yet avoid using such awkward descriptors (particularly in table titles), we shall make occasional use of terms such as "nonwhite" and "nonHispanic," despite the current "political incorrectness" of ethnic category descriptors having the prefix "non."

One needed data element needed for the present example that is not available from the referenced sources is the 1970 Arizona population by Hispanic status (for the whole state and by county). The 1970 county-by-Hispanic-status data will hence be estimated. Hispanic-status data are available for 1980 and later years, so this is no longer a problem in using the program to make forecasts from a base year of 1990 or later.

The approach used earlier to estimate 1970 populations for whites, Indians, and others does not work here, since the 1970 population totals are not available for Hispanics and nonHispanics. Hence, it is not possible to apportion a known 1970 race population total over the counties in the same proportions as observed for 1980. Instead, it will be assumed that the relative proportion of the races (Hispanic and nonHispanic) in each county was the same in 1970 as in 1980, and apportion the 1970 total county population (which is known) between the two races accordingly. This procedure provides estimates of the population of each county by race and, by summing, estimates of the total population of each of the two races.

B. PARAM Run Parameters

The example presented here includes two ethnic groups (Hispanic and other) and fourteen regions (the fourteen counties of Arizona in 1980). (As noted earlier, in 1983, Yuma County was split to form the two counties of Yuma and La Paz. The Yuma County of the example presented here refers to the union of the present Yuma and La Paz Counties.) In the run of the PARAM program, the name AZ80HC.DAT was given to the parameter file, and the base year was stated as 1980. (In the file name, AZ stands for Arizona, 80 stands for 1980, H stands for Hispanic, and C stands for county.) The seven Input Option Parameters were as follows:

P1: Number of races = 2
P2: Number of regions = 14
P3: Demographic Parameter Option = 1 (i.e., the demo- graphic parameters are to be the same for all ten five-year projection periods)
P4: Life Table Option = 1 (i.e., the survival prob- abilities will be determined by the Infant Mortality Rate, rather than by the Life Expectancy at Birth)
P5: External Migration Option = 1 (i.e., a single migration rate and/or migration number will be specified, to be used for all projection periods
P6: Internal Migration Option = 1 (i.e., internal migra- tion among the counties will be specified)
P7: Service System Option = 0 (i.e., no service system parameters are included in the model)

The following paragraphs describe the demographic data input to the PARAM program. As in the previous chapter, the data are presented demographic-category-by-demographic-category, rather than race-by-race (the order requested by the PARAM program.)

Total Fertility Rates; Fertility Age Distributions

Total Fertility Rates are not available by Hispanic status for Arizona from published state vital statistics sources, and they are not available by state in VS78. Hence, the TFRs will be estimated, using the formula

TFR = .005*CBR*POPT/BFAC

given earlier. In order to use this formula, data are required, by Hispanic status, for crude birth rates for the base year, for the total population in the base year, for the fertility age distribution, and for the female populations in the child-bearing age categories.

The required population data are available from CPAZ80 (Table 16, "Total Persons and Spanish Origin Persons by Type of Spanish Origin and Race: 1980"). The total populations for 1980 for the two races of the model are 440,701 for Hispanics and 2,277,514 for others.

The crude birth rates for 1980 are estimated from data on births presented in VSAZ80. For 1980, Table 2.12 reports 13,082 Hispanic

births out of a total of 50,049 births, implying (by subtraction) that there are 36,967 in the other (nonHispanic) category. Dividing these figures by the respective populations produces the crude birth rate of 29.7 for Hispanics and 16.2 for others (nonHispanics).

The remaining data required by the TFR estimation formula are the fertility age distributions and the populations of females in the fertile age categories.

For the fertility age distributions, the national-level data presented in VS78 will be used (no state-level FAD data are available from VSAZ80). These data are available for total, white, all other, and black races. The total fertility rates for these four categories are 1.799, 1.708, 2.312, and 2.284, respectively. Data are not available by Hispanic status. Hispanic persons may be of any race. Since the Hispanic group has a very high birth rate, its fertility rate is high. Groups having high fertility rates typically have a FAD that has larger probabilities in the lower-age categories, such as the "all other" and "black" FADs. This suggests using either the "all other" or "black" FADs for the Hispanic category.

With respect to the "other" (nonHispanic) category of the model, it is observed that it is heavily white, since the combined size of the other racial groups (Indians, blacks, etc.) is small. This suggests using the "white" FAD for the nonHispanic category.

In view of the preceding considerations, we shall use the "all other" FAD for the Hispanic category and the "white" FAD for the nonHispanic category of the model.

The FAD data for these categories were presented earlier, in the chapter on the US two-race model, and are repeated here.

Age of Mother	Fertility Age Distribution	
	Hispanic	Other(NonHispanic)
15-19	.221	.147
20-24	.312	.312
25-29	.251	.312
30-34	.143	.166
35-39	.058	.052
40-44	.015	.011
Total	1.000	1.000

The final data required are the numbers of females in the fertile age cohorts. These counts are available from Table 45 of CPAZ80 ("Age by Race, Spanish Origin, and Sex for Counties: 1980"). The data in this table are presented county by county, and must be totalled to obtain the total populations for all counties. The complete population distributions are presented later.

Age	Female Population	
	Hispanic	Other (NonHispanic)
15-19	24,824	98,910
20-24	22,734	107,563

25-29	19,195	97,716
30-34	15,780	87,129
35-39	12,241	70,299
40-44	10,217	58,062

With the preceding data, the TFR estimates may now be calculated for the two race categories.

For Hispanics, we have:

BFAC = .221(24,824) + .312(22,734) + .251(19,195)
+ .143(15,780) + .058(12,241) + .015(10,217)

= 20,516.83

and

TFR = .005*29.7*440,701/20,516.83 = 3.190.

For others (nonHispanics), we have:

BFAC = .147(98,910) + .312(107,563) + .312(97,716)
+ .166(87,129) + .052(70,299) + .011(58,062)

= 97,344.462

and

TFR = .005*16.2*2,277,514/97,344.462 = 1.895.

Infant Mortality Rates

Infant Mortality Rates are available from VS78 by state, but not by Hispanic status. VSAZ80 presents data on births by Hispanic status, but not infant deaths by Hispanic status. Infant deaths are reported for the categories all races, white, and nonwhite. Rather than make somewhat tenuous assumptions about which of these categories might approximate the IMR experience of Hispanics, we shall simply use the overall IMR for both Hispanics and nonHispanics. For 1980 the birth data are 50,049 total births, and the infant death data are 619. Dividing these numbers yields the rate 12.4.

Base-Year Population by Age, Sex, and Hispanic Status

Base-year population data by age, sex, and Hispanic status are presented in CPAZ80 (Table 45, "Age by Race, Spanish Origin, and Sex for Counties: 1980"). Summing over the counties produces the following population distribution by age, sex, and Hispanic status for the state.

	Hispanic		Other(NonHispanic)	
Category	Male	Female	Male	Female
0-4	27,940	26,823	81,135	77,985
5-9	25,652	25,079	81,998	78,338

10-14	24,234	23,538	87,349	84,452
15-19	26,081	24,824	102,202	98,910
20-24	23,080	22,734	110,406	107,563
25-29	20,171	19,195	98,969	97,716
30-34	15,889	15,780	88,966	87,129
35-39	11,668	12,241	68,665	70,299
40-44	9,644	10,217	57,192	58,062
45-49	8,380	9,015	53,158	54,518
50-54	7,608	8,290	52,687	58,164
55-59	6,317	6,759	54,838	64,593
60-64	4,672	5,073	53,010	61,645
65-69	3,525	3,986	49,484	57,849
70-74	2,545	2,938	37,322	44,471
75+	2,840	3,963	40,315	58,124
Sex Tot.	220,246	220,445	1,117,696	1,159,818
Race Totals	440,701		2,277,514	
Grand Total		2,718,215		

Crude Birth Rate for Base Year

As discussed earlier, we shall use the birth data available in VSAZ80 to calculate the crude birth rate of 29.7 for Hispanics and 16.2 for others (nonHispanics).

Crude Death Rate for Base Year

Data on deaths by Hispanic status are not available from any of the referenced sources. VSAZ80 reports the death rate for all persons in Arizona (based on a total of 21,226 deaths) as 7.8. This number will be used for both Hispanics and nonHispanics.

Infant Mortality Rate for the Base Year

As discussed earlier, we shall use the single IMR, 12.4, for both Hispanics and nonHispanics.

Population Ten Years Prior to Base Year

As discussed in the introduction to this chapter, data are not available on Hispanic status of the Arizona population for the year 1970, and the hypothetical numbers 282,293 and 1,488,607 will be used in place of the actual number of Hispanics and nonHispanics. This number does not affect the projections, but it does affect the population growth estimates produced by the CHECK program.

Average Crude Birth Rate for the Ten-Year Period Prior to Base Year

In lieu of better estimates, the base-year crude birth rate estimates of 29.7 and 16.2 will be used.

Average Crude Death Rate for the Ten-Year Period Prior to Base Year

The base-year crude death rate of 7.8 will be used for both Hispanic and nonHispanic statuses, in lieu of better estimates.

Average Infant Mortality Rate for the Ten-Year Period Prior to Base Year

For the same reason given above, the base-year data presented above will be used (12.4 for both Hispanics and nonHispanics).

External Migration

As before, external migration will be estimated as the population change net of births and deaths. Using this procedure, the estimates of net external migration are 8,159 per year for Hispanics and 63,450 for nonHispanics. (Note that the total of these estimates, 71,609, is close to the net external migration estimate of 71,507 obtained for the combined-race model.

Base-Year Population by Region (County)

CPAZ80 presents the Hispanic population of each county, by Hispanic status (Table 16, "Total Persons and Spanish Origin Persons by Type of Spanish Origin and Race: 1980"). The data are presented in the table which follows:

	Population by Hispanic Status (1980)		
County	Hispanic	Other (NonHispanic)	Total
Apache	1,983	50,125	52,108
Cochise	22,846	62,840	85,686
Coconino	7,315	67,693	75,008
Gila	7,723	29,357	37,080
Graham	5,457	17,405	22,862
Greenlee	5,446	5,960	11,406
Maricopa	199,003	1,310,049	1,509,052
Mohave	2,148	53,717	55,865
Navajo	4,538	63,091	67,629
Pima	111,418	420,025	531,443
Pinal	26,752	64,166	90,918
Santa Cruz	15,229	5,230	20,459
Yavapai	4,205	63,940	68,145
Yuma	26,638	63,916	90,554
Total	440,701	2,277,514	2,718,215

Regional Populations Ten Years Prior to Base Year

As mentioned earlier, county-by-race data were not collected until the 1980 Census, and so such data are not available for the year (1970) ten years prior to the base year of this example. We shall estimate the 1970 county populations by race by apportioning the 1970 population of each county between the races in the same proportion as existed in 1980. The result of this procedure is shown in the following table. The populations under the column labeled "Total" are known (not estimated). The other two populations in each row are estimated. This is a rough estimate, since the fertility rates for Hispanics and nonHispanics are believed to be substantially different. A more elaborate procedure could be used to obtain better

estimates, but these estimates are quite adequate for illustration purposes.

Population by Hispanic Status (Estimated, 1970)

County	Hispanic	Other (NonHispanic)	Total
Apache	1,229	31,069	32,298
Cochise	16,507	45,403	61,910
Coconino	4,713	43,613	48,326
Gila	6,093	23,162	29,255
Graham	3,957	12,621	16,578
Greenlee	4,932	5,398	10,330
Maricopa	127,590	839,932	967,522
Mohave	994	24,863	25,857
Navajo	3,202	44,513	47,715
Pima	73,728	277,939	351,667
Pinal	19,984	47,932	67,916
Santa Cruz	10,396	3,570	13,966
Yavapai	2,267	34,466	36,733
Yuma	17,893	42,934	60,827
Total	293,485	1,477,415	1,770,900

Internal Migration

As before, internal migration is estimated as the population change net of births and deaths and proportional allocation of external migration to the regions. The following table presents the results of this estimation (using the formulas for the rate, n, and the amount, N). The rate is per 1,000 people. As noted before, there is no need to compute any of the internal migration parameter estimates (table entries) by hand, since the CHECK program computes them and displays them.

Internal Migration Amounts and Rates

	Hispanic		NonHispanic	
County	Amount	Rate	Amount	Rate
Apache	10.	6.697	151.	3.852
Cochise	-145.	-7.581	-486.	-9.138
Coconino	18.	3.079	31.	.579
Gila	-107.	-15.731	-431.	-16.613
Graham	-36.	-7.913	-139.	-9.445
Greenlee	-147.	-28.458	-160.	-28.348
Maricopa	555.	3.535	1035.	.991
Mohave	49.	34.036	1045.	28.402
Navajo	-20.	-5.378	-375.	-7.120
Pima	53.	.593	-573.	-1.684
Pinal	-244.	-10.672	-660.	-11.968
Santa Cruz	-29.	-2.304	-19.	-4.317
Yavapai	60.	19.723	734.	15.632
Yuma	-17.	-.801	-154.	-2.955
Total	0		0	

As usual, the rate is used if it is negative and the amount is used if it is positive.

This completes the data specification for the construction of the file AZ80HC.DAT.

C. Results of CHECK Run

The output of a CHECK run of the file AZ80HC.DAT is shown in Listing 9. The printout reveals no errors in the data entry.
The run shows that the manual computations of the Total Fertility Rates (3.190 and 1.895) were correct.

D. Results of PROJ Run

Listing 10 illustrates a run of the PROJ program, which projects the population two five-year periods out, from the base year of 1980 to the year of 1990. Since the input population data are disaggregated by age, sex, race, and region, the projections may be also. The total projected population for 1990 is 3,702,132, which corresponds to the actual value for 1990 of 3,665,000 (SA92, Table No. 25, "Resident Population -- States: 1970 to 1991"). This is an error of approximately 1%.

Note that the 1990 total-population projection of this model differs slightly from the 1990 total-population projection of the single-race model for Arizona presented earlier (3,694,625). It is not quite as accurate, probably a result of the difficulty in estimating net migration by race.

The projections for 1990 by race are 647,662 for Hispanics and 3,054,470 for nonHispanics. These may be compared to the actual 1990 figures available from the 1990 Census (1990 Census of Population, General Population Characteristics, United States, 1990 CP-1-1, issued November, 1992, US Department of Commerce, Bureau of the Census, Washington, DC (henceforth referred to as CP90), Table 262, "Age and Sex by Race and Hispanic Origin: 1990"): 3,665,228 total, 688,388 for Hispanics, and (by subtraction) 2,976,840 for nonHispanics. The errors in these race-by-race projections are -5.9% for Hispanics and 2.6% for others. These results are displayed in the following table.

Ethnic Group	1990 Projected Population	1990 Actual Population	Percentage Error
Hispanic	647,662	688,388	-5.9
Other (nonHisp.)	3,054,470	2,976,840	2.6
Total	3,702,132	3,665,228	1.0

The projections for 1990 by county and Hispanic status may be compared to the 1990 actual values, available from the County and City Data Book, 1994, US Department of Commerce, Bureau of the Census, Washington, DC. The following table compares the 1990 county projections and the 1990 actual values.

Hispanic Population

County	1990 Projected Population	1990 Actual Population	Percentage Error
Apache	2,867	2,599	10.3
Cochise	29,228	28,379	3.0
Coconino	10,332	9,696	6.6
Gila	9,098	7,486	21.5
Graham	6,958	6,682	4.1
Greenlee	5,633	3,456	63.0
La Paz	*	3,139	*
Maricopa	281,931	345,498	-18.4
Mohave	3,602	4,919	-26.8
Navajo	5,936	5,652	5.0
Pima	153,500	163,262	-6.0
Pinal	33,174	34,062	-2.6
Santa Cruz	20,544	23,221	-11.5
Yavapai	6,584	6,899	-4.6
Yuma	36,480	43,388	-21.6*
Total	647,662	668,338	-5.9

No projection is available for La Paz County, since that county was created in 1983, and was not included in the model. Since that county was created from Yuma County, the sum of the 1990 actual populations for La Paz and Yuma Counties (46,527) should be compared to the projection for Yuma County (36,480). The error in this projection is -21.6%.

The mean absolute deviation of the relative projection errors for the race-by-county Hispanic population projections is 14.6%. As might be expected, the relative (percentage) error is largest for counties having small Hispanic populations. For ten-year-out regional projections of a small minority in a state whose population is changing very rapidly, the accuracy of the projections is considered, overall, quite good.

NonHispanic Population

County	1990 Projected Population	1990 Actual Population	Percentage Error
Apache	62,147	58,992	5.3
Cochise	69,032	69,245	-.3
Coconino	81,880	86,895	-5.8
Gila	29,898	32,730	-8.7
Graham	19,061	19,872	-4.1
Greenlee	5,383	4,552	18.3
La Paz	*	10,705	*
Maricopa	1,589,762	1,776,603	-10.5
Mohave	77,062	88,578	-13.0

Navajo	70,732	72,006	-1.8
Pima	497,322	503,618	-1.3
Pinal	68,501	82,317	-16.8
Santa Cruz	6,031	6,455	-6.6
Yavapai	85,688	100,815	-15.0
Yuma	74,720	63,507	.7*
Total	3,054,470	2,976,890	2.6

No projection is available for La Paz County, since that county was created in 1983, and was not included in the model. Since that county was created from Yuma County, the sum of the 1990 actual populations for La Paz and Yuma Counties (74,212) should be compared to the projection for Yuma County (74,720). The error in this projection is 2.6%.

The mean absolute deviation of the projection errors for the ten-year-out race-by-county projections for the nonHispanic population is 7.3%. This level of accuracy for regional projections of a particular ethnic group is quite good.

Both the Hispanic and nonHispanic results show that the relative error of a ten-year-out projection can be substantial for counties having small respective populations. As mentioned earlier, the relative projection error may be reduced by combining counties having very small populations (of a particular race).

XI. Example 6: Rehabilitation Services, Projection of the Work-Disabled

A. Projection Objectives; Model Structural Parameters

This chapter illustrates a typical use of the DESTINY program -- the estimation of a target population, based on available incidence or prevalence data. This example illustrates the application of the technique of "synthetic estimation," by which national incidence/prevalence rates by demographic category are used to construct state estimates. This procedure assumes, of course, that the national rates do in fact apply to the state.

In order to use the DESTINY system, it is necessary to enter data on the incidences or prevalences of conditions of interest. In some cases, such data are available directly from published sources, but in many cases the available data are not in the exact form required for input to the program, and some additional processing or assumptions are required to obtain data in the exact form needed. The examples presented in this and the following chapters will illustrate in detail the way in which the required data may be obtained from available data.

Service-system data may be specified to the program in varying levels of detail, ranging from values (means or proportions) for the entire population to rates by age, sex, race, and region. The level of detail used for the data entry should match, whenever possible, the level of detail desired for the output. For example, if it is desired to make projections of the number of persons with a work disability by age, then the prevalence of persons with a work disability should, if possible, be specified by age. If it is desired to make projections by race, then the prevalences should be specified by race (unless it can be shown or safely assumed that the prevalences do not vary much by race).

The example of this and the next several chapters will illustrate the use of the DESTINY system to project the number of persons with having various conditions for the state of Arizona, and the services, resources, and costs associated with these "target" populations. These examples will use the three-race, 14-region population data base (parameter file) that was presented earlier. The PARAM program is used to derive the data base for these examples from the AZ803C.DAT data base presented earlier. When the program requests

```
     ENTER NAME OF OLD PARAMETER FILE (12X):
```

the user enters AZ803C.DAT, and when the program requests

```
     ENTER NAME OF NEW PARAMETER FILE (12X):
```

the user enters, for example, AZ803CD.DAT ("D" for "work disabled").

From this point on, the program prints out sections of the AZ803C.DAT parameter file, requesting the user to accept the original values or to modify them.

The first change to the data base is to change the value of the Input Option parameter P7 to reflect the fact that a "service system" will be included in the model:

> P7: Service System Option = 1 (i.e., service system parameters are included in the model)

The program prints out all of the input option parameters, and requests:

> ENTER 1 TO CHANGE PRECEDING PARAMETERS, 0 TO LEAVE AS IS:

The user enters a 1 and reenters the values as before, except for the Service System Option parameter, for which the value is changed from a 0 to a 1. From this point on, the user accepts all of the original file parameters, since the demographic specification is exactly as before. When the demographic-parameter section of the program is finished, the program requests entry of the target-population and/or service-system parameters.

As discussed earlier, service system data include data on target populations, service populations, services, resources, and costs. The example of the present chapter will include just target population data, but the examples of later chapters will include more elaborate service-system specifications.

In some cases, service-system data may be available for the same political unit of the population data base (in these examples, Arizona). In many cases, however, it will be necessary to use national-level data as a proxy for the state data.

The present example will estimate the numbers of persons with work disabilities. There are two target populations: persons with severe work disabilities and persons with partial work disabilities. The target population and service-system parameter values to be specified to the PARAM program are as follows:

> No. of target populations = 2 (i.e, severely work-disabled and partially work-disabled)
> Service Population Option = 0 (i.e., no service-system data will be included in the model)
> Names of target populations: WRKDISSV, WRKDISPT .

B. Data

Information about work disabilities is presented in SA81, Table 555, "Persons with Work Disability, by Selected Characteristics: 1978." A portion of this table is presented below. In this example, it is

assumed that the national data on the prevalence of work disabilities may be used as a proxy for the state prevalences.

Characteristic	Persons with Work Disability (percent) Severely	Partially
18-24 years old	2.2	4.0
25-34 years old	3.0	7.2
35-44 years old	6.5	8.5
45-54 years old	11.3	12.8
55-64 years old	24.9	12.1

There are two problems with the available data, from the point of view of data entry to the DESTINY system. First, the data are relative to the civilian noninstitutionalized population and members of Armed Forces living off post or with their families on post. The population included in the three-race, 14-region AZ803C.DAT data base are resident population. The total resident population of the US in 1980 was 226,505,000, and the total civilian noninstitutionalized population was 220,208,000 (227,020,000 total population (Table 30 SA81) less 2,051,000 military population (Table 602 SA81) less 5,786,000 population in institutions and other group quarters (1970 est., Table 77 SA81) + 1,025,000 in military barracks already subtracted (Table 77 SA81) = = . Since the population data in the data base are resident population, all incidences and prevalences must be expressed relative to that population. The percentages presented in the above table will be converted to percentages of the resident population by multiplying by the factor 220,208,000/226,505,000 = .972199. Multiplying by this factor produces the following table. (Had data on the civilian noninsitutionalized population of Arizona in 1980 been available, this adjustment factor would have been obtained from the state, rather than the national, populations.)

Characteristic	Persons with Work Disability (percent) Severely	Partially
18-24 years old	2.1	3.9
25-34 years old	2.9	7.0
35-44 years old	6.3	8.3
45-54 years old	11.0	12.4
55-64 years old	24.2	11.8

The second problem with the available data is that they do not match the five-year age categories of the DESTINY program (0-4, 5-9, 10-14, 15-19, 20-24, etc.). The rates for the desired age categories are obtained by assuming the rate specified in the preceding table for each individual age category, and averaging. For example, the severely-disabled rate for the age category 15-19 is estimated as:

(0 (for age 15) + 0 (for age 16) + 0 (for age 17)
+ 2.1 (for age 18) + 2.1 (for age 19))/5

= .84 .

Applying this process produces the following table, which includes prevalences for all of the age categories used by the DESTINY program. Values of zero are used for ages below 14 and above 65. In this table, the percentages have been converted to fractions, since it is fractional rates, not percentage rates, that are entered into the PARAM program.

Age	Persons with Work Disability (percent) Severely	Partially
0-4	0	0
5-9	0	0
10-14	0	0
15-19	.0084	.0156
20-24	.021	.039
25-29	.029	.070
30-34	.029	.070
35-39	.063	.083
40-44	.063	.083
45-49	.110	.124
50-54	.110	.124
55-59	.242	.118
60-64	.242	.118
65-69	0	0
70-74	0	0
75+	0	0

Although the prevalence data are now available by the age categories used by the DESTINY system, they cannot be entered in the same format as above. As discussed, the PARAM program accepts at most nine different incidence or prevalence values (per condition). Up to nine values are specified, and the index of one of these values is specified for each cell of a stratification table.

In the present case, the data are available by age category, so the age stratification table is used. The program presents the following prompt:

```
THE FOLLOWING TYPES OF STRATIFICATION ARE AVAILABLE:
    1: NONE
    2: AGE
    3: SEX
    4: RACE
    5: AGE X SEX
    6: AGE X RACE
    7: SEX X RACE
    8: AGE X SEX X RACE
    9: REGION
    10: REGION X RACE
ENTER TYPE OF STRATIFICATION (1-10): ,
```

to which the user enters a 2 (for stratification by age). The program then requests:

```
ENTER 9 INCIDENCE/PREVALENCE RATE(S) (8X.XXXXXXXX): .
```

For the partial disability condition, there are seven different values entered in the preceding table -- 0, .0084, .021, .029, .063, .110, and .242. A total of nine different values must be entered, so the user responds:

```
0., .0084, .021, .029, .063, .110, .242, 0., 0. .
```

Next, it is necessary to specify which of these seven stratum values is used by each of the 17 age categories. This is done by specifying the stratum index for each of the 17 age categories. These are as follows:

Age	Stratum Index
0-4	1 (corresponding to the value 0)
5-9	1
10-14	1
15-19	2 (corresponding to the value .0084)
20-24	3 (i.e., the value .021)
25-29	4 (i.e., the value .029)
30-34	4 (i.e., the value .029)
35-39	5 (i.e., the value .063)
40-44	5 (i.e., the value .063)
45-49	6 (i.e., the value .110)
50-54	6
55-59	7
60-64	7
65-70	1
70-74	1
75+	1

The program requests:

```
ENTER 16 INDICES (1 FOR EACH AGE COHORT) EACH OF VALUE 1-9
     (16X): .
```

to which the user responds:

```
1112344556677111 .
```

Similarly, for the partial work disability, the user specifies the stratification type as 2, the nine incidence/prevalence rates as 0, .0156, .039, .070, .083, .124, .118, 0., 0., and the nine stratification indices as 1112344556677111.

The forms of Appendix B may be used to record the stratification values and indices, prior to data entry.

The CHECK program may be run to display or print the entered service-system data, so that it may be reviewed for correctness. Listing 11 presents the CHECK run for this example.

C. Projection Results

Listing 12 presents a projection of the work-disabled population to the year 1990. The projection is disaggregated by age. The base-year work-disabled population is also printed out.

In the printout, the acronym WRKDISSV stands for "Severely Work-Disabled," and the acronym WRKDISPT stands for "Partially Work-Disabled."

XII. Example 7: Education, Projection of School Enrollment

A. Projection Objectives; Model Structural Parameters

This example is similar to the previous one, since it deals with the estimation of a specific target population -- in this case, those enrolled in schools. This example carries the estimation process a little further, in also estimating the number of elementary and secondary school teachers. The number of teachers is estimated for 0-18 year olds, assuming a student/teacher ratio of 20. The total salary cost of the teachers is also estimated, assuming an average salary of $17,200 per year.

As in the previous example, the PARAM program is executed to develop a new parameter file from the AZ803C.DAT population data file. The new file is called AZ803CE.DAT ("E" for education). The Input Option parameter values are the same as in the previous example, i.e., Service-System Option = 1.

The target population in this example is all students, and the served population is all students in elementary and secondary schools. The service is teaching, the resource is teachers, and the cost is the dollar cost of the teachers' salaries.

The target population and service-system parameter values to be specified to the PARAM program are as follows:

No. of target populations = 1 (i.e, school students)
Service Population Option = 2 (i.e., service-system data will be included in the model, and the service population is taken to be some subset of the target population)
No. of services = 1 (teaching)
No. of resources = 1 (teachers)
No. of cost categories = 1 (salaries)

The names entered for the various model variables are as follows:

Name of target population: STUDENTS

Name of service population: ELEM/SEC

Name of service: TEACHING

Name of resource: TEACHERS

Name of cost category: SALARIES .

The amount service provided to each served person is one "unit" of teaching. As mentioned, the projection will be done assuming a student/teacher ratio of 20, so that the amount of resources

(teachers) expended per student served is .05. For the projection, an average teacher salary of $17,200 will be assumed.

The preceding data are entered in response to the various program requests. At this point, the structure of the target population and service system has been specified. What remains is to specify the incidence/prevalence data for the target population and the service ratios that specify what proportion of the target population is served.

B. Data

Table No. 225 of SA81, "School Enrollment and Rate, by Age, Sex, and Race: 1960 to 1980," provides data on the proportions of the noninstitutional civilian population that are enrolled in school. It is assumed that the state enrollment rates are similar to the national rates. The enrollment rates do not vary much by sex or race, so the prevalence of students will be specified only by age. The following table, which is extracted from the previous table, presents enrollment rates by age for 1980. As was done in the preceding example, the rates are adjusted by the factor .972199 to convert to the rates to proportions of the resident population.

	Enrollment Rate	
Age	Noninst Civ Pop Base	Res Pop Base
3-4	.367	.357
5-6	.957	.930
7-13	.993	.965
14-15	.982	.955
16-17	.890	.865
18-19	.464	.451
20-21	.310	.301
22-24	.163	.158
25-29	.093	.090
30-34	.064	.062

The age categories used in this table do not correspond to the age categories used in the DESTINY model. The estimates for the DESTINY age categories will be estimated by the same procedure used in the preceding example, viz., by assuming the rates specified in the preceding table for individual years and averaging over five-year intervals. For example, the rate for the 0-4 age category is:

(0 (for age 0) + 0 (for age 1) + 0 (for age 2)
+ .357 (for age 3) + .357 (for age 4))/5 = .143 .

Application of this procedure results in the following table:

Age	Enrollment Rate
0-4	.143
5-9	.952
10-14	.963

15-19	.717
20-24	.215
25-29	.090
30-34	.062
35-39	0
40-44	0
45-49	0
50-54	0
55-59	0
60-64	0
65-69	0
70-75	0
75+	0

These prevalences are stratified by age, and so, as in the preceding example, they will be specified to the model using stratification by age. The nine stratum values are .143, .953, .965, .717, .216, .090, .060, 0.0, and 0.0, and the 16 stratum indices are 1234567888888888.

The next items to be specified are the service ratios -- the proportion of the target population that is served, by age category. In this example we are interested in the students in elementary and secondary schools. It will be assumed that these are all of the students aged 0-18. Under this assumption the service ratios are 1.0 for the first three age categories, .874 for the fourth age category, and zero for all later age categories. The number .874 (for ages 15-19) is obtained as:

(.955+.865+.865+.451+0)/(.955+.865+.865+.451+.451)

= .874 .

This computation is based on the assumption that the numbers of students in each age category (of the cohort 15-19) are identical, all students through age 18 are served, and no students aged 19 are served.

Age	Service Ratio
0-4	1.0 (i.e., all are served)
5-9	1.0
10-14	1.0
15-19	.874
20-24	0
25-29	0
30-34	0
35-39	0
40-44	0
45-49	0
50-54	0
55-59	0
60-64	0
65-69	0
70-75	0
75+	0

These prevalences are stratified by age. The nine age-stratum values are 1.0, .874, and seven zeros. The 16 age-stratum indices are 1112333333333333.

Listing 13 presents the CHECK run for this example.

C. Projection Results

Listing 14 presents a projection of the elementary and secondary school student population by age and region. The projection also shows the projected number of teachers and salaries by region.

In the printout, the acronym ELEM/SEC stands for "Elementary and Secondary School Students." Also, in the distribution of teachers and teachers' salaries by age, "age" refers to age of students.

XIII. Example 8: Criminal Justice, Projection of Prison Admissions and Operating Cost

A. Projection Objectives; Model Structural Parameters

This example illustrates the use of DESTINY to project prison admissions and operating cost.

As in the previous examples, the PARAM program is executed to develop a new parameter file from the AZ803C.DAT population data file. The new file is named AZ803CP.DAT ("P" for prison population). The Input Option parameter values are the same as in the previous example, i.e., Service-System Option = 1.

The approach taken in this example will be somewhat unusual, in that the target population will be taken to be prison admissions, rather than prison inmates. The size of the target population will hence be specified in terms of incidences (admissions per capita per year), instead of prevalences (inmate population as a proportion of the resident population). Furthermore, the system will be used to estimate the expected cost of care until the earliest possible release date associated with the admissions of each year, rather than the annual cost of care. The reason for this approach is that the average time served to parole eligibility is increasing, and it is desired to project the contingent liability associated with incarceration.

In this example, the service population will be the sentence-years associated with the admissions. The service will be incarceration, the resource will be cells, and the cost will be operating cost per cell. The reason for defining the service population as sentence-years rather than admissions (i.e., identical to the target population) is that sentences vary substantially by sex, but the service, resource, and cost parameters do not vary (in the DESTINY model) by the demographic features of the person served. It is necessary to reflect dependencies on demographic characteristics either in the target population incidences/prevalences or the service population service ratios.

The target population and service-system parameter values to be specified to the PARAM program are as follows:

> No. of target populations = 1 (i.e, prison admissions)
> Service Population Option = 2 (i.e., service-system data will be included in the model, and the service population will be proportional to the target population)
> No. of services = 1 (incarceration)
> No. of resources = 1 (cell)
> No. of cost categories = 1 (operating cost per cell)

The names entered for the various model variables are as follows:

Name of target population: ADMIS'NS

Name of service population: SENTYR

Name of service: INCARC'N

Name of resource: CELL

Name of cost category: OP COST .

The service provided to each service population unit (a sentence-year) is a one-year incarceration. For each one-year incarceration, the resource expended is a prison cell (for one year). For each cell, the cost will be taken as $16,000 (for one year).

The preceding data are entered in response to the various program requests. At this point, the structure of the target population and service system has been specified. What remains is to specify the incidence/prevalence data for the target population and the service ratios that specify the served population as a proportion of the target population.

B. Data

The data for this example were obtained from the Arizona Department of Corrections. The $16,000 figure cited earlier was the approximate per-inmate operating cost in 1980 (source: Arizona Department of Corrections Information Office).

The following data are available from Arizona Correctional Statistics, 1980. The average time to serve to parole eligibility in 1979 was 35.8 months for men (sample size 1,338) and 27.7 months for women (sample size 741). In 1979, the number of admissions, by age and sex, was as follows:

Age	Adult Admissions Male	Female
15-19	254	25
20-24	560	25
25-29	345	28
30-34	224	17
35-39	104	8
40-44	55	4
45-49	43	4
50-54	36	2
55-59	16	1
60+	13	0
Total	1,652	114

Dividing these numbers by the Arizona resident population in each age category produces the following table of admissions rates. (For example, 254/128,283 = .00198, and 25/123,734 = .00020.)

Age	Admission Rate Male	Female
15-19	.0020	.00020
20-24	.0042	.00019
25-29	.0029	.00024
30-34	.0021	.00016
35-39	.0013	.00010
40-44	.00082	.00006
45-49	.00070	.00006
50-54	.00060	.00003
55-59	.00026	.00001
60+	.00007	0

These data are stratified by age and sex, and so the age-by-sex stratification option will be used to enter them into the PARAM program. At most nine stratification values are allowed. These values will be taken as 0., .002, .004, .003, .001, .0003, .00007, .0002, and .00002. The index values are 1112342555567777 for males and 1118888777991111 for females. Note that there are more than nine different values in the incidence table, but that a maximum of nine different stratum values is allowed. In this case, an approximation is made, and the actual incidences are represented by nearby values. This approximation will have little effect on the overall estimate of admissions, but projections should not be made by age and sex jointly (since individual cell incidences are not correct for some of the smaller cells).

Service ratios (the number of sentence-years per admission) will be computed from the average number of months to parole eligibility. For men, this average is 35.8, corresponding to 3.0 years. For females, the average is 27.7, corresponding to 2.3 years. These service ratios are stratified by sex, and so the stratification-by-sex data entry option will be used. The stratum values are 3.0 (male) and 2.3 (female).

Listing 15 presents the CHECK run for this example.

C. Projection Results

Listing 16 presents a projection of admissions and obligated cost associated with the admissions. Recall that the term "cost" in this example is the total sentence-long operating cost associated with (obligated by) the admissions of a particular year, not just the expense during that year. (To estimate the expense for particular years, the model should be respecified with inmates as the target population and service population, instead of admissions as the target population and sentence-years as the service population.)

In the printout, the acronym ADMIS'NS denotes "admissions," SENTYR denotes "sentence-years," CELL denotes "prison cell," and OP COST denotes the cost of care for inmates (exclusive of capital costs).

In an actual policy analysis, a number of runs similar to the example would be required. For example, to determine the effect of sentencing only violent criminals to prison, and at different sentence lengths from current practice, a run would be required which included not just one but several inmate ("target") populations, each representing a different level of violence and past behavior.

XIV. Example 9: Health Care, Projection of the Need for Short-term and Long-term Beds

A. Projection Objectives; Model Structural Parameters

This example illustrates the projection (by year) of bed needs for short-term care (less than 30 days) and for long-term care (30 days or more). This example illustrates the application of DESTINY to estimate four different target populations simultaneously.

The PARAM program is run to construct a new parameter file from the AZ803C.DAT file. The new file is called AZ803CH.DAT ("H" for health). In this example, there will be four target populations but no service population. The four target populations are short-term-stay hospital beds, nursing-home beds, psychiatric-hospital beds, and mental-hospital beds.

The target population and service-system parameter values to be specified to the PARAM program are as follows:

> No. of target populations = 4 (i.e, four bed types)
> Service Population Option = 0 (i.e., no service-system data will be included in the model)

The names entered for the various model variables are as follows:

> Names of target population: ST BEDS, NH BEDS, PSY BEDS, and MH BEDS

The preceding data are entered in response to the various program requests. The incidence/prevalence data for the target populations will now be specified.

B. Data

The need for beds will be measured by applying the national number of short-term-stay beds per 100,000 population to the Arizona population, and applying the national proportions of the population in long-term-care institutions to the Arizona population.

Data on short-term-stay beds are found in Table 179 of SA81, "Hospital Utilization Rates, by Sex and Age of Patient: 1965 to 1979." The rates are relative to the total civilian noninstitutional population; as before, they are converted to the resident population base by multiplying by .972199

	Beds/100,000	
Age	Civ noninst pop	Res pop
Under 1	360	350.0

1-4	93	90.4
5-14	58	56.4
15-24	180	175.0
25-34	249	242.1
35-44	262	254.7
45-64	440	427.8
65+	1,146	1,114.1

The rate for the 0-4 age category is estimated as .2(350) + .8(90.4) = 142.3. Using the stratification-by-age option for data entry, the nine age stratum values are (dividing by 100,000) .00142, .00056, .00175, .00242, .00255, .00428, .01114, 0. and 0., and the 16 stratification indices are 1223344556666777.

Data for long-term-stay beds are found in Table 182 SA81, "Long-Term Care Institutions -- Summary: 1976," a portion of which is shown below:

	Number of Residents (US, 1976)		
Age	Nursing Home	Psychiatric	Mentally Handicapped
0-17	9,000	28,000	56,000
18-64	154,000	32,000	125,000
65+	989,000	5,000	6,000

Additional data for nursing homes are found in Table 184 SA81, "Nursing and Personal Care Homes -- Selected Characteristics of Homes and Residents, and Primary Sources of Payment: 1964-1977," a portion of which is shown below (excluding personal care homes without nursing):

	Number of Residents (US, 1973-74)	
Age	Male	Female
Under 65	52,000	62,000
65-74	65,000	98,000
75-84	102,000	283,000
85+	98,000	315,000

From Table 30 SA81, the total population in the various age categories of the preceding tables may be determined. The proportion male is taken from the Coale-Demeny model life table for the US for life expectancy 74 years. The 1974 and 1976 populations are obtained by multiplying the 1980 populations by the ratios of the 1974 and 1976 populations (213,342,000 and 217,563,000, from Table 8 SA81) to the 1980 population (226,505,000). The populations of the table are in millions. The vertical bars above and below the entry 24.49 indicates that that value includes the populations for the preceding and following age categories.

	Total				Est 1974 Res Pop		
	1980	Prop					Est 1976
Age	Pop	Male	Male	Female	Male	Female	Res Pop
0-17	63.7	.508	32.4	31.3	30.52	29.48	61.18
18-64	137.7	.49	67.5	70.2	63.58	66.12	132.26
65-69	8.8	.43	3.78	5.02	3.56	4.73	|

70-74	6.8	.41	2.79	4.01	2.63	3.78	24.49
75+	9.9	.34	3.37	6.53	3.17	6.15	|
	226.9		226.9		213.72		217.94

Dividing the populations into the numbers of residents produces the following results.

Proportion of Population in Indicated Facility, 1976

Age	Nursing Home	Psychiatric	Mentally Handicapped
0-17	.00015	.00046	.00092
18-64	.00117	.00024	.00095
65+	.0404	.00020	.00024

Proportion of Population in Nursing Homes, 1974

Age	Male	Female
0-64	.00055	.00065
65-74	.0105	.0115
75+	.063	.097

Combining the preceding results for nursing homes produces the following table:

Proportion of Population in Nursing Homes, 1974 and 1976

Age	Male	Female
0-17	.00015	.00015
18-64	.0012	.0012
65-74	.011	.012
75+	.063	.097

Residents of nursing homes, psychiatric, and mentally handicapped facilities will be used as a proxy for beds.

The prevalence data for nursing home beds are stratified by age and sex, and so they will be entered using the corresponding option. The nine stratum values are .00015, .0012, .011, .063, .00015, .0012, .012, .097, and 0. The 16 stratification indices for males are 1111222222222334, and the indices for females are 1111222222222556.

The prevalence data for psychiatric facility beds are stratified by age. The nine stratification values are .00046, .00024, .00020, and six zeros. The stratification indices are 1111222222222333.

The prevalence data for mentally handicapped facilities are also stratified by age. The stratification values are .00092, .00095, .00024, and six zeros. The stratification indices are 1111222222222333.

Listing 17 presents the CHECK run for this example.

C. Projection Results

Listing 18 presents a projection of the need for the four types of beds by year to 1990.

In the printout, ST BEDS refers to beds in short-stay hospitals, and the acronyms NH BEDS, PSY BEDS, and NH BEDS refer to beds in long-term care facilities (nursing homes, psychiatric facilities, and facilities for the mentally handicapped, respectively).

XV. Example 10: Social Services, Projection of Counselors and Budget Needed to Provide Social Services to the Elderly Population

A. Projection Objectives; Model Structural Parameters

This example illustrates the use of the DESTINY program to project service levels, personnel, and budget levels required to provide social services to the elderly. The data used in this example are hypothetical. In a real application, the service ratios would be estimated from client caseload data, and the unit of service, unit of resource, and unit cost data would be estimated from program administrative records.

This example will build on the three-race, 14-region population data file for Arizona, AZ803C.DAT. The PARAM program is run to construct a new parameter file from the AZ803C.DAT file. The new file is called AZ803CS.DAT ("S" for social services). In this example, there will a single target population (the elderly) and a single service population (a subset of the target population), seven services, three resources, and three cost categories. The seven services are counseling, chore services, homemaker services, substitute care, day care, transportation, and other. The three resources are counselors, purchased services, and payments. The three cost categories are direct services, purchased services, and payments.

The target population and service-system parameter values to be specified to the PARAM program are as follows:

No. of target populations = 1 (i.e, the elderly)
Service Population Option = 2 (i.e., service-system data will be included in the model, and the service population will be proportional to the target population)
No. of services = 7
No. of resources = 3
No. of cost categories = 3

The names entered for the various model variables are as follows:

Names of target population: ELDERLY

Name of service population: ELDR(SV)

Names of services: COUNSLNG, CHORE SV, HOMEMAKR, SUBSCARE, DAY CARE, TRANSPRT, OTHER

Names of resources: COUNSELR, PURCHSVC, PAYMENTS

Names of cost categories: DIRCTSV$, PURCHSV$, PAYMENT$.

B. Data

The preceding data are entered in response to the various program requests. The incidence/prevalence data for the target population will now be specified. As mentioned, hypothetical data will be used for this example. This example assumes that approximately five percent of the elderly population requires social services (specifically, 3% of those aged 65-69, 5% of those aged 70-74,and 7% of those aged 75+).

Target Population Parameters

In the present example, the target population is all persons aged 65 or older. The prevalence of the target population in the general population is hence to be specified in terms of age categories. The data are hence entered into the program by selecting stratification option number 2 (ST2), in which a separate rate is specified for each five-year age category. Under this option, the user may enter up to nine different prevalences. In the present example, however, only two are needed: the prevalence is 0.00 (0%) for all persons whose age is less than 65, and 1.00 (100%) of those whose age is 65 or over.

The following table indicates the nine prevalences entered to the PARAM program (only the first two are of concern in this example:

Index	Rate
1	0.00
2	1.00
3	0.00
4	0.00
5	0.00
6	0.00
7	0.00
8	0.00
9	0.00

Next needs to be specified which of the preceding rates applies to each of the sixteen age categories. The first rate (0.00, Index = 1) applies to the first 13 age categories (ages 0 - 64), and the second rate (1.00, Index - 2) applies to the last three age categories (ages 65+.) The list of indexes to be entered is hence as follows:

Stratum (Age Category)	Index
0-4	1
5-9	1
10-14	1
15-19	1
20-24	1
25-29	1
30-34	1
35-39	1
40-44	1
45-49	1

50-54	1
55-59	1
60-64	1
65-69	2
70-74	2
75+	2

Service Population Parameters

The service population is assumed to be 3% of the target population aged 65-69, 5% of the target population aged 70-74, and 7% of the target population aged 75+. Once again, since these prevalences depend only on age, stratification option ST2 is used. There are four rates of interest: 0.00 (0%), .03 (3%), .05 (5%), and .07 (7%).

The following table indicates the nine prevalences entered to the PARAM program (only the first four of which are of interest in this example.):

Index	Rate
1	0.00
2	0.03
3	0.05
4	0.07
5	0.00
6	0.00
7	0.00
8	0.00
9	0.00

The four prevalences apply to the last four age categories, in order. The list of indexes to be entered to the program:

Stratum (Age Category)	Index
0-4	1
5-9	1
10-14	1
15-19	1
20-24	1
25-29	1
30-34	1
35-39	1
40-44	1
45-49	1
50-54	1
55-59	1
60-64	1
65-69	2
70-74	3
75+	4

Service Parameters

The following table indicates the average number of units of service of each type provided to each served client per year:

Average Number of Service Units Per Case Per Year

Service	No. of Service Units per Case per Year
S1. Counseling	2 hours
S2. Chore Services	16 dollars
S3. Homemaker Services	750 dollars
S4. Substitute Care	12 dollars
S5. Day Care	7 dollars
S6. Transportation	10 dollars
S7. Other	10 dollars

In this example, counseling is the only "direct" service, i.e., service provided by the state social service staff. All of the other services are purchased from "service providers," and the unit of service is taken to be equal to one dollar.

Resource Parameters

The average number of service units per served client is as specified in the following table:

Average Number of Resource Units Per Service Unit
(Service types as defined in the preceding table)

Resource	No. of Resource Units per Service Unit (by Service Type) S1	S2	S3	S4	S5	S6	S7
R1. Counselor	1	0	0	0	0	0	0
R2. Dollar (Purchase)	0	1	1	1	1	.5	.5
R3. Dollar (Payment)	0	0	0	0	0	.5	.5

In this example, half of the TRANSPRT service (S6) is a payment to the client, and half is a payment to the service provider. The same is true of the OTHER service.

Cost Parameters

It is assumed that the cost of counselor service is $15 per hour. Since the other services are in fact dollars, their cost is $1 per dollar. The following table summarizes these costs:

Average Cost Per Resource Unit
(Resource types as defined in the preceding table)

	Cost per Resource Unit (by resource type)

Cost Category	R1	R2	R3
C1. Direct Service	15	0	0
C2. Purchased Service	0	1	0
C3. Payment	0	0	1

Listing 19 presents the CHECK run for this example.

C. Projection Results

Listing 20 presents a projection of the social services served population, services, resources, and costs. In this example we show a three-year-ahead projection, as opposed to the ten-year-ahead projections that were illustrated in the other examples.

The printout shows the services, resources, and budget required to provide services to the served population.

The DESTINY program could be used to estimate the changes in the budget that would occur if different service levels or different service costs were adopted. Used in this way, DESTINY is an ideal tool in the evaluation of alternative strategies for rationing social services.

The example illustrates several of the different types of crosstabulations that can be constructed by the DESTINY program. The total number of possible crosstabs is very large, and typically only a few of them would be selected by the user for printout. Up to nine demographic distributions or crosstabs may be constructed for each of the many variables forecast by the program (general population, target population (the elderly), seven social services, three resources, and three cost categories). These include crosstabs by age, sex, race, age by sex, age by race, sex by race, age by sex by race, region, and race by region. In addition, nine different service-system-related distributions or crosstabs may be specified:

- distribution of services by type
- distribution of resources by type
- distribution of costs by type
- distribution of services by served population
- distribution of resources by served population
- distribution of cost by served population
- distribution of resources by services
- distribution of costs by services
- distribution of costs by resources

In this example, we present only a small fraction of the possible output tables.

Data such as these may be used to back up legislative budget requests, to prepare Comprehensive Annual Services Program plans, or to estimate staffing levels. Additional runs could reveal the budgetary impact of changes in service levels or costs.

References

1. DESTINY Planning and Forecasting System: Description of Capabilities, Joseph George Caldwell, 503 Chastine Drive, Spartanburg, SC 29301 USA 1995

Appendix A. Data Sources, Model Parameterization and Model Calibration

There are two types of information required by the PARAM program, in order to construct a parameter file for use by the DESTINY package -- demographic information and service-system information. The demographic information consists of a number of demographic parameters, such as birth and death rates, and some demographic variables, such as population totals by age, sex, race, and geographic region. The service-system information consists of incidences or prevalences for target populations of interest, service ratios, and various service, resource, and cost parameters.

Demographic Specification

The demographic data (parameters and variables) required by the DESTINY program are very basic quantities, and most of them are available at the national and state levels. For the United States, the publications which are of greatest value in obtaining these data are the following:

1. Statistical Abstract of the United States (annual) (various years)

2. Vital Statistics of the United States (annual), Volume I, Natality and Volume II, Mortality, Part A

3. Census of Population (decennial)

At the state level, major data source is the County and City Data Book supplement to the Statistical Abstract; it is published in various years. Each state publishes state-level versions of the statistical abstract and vital statistics reports; the 1980 Census data are available at the state level as well.

The Census of Population presents detailed population breakdowns by age, sex, race, and geographic region. The Vital Statistics and Statistical Abstract present demographic parameters such as birth and death rates.

Most countries other than the US have publications similar to those cited above, at least for the national level. For some developing nations, however, even basic demographic parameters such as fertility rates are not available on a reliable or timely basis, and other sources must be consulted. Such sources include:

1. World Fertility Survey

2. United Nations Demographic Handbook

The DESTINY program population projections are based on a five-year time interval, and the required parameters refer to future five-year periods. The program makes projections corresponding to whatever demographic assumptions the user wishes to specify about the future, and the user's specified values may differ from historical values.

If historical data are used to determine these parameters, the average values over the last five years should normally be used. If data for a recent five-year period are not available, data for the latest available year may be used. If historical values fluctuate substantially from year to year, a several-year average would usually be preferable to an estimate based on a single year. If a demographic parameter appears to be changing over time (e.g., a declining trend in the birth rate), the value entered to DESTINY may be based on the five-year average of values derived from a statistical time-series forecasting model.

Even in the US reliable information on Total Fertility Rates (TFRs) and Fertility Age Distributions (FADs) may not be available at the state level for different races. If reliable state data are not available, national-level data may be used. Perhaps the most critical parameter of all is the TFR, since it has a substantial impact on even the nearer-term population projections. If state data are used for the TFR, the user should always make a CHECK run to examine the reasonableness of the state TFR. If the ratio of the estimated base-year TFR to the user-specified TFR is quite different from unity, the user should attempt to ascertain why the population is evidently so unstable. If no reason is apparent, it would be prudent to revise the specified TFR.

The user must decide whether to characterize the population survival rates by the Infant Mortality Rate (IMR) or the Expectation of Life at Birth (ELB), corresponding to Life Table Option parameter value equal to 1 or to 2, respectively. As a general rule, use Option 1 (i.e., specify the IMR) for countries in which the IMR is high, and the ELB for countries in which the IMR is low. For whichever option the user specifies, the CHECK program will print out the value of the non-specified parameter, according to the Coale-Demeny "West" model life table.

For example, suppose that the user has specified Life Table Option 1 (specify the IMR), but he is particularly interested in projections of the elderly population. If the CHECK printout indicates that the user-specified value of the IMR implies an ELB value that is quite different from the observed value, it would be advisable to respecify the model in terms of Life Table Option 2, and enter the desired Expectation of Life at Birth.

Service-System Parameters

Because of the tremendous variety of target populations and service systems to which the DESTINY program may be applied, it is not possible to identify standard sources from which information pertaining to these model aspects may be obtained. With regard to target populations, local-level data are often not available on incidences and prevalences, and national- or regional-level data, by age, sex, or race must be used. Such data are available in published form from nationwide surveys, such as the Disability Survey of 1972 or the National Health Interview Survey.

With regard to service-system data, most health or social service programs are operated at the state or local level, and data on program services, resources, and costs are often available from administrative records maintained at these levels. A major problem that may be encountered is that the DESTINY program needs these parameters on an annual basis (e.g., average number of cases per year, average number of service units per case per year), and many organizations do not collect client caseload data this way. This situation is changing, however, as the awareness of the need to do planning based on parametric models is increasing.

Appendix B. Data Entry Forms

This appendix includes data entry forms for use in collecting the data required by the PARAM and CHECK programs. The data entry forms list the data in order of entry to the PARAM program. To assist the user in remembering where each data element was obtained, space is provided to record the "source" of each element.

The data entry forms do not describe the meaning of the various options that are available for each input parameter. Those descriptions are presented in the text of this user's manual. The forms do specify, however, the format required for each data element.

PARAM Form 1: Basic File Structure Parameters

Parameter File Name (12X): _____

General Population Description (8OX):_____

_____

Base Year (4X):_____

Basic File Structure Parameters:

P1: Number of Races (1-3):_____

P2: Number of Regions (1-14):_____

P3: Demographic Parameter Option (1 or 2):_____

P4: Life Table Option (1 or 2):_____

P5: External Migration Parameter Option (0, 1, or 2):_____

P6: Internal Migration Parameter Option (0 or 1):_____

P7: Service System Option (0 or 1):_____

Names of Races (8X):RA1_____

RA2_____

RA3_____

Names of Regions (8X):RE1_____ RE8_____

RE2_____ RE9_____

RE3_____ RE10_____

RE4_____ RE11_____

RE5_____ RE12_____

RE6_____ RE13_____

RE7_____ RE14_____

PARAM Form 2: Demographic Parameters and Variables

for Race = _____ (one complete set needed for each race)

Total Fertility Rate(s)

Source:_____

If P3 = 1, specify 1 TFR (X.XXX):_____

If P3 = 2, specify 10 TFRs (10X.XXX), one for each 5-year projection period:

_____,_____,_____,_____,_____,_____,_____,_____,_____,_____

Fertility Age Distribution(s)

Source:_____

If P3 = 1, specify 1 FAD (6X.XXX):

_____,_____,_____,_____,_____,_____

If P3 = 2, specify 10 FADs (6X.XXX), one for each 5-year projection period:

_____,_____,_____,_____,_____,_____

_____,_____,_____,_____,_____,_____
_____,_____,_____,_____,_____,_____
_____,_____,_____,_____,_____,_____

_____,_____,_____,_____,_____,_____

_____,_____,_____,_____,_____,_____
_____,_____,_____,_____,_____,_____
_____,_____,_____,_____,_____,_____

_____,_____,_____,_____,_____,_____
_____,_____,_____,_____,_____,_____

Infant Mortality Rate(s) (required if P4 = 1)

Source:_____

If P3 = 1, specify 1 IMR (XXX.XX):_____

If P3 = 2, specify 10 IMRs (10XXX.XX), one for each 5-year projection period:

_____,_____,_____,_____,_____,_____,_____,_____,_____,_____

Expectation(s) of Life at Birth (required if P4 = 2)

Source:_____

If P3 = 1, specify 1 ELB (XX.XX):_____

If P3 = 2, specify 10 ELBs (10XX.XX), one for each 5-year projection period:

_____,_____,_____,_____,_____,_____,_____,_____,_____,_____

Base-Year Population

Source:_____

For Males (8XXXXXXXXX.):

_____,_____,_____,_____,_____,_____,_____,_____(CR)

_____,_____,_____,_____,_____,_____,_____,_____

For Females (XXXXXXXXX.):

_____,_____,_____,_____,_____,_____,_____,_____(CR)

_____,_____,_____,_____,_____,_____,_____,_____

Base-Year Infant Mortality Rate (XXX.XX):_____

Source:_____

Base-Year Birth Rate (XXX.XX):_____

Source:_____

Base-Year Death Rate (XXX.XX):_____

Source:_____

Population Ten Years Prior to Base Year (XXXXXXXXX.):

_____ Source:_____

Infant Mortality Rate Ten Years Prior to Base Year (XXX.XXXX):

_____ Source:_____

Birth Rate Ten Years Prior to Base Year (XXX.XXXX):

_____ Source:_____

Death Rate Ten Years Prior to Base Year (XXX.XX):

_____ Source:_____

External Migration Parameters (data required only if P5 is greater than zero)

Source:_____

If P5 = 1:

Annual Migration Rate (XXXX.XXX)_____

Annual Migration Number (XXXXXXXXX.)_____

If P5 = 2:

Specify ten annual migration rates (10XXXX.XXX), one for each 5-year projection period:

_____,_____,_____,_____,_____,_____,_____,_____,_____,_____

Specify ten annual migration numbers (8XXXXXXXXX.), one for each 5-year projection period:

_____,_____,_____,_____,_____,_____,_____,_____,_____,_____

Regional Population (data required only if P2 is greater than 1)

Source:_____

_____,_____,_____,_____,_____,_____,_____,_____

_____,_____,_____,_____,_____,_____,_____,_____

Regional Population Ten Years Prior to Base Year (data required only if P2 is greater than 1)

Source:_____

_____,_____,_____,_____,_____,_____,_____,_____

_____,_____,_____,_____,_____,_____,_____,_____

Internal Migration Parameters (Data required only if P6 is greater than zero)

Source:_____

Specify one annual internal migration rate for each region (8XXXX.XXX):

_____,_____,_____,_____,_____,_____,_____,_____

_____,_____,_____,_____,_____,_____

Specify one annual internal migration amount (number) for each region (8XXXXXXXXX.):

_____,_____,_____,_____,_____,_____,_____,_____

_____,_____,_____,_____,_____,_____

PARAM Form 3: Service-System Parameters

(Required only if P7 = 1)

Service-System Structural Parameters

S1: Number of Target Populations (1-4):_____

S2: Service Population Option (0, 1, or 2):_____

S3: Number of Services (0-10):_____

S4: Number of Resources (0-7):_____

S5: Number of Cost Categories (0-4):_____

Names of Target Populations (8X):

TP1:_____

TP2:_____

TP3:_____

TP4:_____

Names of Service Populations (8X):

SP1:_____

SP2:_____

SP3:_____

SP4:_____

Names of Services (8X):

S1:_____

S2:_____

S3:_____

S4:_____

S5:_____

S6:_____

S7:_____

S8:_____

S9:_____

S10:_____

Names of Resources (8X):

R1:_____

R2:_____

R3:_____

R4:_____

R5:_____

R6:_____

R7:_____

Names of Cost Categories (8X):

C1:_____

C2:_____

C3:_____

C4:_____

Service Parameters

Service Population Name	Names:	Service Type S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
SP1:_____		___	___	___	___	___	___	___	___	___	___
SP2:_____		___	___	___	___	___	___	___	___	___	___
SP3:_____		___	___	___	___	___	___	___	___	___	___
SP4:_____		___	___	___	___	___	___	___	___	___	___

Note: Each table entry (XXXXX.XXXX) is entered to the program separately, reading across the first row, then the second row, etc.

Resource Parameters

Service Type Name	Names:	Resource Type R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
S1:_____		___	___	___	___	___	___	___	___	___	___
S2:_____		___	___	___	___	___	___	___	___	___	___

S3:_____ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

S4:_____ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

S5:_____ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

S6:_____ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

S7:_____ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

S8:_____ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

S9:_____ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

S10:_____ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

Note: Each table entry (XXXXX.XXXX) is entered to the program separately, reading across the first row, then the second row, etc.

Cost Parameters

Resource Type

Name Names:_____ _____ _____ _____

R1:_____ _____ _____ _____ _____

R2:_____ _____ _____ _____ _____

R3:_____ _____ _____ _____ _____

R4:_____ _____ _____ _____ _____

R5:_____ _____ _____ _____ _____

R6:_____ _____ _____ _____ _____

R7:_____ _____ _____ _____ _____

PARAM Form 4: Target Population Parameters

for Target Population = _____

(Required only if P7 = 1, in which case one form is needed for each target population.)

Data Source:_____

Stratification Option:

Specify 1 Option:

___ST1 No stratification (single rate for entire population)

___ST2 Stratify by Age

___ST3 Stratify by Sex

___ST4 Stratify by Race

___ST5 Stratify by Age x Sex

___ST6 Stratify by Age x Race

___ST7 Stratify by Sex x Race

___ST8 Stratify by Age x Sex x Race

___ST9 Stratify by Region

___ST10 Stratify by Region x Race

Enter data in the section below corresponding to the Stratification Option selected above.

Option ST1: No Stratification

Specify a single rate for the entire population: _____

Option ST2: Stratification by Age

Age Category	Rate
0-4	_____
5-9	_____
10-14	_____
15-19	_____
20-24	_____
25-29	_____
30-34	_____
35-39	_____
40-44	_____
45-49	_____
50-54	_____

55-59	_____
60-64	_____
65-69	_____
70-74	_____
75+	_____

Option ST3: Stratification by Sex

Sex	Rate
Male	_____
Female	_____

Option ST4: Stratification by Race

Race	Rate
RA1_____	_____
RA2_____	_____
RA3_____	_____

Option ST5: Stratification by Age x Sex

Sex = Male

Age Category	Rate
0-4	_____
5-9	_____
10-14	_____
15-19	_____
20-24	_____
25-29	_____
30-34	_____
35-39	_____
40-44	_____
45-49	_____
50-54	_____
55-59	_____
60-64	_____
65-69	_____
70-74	_____
75+	_____

Sex = Female

Age Category	Rate
0-4	_____
5-9	_____
10-14	_____
15-19	_____
20-24	_____
25-29	_____
30-34	_____

35-39	_____
40-44	_____
45-49	_____
50-54	_____
55-59	_____
60-64	_____
65-69	_____
70-74	_____
75+	_____

Option ST6: Stratification by Age x Race

Race = RA1_____

Age Category	Rate
0-4	_____
5-9	_____
10-14	_____
15-19	_____
20-24	_____
25-29	_____
30-34	_____
35-39	_____
40-44	_____
45-49	_____
50-54	_____
55-59	_____
60-64	_____
65-69	_____
70-74	_____
75+	_____

Race = RA2_____

Age Category	Rate
0-4	_____
5-9	_____
10-14	_____
15-19	_____
20-24	_____
25-29	_____
30-34	_____
35-39	_____
40-44	_____
45-49	_____
50-54	_____
55-59	_____
60-64	_____
65-69	_____
70-74	_____
75+	_____

Race = RA3_____

Age Category	Rate
0-4	_____
5-9	_____
10-14	_____
15-19	_____
20-24	_____
25-29	_____
30-34	_____
35-39	_____
40-44	_____
45-49	_____
50-54	_____
55-59	_____
60-64	_____
65-69	_____
70-74	_____
75+	_____

Option ST7: Stratification by Sex x Race

Race = RA1_____

Sex	Rate
Male	_____
Female	_____

Race = RA2_____

Sex	Rate
Male	_____
Female	_____

Race = RA3_____

Sex	Rate
Male	_____
Female	_____

Option ST8: Stratification by Age x Sex x Race

Race = RA1_____

Sex = Male

Age Category	Rate
0-4	_____
5-9	_____
10-14	_____
15-19	_____
20-24	_____

25-29	_____
30-34	_____
35-39	_____
40-44	_____
45-49	_____
50-54	_____
55-59	_____
60-64	_____
65-69	_____
70-74	_____
75+	_____

Sex = Female

Age Category	Rate
0-4	_____
5-9	_____
10-14	_____
15-19	_____
20-24	_____
25-29	_____
30-34	_____
35-39	_____
40-44	_____
45-49	_____
50-54	_____
55-59	_____
60-64	_____
65-69	_____
70-74	_____
75+	_____

Race = RA2_____

Sex = Male

Age Category	Rate
0-4	_____
5-9	_____
10-14	_____
15-19	_____
20-24	_____
25-29	_____
30-34	_____
35-39	_____
40-44	_____
45-49	_____
50-54	_____
55-59	_____
60-64	_____
65-69	_____
70-74	_____
75+	_____

Sex = Female

Age Category	Rate
0-4	_____
5-9	_____
10-14	_____
15-19	_____
20-24	_____
25-29	_____
30-34	_____
35-39	_____
40-44	_____
45-49	_____
50-54	_____
55-59	_____
60-64	_____
65-69	_____
70-74	_____
75+	_____

Race = RA3_____

Sex = Male

Age Category	Rate
0-4	_____
5-9	_____
10-14	_____
15-19	_____
20-24	_____
25-29	_____
30-34	_____
35-39	_____
40-44	_____
45-49	_____
50-54	_____
55-59	_____
60-64	_____
65-69	_____
70-74	_____
75+	_____

Sex = Female

Age Category	Rate
0-4	_____
5-9	_____
10-14	_____
15-19	_____
20-24	_____
25-29	_____
30-34	_____
35-39	_____

40-44	_____
45-49	_____
50-54	_____
55-59	_____
60-64	_____
65-69	_____
70-74	_____
75+	_____

Option ST9: Stratification by Region

Region	Rate
RE1_____	_____
RE2_____	_____
RE3_____	_____
RE4_____	_____
RE5_____	_____
RE6_____	_____
RE7_____	_____
RE8_____	_____
RE9_____	_____
RE10_____	_____
RE11_____	_____
RE12_____	_____
RE13_____	_____
RE14_____	_____

Option ST10: Stratification by Region x Race

Race = RA1_____

Region	Rate
RE1_____	_____
RE2_____	_____
RE3_____	_____
RE4_____	_____
RE5_____	_____
RE6_____	_____
RE7_____	_____
RE8_____	_____
RE9_____	_____
RE10_____	_____
RE11_____	_____
RE12_____	_____
RE13_____	_____
RE14_____	_____

Race = RA2_____

Region	Rate
RE1_____	_____
RE2_____	_____
RE3_____	_____

RE4_____	_____
RE5_____	_____
RE6_____	_____
RE7_____	_____
RE8_____	_____
RE9_____	_____
RE10_____	_____
RE11_____	_____
RE12_____	_____
RE13_____	_____
RE14_____	_____

Race = RA3_____

Region	Rate
RE1_____	_____
RE2_____	_____
RE3_____	_____
RE4_____	_____
RE5_____	_____
RE6_____	_____
RE7_____	_____
RE8_____	_____
RE9_____	_____
RE10_____	_____
RE11_____	_____
RE12_____	_____
RE13_____	_____
RE14_____	_____

PARAM Form 5: Service Population Parameters

for Service Population = _____

(Needed only if P7 = 1 and S2 = 2, in which case one form is needed for each service population.)

Data Source:_____

Stratification Option:

Specify 1 Option:

___ST1 No stratification (single rate for entire population)

___ST2 Stratify by Age

___ST3 Stratify by Sex

___ST4 Stratify by Race

___ST5 Stratify by Age x Sex

___ST6 Stratify by Age x Race

___ST7 Stratify by Sex x Race

___ST8 Stratify by Age x Sex x Race

___ST9 Stratify by Region

___ST10 Stratify by Region x Race

Enter data in the section below corresponding to the Stratification Option selected above.

Option ST1: No Stratification

Specify a single rate for the entire population:_____

CHECK Form 1

(This form is needed only if the CHECK program is used to adjust the service-system parameters.)

Target Population	Actual Base-Year Value	PROJ Base-Year Value	Actual Ratio = PROJ
TP1			
TP2			
TP3			
TP4			

Service Population

SP1_____
SP2_____
SP3_____
SP4_____

Service

S1_____
S2_____
S3_____
S4_____
S5_____
S6_____
S7_____
S8_____
S9_____
S10_____

Resource

R1_____
R2_____
R3_____
R4_____
R5_____
R6_____
R7_____

Cost

C1_____
C2_____
C3_____
C4_____

Appendix C. Technical Notes

Demographic Projection Equations

This Appendix presents the basic demographic equations which define the cohort-component method for making population projections. Only a summary description of the demographic equations is presented here. For detailed discussion of the cohort-component method, refer to a demographic text such as:

> Shryock, Henry S., Jacob S. Siegel and Associates, The Methods and Materials of Demography, Fourth Printing (rev.), US Bureau of the Census, US Government Printing Office, Washington, DC 1980

The formulas presented below correspond to External Migration Option 1 and Internal Migration Option 0. In the model, the complete set of formulas is used once for each race represented in the model, with appropriate changes in the values of the parameters.

The following notation is introduced. The index t refers to time. The index k refers to five-year age cohort. There are sixteen age cohorts, first one being ages 0-5, and the last being ages 75+.

TFR_t = total fertility rate at time t (the average number of children born to a woman in her lifetime)

$FAD_t(k)$ = fertility age distribution density function (probability that a woman giving birth belongs to age cohort k) at time t

$S_t^j(1)$ = probability at time t that an infant of sex j survives to age 1 (j = 1, 2)

$S_t^j(k)$ = probability that a person of sex j in cohort k-1 alive at time t survives to time t+5 (k = 2, 3, ..., 17; j = 1, 2)

$S_t^{j*} = (S_t^j(k) + S_t^{j+5}(k))/2$

IM_t = number of immigrants in time t to time t+5

EM_t = rate of emigration in time period t to t+5 (number of emigrants divided by the total population)

$P_t(k)$ = total population in age cohort k at time t

$R_t(m)$ = population in region m at time t

BSR_t = birth sex ratio (proportion of newborns that are males)

BIR_t = births in time period t to t+5

In terms of the preceding notation, the following formulas define the population at the time t+5, given the population at time t.

1. Survivors, Age Cohorts 2-15:

$$PS_{t+5}^{j}(k) = P_t^{j}(k)\ S_t^{j^*}(k+1) \qquad (k=2,3,...,16)$$

2. Survivors, Last Age Cohort:

$$PS_{t+5}^{j}(16) = PS_{t+5}^{j}(16)\ S_t^{j^*}(17)$$

3. Births

$$BIR_t = TFR_t \sum_{k=4}^{9} FAD(k)\ (P_t^{2}(k) + PS_{t+5}^{2}(k))/2$$

4. Survivors, First Age Cohort

$$PS_{t+5}^{j}(1) = BIR_t\ S_t^{j^*}(1)$$

5. Total Survivors Plus Births

$$TS = \sum_{j,k} PS_{t+5}^{j}(k)$$

6. External Migration (Option 1)

$$\text{Total Net Migration} = TM = IM_t - EM_t\ TS$$

$$F = 1 + TM/TS$$

$$P_{t+5}j(k) = PS_{t+5}^{j}(k)\ F$$

7. Total Population at Time t

$$TP = \sum_{j,k} P_t^{j}(k)$$

8. Internal Migration (Option 0)

$$R_{t+5}(m) = R_t(m)\ (TS + TM)/TP$$

External Migration Options 2-4 and Internal Migration Option 1 are similar to the above.

Service-System Parameter Adjustment Equations

In the CHECK program, the user has the option of entering an adjustment factor, or calibration factor, for each target population, service population, service, resource, and cost total that the PROJ program computes and prints. Each adjustment factor is the ratio of the actual (observed) base-year level of each quantity to the base-year level estimated by PROJ.

After the user enters the adjustment factors, the CHECK program modifies each incidence, service ratio, service, resource, and cost parameter, and creates a new parameter file containing the modified parameters. The parameters are modified so that the base-year estimates printed by the PROJ program will each be multiplied by the adjustment factor. The formulas which the CHECK program uses to modify the parameters are as follows:

$$tp_R' = f_R^{tp}\ tp_R \qquad (R = 1,2,...,n_{tp})$$

$$sp_R' = f_R^{sp}\ sp_R 1/f_R^{tp}) \qquad (R = 1,2,...,n_{tp})$$

$$s_{kR}' = f_k^{s}\ s_{kR} 1/f_R^{sp}) \qquad (k = 1,2,...,n^s;\ R = 1,2,...,n_{tp})$$

$$r_{jk}' = f_j^{r}\ r_{jk}\ (1/f_k^{s}) \qquad (j = 1,2,...,n_r;\ k = 1,2,...,n_s)$$

$$c'_{ij} = f_i^{c}\ c_{ij}\ (1/f_j^{r}) \qquad (i = 1,2,...,n_c;\ j = 1,2,...,n^r)$$

where

tp_R = old incidence

tp_R' = new incidence

sp_R = old service ratio

sp_R' = new service ratio

s_{kR} = old number of units of service type k per served case of type R

s_{kR}' = new number of units of service type k per served case of type R

r_{jk} = old number of units of resource type j per unit of service type k

r_{jk}' = new number of units of resource type j per unit of service type k

c_{ij} = old number of dollars of cost type i per unit of resource type j

c_{ij}' = new number of dollars of cost type i per unit of resource type j

f_R^{tp} = adjustment factor for target population R

f_R^{sp} = adjustment factor for service population R

f_k^{s} = adjustment factor for service type k

f_j^{r} = adjustment factor for resource type j

f_i^{c} = adjustment factor for cost type i

n_{tp} = number of target populations

= number of service populations

n_s = number of service types

n_r = number of resource types

n_c = number of cost categories.

Appendix D. Computer Program Output Listings

Computer Program Output Listings

Listing 1. CHECK Run for Example 1 (National Population Projection, Single-Race Model)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: CHECK
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   10:49:59

 NAME OF PARAMETER FILE = US801.DAT
 GENERAL POPULATION DESCRIPTION:
 UNITED            STATES            RESIDENT            POPULATION

 BASE YEAR = 1980

 NO OF RACIAL/ETHNIC GROUPS = 1
 NO OF REGIONS =  0
 VITAL STATISTICS PARAMETER OPTION = 1
 LIFE TABLE OPTION = 1
 EXTERNAL MIGRATION OPTION = 1
 INTERNAL MIGRATION OPTION = 0
 SERVICE SYSTEM OPTION = 0
 NAME(S) OF RACE    ...
      ALL

 PARAMETERS FOR RACE = ALL
 TOTAL FERTILITY RATE(S)...
      1.810
 FERTILITY AGE DISTRIBUTION(S)...
       .147 .312 .312 .166 .052 .011
 INFANT MORTALITY RATE(S)...
       14.80
 EXPECTATION OF LIFE AT BIRTH CORRESPONDING TO IMR FOR FIRST
   PROJECTION PERIOD = 73.96
 BASE-YEAR POPULATION AND SURVIVAL PROBABILITIES FOR FIRST PROJECTION
PERIOD...
                     MALE      FEMALE        MALE    FEMALE
         0                                  .9793    .9852
        0-4       8360135.    7984272.      .9967    .9977
        5-9       8537903.    8159231.      .9981    .9989
       10-14      9315055.    8925864.      .9974    .9987
       15-19     10751544.   10410123.      .9960    .9980
       20-24     10660063.   10652494.      .9953    .9973
       25-29      9703259.    9814413.      .9951    .9966
       30-34      8675505.    8882452.      .9940    .9954
       35-39      6860236.    7102772.      .9913    .9933
       40-44      5707550.    5960689.      .9857    .9894
       45-49      5387511.    5700872.      .9757    .9830
       50-54      5620474.    6088510.      .9586    .9731
       55-59      5481152.    6132902.      .9321    .9567
       60-64      4669307.    5416404.      .8913    .9265
```

```
       65-69      3902083.    4878761.      .8282    .8727
       70-74      2853116.    3943626.      .7358    .7856
       75+        3547402.    6419145.      .4891    .5275
       TOTAL    110032295.  116472530.
 TOTAL BASE-YEAR POPULATION (POPBASE) = 226504825.
 CRUDE BIRTH RATE FOR BASE YEAR =  15.90
 CRUDE DEATH RATE FOR BASE YEAR =   8.70
 INFANT MORTALITY RATE FOR BASE YEAR =  13.80
 POPULATION (POPPREV) TEN YEARS PRIOR TO BASE YEAR = 203302031.
 AVERAGE CRUDE BIRTH RATE FOR PREVIOUS TEN YEARS =  15.14
 AVERAGE CRUDE DEATH RATE FOR PREVIOUS TEN YEARS =   8.96
 AVERAGE INFANT MORTALITY RATE FOR PREVIOUS TEN YEARS =  16.08
 ANNUAL EXTERNAL MIGRATION RATE(S) (PER 1000) (EMRATE)...
         .000
 ANNUAL EXTERNAL MIGRATION NUMBER(S) (IMMNO)...
        1000075.
 TOTAL FERTILITY RATE (TFREST) ESTIMATED FROM BASE-YEAR BIRTH RATE =
1.833
 TOTAL FERTILITY RATE (TFR) SPECIFIED FOR FIRST PROJECTION PERIOD =
1.810
   GENERAL FERTILITY RATE (BIRTH RATE (BRFF) PER 1000 FEMALES AGED
15-44)
    FOR BASE YEAR =  68.18
 ESTIMATE OF ANNUAL NET EXTERNAL MIGRATION NUMBER (BASED  ON BIRTH
RATE
   AND DEATH RATE FOR PREVIOUS TEN YEARS) =   1000075.
   ESTIMATED ANNUAL RATE PER 1000 =    4.686
 ANNUAL NET MIGRATION NUMBER SPECIFIED FOR FIRST PROJECTION PERIOD =
 1000075.
   ANNUAL NET MIGRATION RATE PER 1000 SPECIFIED FOR FIRST PROJECTION
   PERIOD =     .000
 ANNUAL NET MIGRATION (MIG) IMPLIED BY MIGRATION NUMBER (IMMNO) AND/OR
   MIGRATION RATE (EMRATE) SPECIFIED FOR FIRST PROJECTION PERIOD =
1000075.
   APPROX ANNUAL RATE PER 1000 POPULATION (MIGR) =    4.415
 CRUDE BIRTH RATE PER 1000 (CBR) FOR FIRST PROJECTION PERIOD = 14.573
 CRUDE DEATH RATE PER 1000 (CDR) FOR FIRST PROJECTION PERIOD =  9.799
 AVERAGE ANNUAL POPULATION GROWTH RATE PER 1000 FOR PREVIOUS TEN YEARS
   = 1000((POPBASE/POPPREV(IR))**.1-1) =  10.87
 PROJECTED POPULATION GROWTH RATE (GIVEN SPECIFIED PARAMETERS):
   1000((POPPROJ/POPBASE)**.2-1) =   9.62
   APPROX. ANNUAL POPULATION GROWTH RATE PER 1000, BASED ON CBR,
    CDR, AND MIGR = CBR-CDR+MIGR =   9.19
```

Listing 2. PROJ Run for Example 1 (National Population Projection, Single-Race Model)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: PROJ
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   11:39: 2

 PARAMETER FILE NAME: US801.DAT
 GENERAL POPULATION DESCRIPTION:
 UNITED            STATES            RESIDENT            POPULATION

 BASE YEAR: 1980

 NO OF FIVE-YEAR PERIODS TO PROJECT = 2

 YEAR: 1990

 DISTRIBUTIONAL ANALYSIS OF POPULATN

 TOTAL POPULATN =   250026462.

 DISTRIBUTION OF POPULATN
  BY AGE
   0-4      18150140.
   5-9      18340630.
  10-14     16961798.
  15-19     17341700.
  20-24     18916165.
  25-29     21907018.
  30-34     22038919.
  35-39     20150596.
  40-44     18063934.
  45-49     14262631.
  50-54     11763287.
  55-59     10935458.
  60-64     11141584.
  65-69     10411490.
  70-74      8156979.
  75+       11484134.

 DISTRIBUTION OF POPULATN
  BY SEX
 MALE      122714472.
 FEMALE    127311990.

 CROSSTABULATION OF POPULATN
  BY AGE AND SEX
               MALE        FEMALE
   0-4       9229281.    8920859.
```

5-9	9321578.	9019052.
10-14	8668490.	8293308.
15-19	8858743.	8482957.
20-24	9644578.	9271587.
25-29	11108700.	10798317.
30-34	11004406.	11034512.
35-39	10003094.	10147502.
40-44	8909808.	9154126.
45-49	6987165.	7275467.
50-54	5721375.	6041912.
55-59	5251952.	5683506.
60-64	5234019.	5907564.
65-69	4745989.	5665501.
70-74	3592512.	4564467.
75+	4432781.	7051353.

Listing 3. CHECK Run for Example 2 (National Population Projection, Two-Race Model)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: CHECK
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   12:16:20

 NAME OF PARAMETER FILE = US802.DAT
 GENERAL POPULATION DESCRIPTION:
 UNITED    STATES    RESIDENT    POPULATION    BY    RACE    (W/O)

 BASE YEAR = 1980

 NO OF RACIAL/ETHNIC GROUPS = 2
 NO OF REGIONS =  0
 VITAL STATISTICS PARAMETER OPTION = 1
 LIFE TABLE OPTION = 1
 EXTERNAL MIGRATION OPTION = 1
 INTERNAL MIGRATION OPTION = 0
 SERVICE SYSTEM OPTION = 0
 NAME(S) OF RACE    ...
      WHITE
      OTHER

 PARAMETERS FOR RACE = WHITE
 TOTAL FERTILITY RATE(S)...
      1.717
 FERTILITY AGE DISTRIBUTION(S)...
       .130 .312 .326 .170 .051 .011
 INFANT MORTALITY RATE(S)...
       12.95
 EXPECTATION OF LIFE AT BIRTH CORRESPONDING TO IMR FOR FIRST
   PROJECTION PERIOD = 74.67
 BASE-YEAR POPULATION AND SURVIVAL PROBABILITIES FOR FIRST PROJECTION
PERIOD...
                     MALE      FEMALE        MALE    FEMALE
         0                                  .9820    .9874
        0-4       6482766.    6148431.      .9974    .9982
        5-9       6684406.    6346611.      .9984    .9991
       10-14      7407610.    7052673.      .9977    .9989
       15-19      8631389.    8326152.      .9965    .9983
       20-24      8680290.    8603095.      .9959    .9978
       25-29      8004161.    7978484.      .9957    .9972
       30-34      7298603.    7344080.      .9948    .9961
       35-39      5830238.    5928994.      .9923    .9942
       40-44      4849123.    4976012.      .9871    .9904
       45-49      4638090.    4817869.      .9774    .9843
       50-54      4918050.    5238845.      .9609    .9749
       55-59      4852081.    5384727.      .9350    .9592
```

```
      60-64      4172521.    4801456.      .8951    .9298
      65-69      3481097.    4329974.      .8327    .8771
      70-74      2551944.    3542234.      .7411    .7910
      75+        3187257.    5851527.      .4938    .5322
      TOTAL     91669626.   96671164.
 TOTAL BASE-YEAR POPULATION (POPBASE) = 188340790.
 CRUDE BIRTH RATE FOR BASE YEAR =  14.80
 CRUDE DEATH RATE FOR BASE YEAR =   8.80
 INFANT MORTALITY RATE FOR BASE YEAR =  12.00
 POPULATION (POPPREV) TEN YEARS PRIOR TO BASE YEAR = 178098000.
 AVERAGE CRUDE BIRTH RATE FOR PREVIOUS TEN YEARS =  14.13
 AVERAGE CRUDE DEATH RATE FOR PREVIOUS TEN YEARS =   9.04
 AVERAGE INFANT MORTALITY RATE FOR PREVIOUS TEN YEARS =  14.11
 ANNUAL EXTERNAL MIGRATION RATE(S) (PER 1000) (EMRATE)...
         .000
 ANNUAL EXTERNAL MIGRATION NUMBER(S) (IMMNO)...
         94517.
 TOTAL FERTILITY RATE (TFREST) ESTIMATED FROM BASE-YEAR BIRTH RATE =
1.748
 TOTAL FERTILITY RATE (TFR) SPECIFIED FOR FIRST PROJECTION PERIOD =
1.717
   GENERAL FERTILITY RATE (BIRTH RATE (BRFF) PER 1000 FEMALES AGED
15-44)
    FOR BASE YEAR =  64.59
 ESTIMATE OF ANNUAL NET EXTERNAL MIGRATION NUMBER (BASED  ON BIRTH
RATE
   AND DEATH RATE FOR PREVIOUS TEN YEARS) =     94517.
   ESTIMATED ANNUAL RATE PER 1000 =     .518
 ANNUAL NET MIGRATION NUMBER SPECIFIED FOR FIRST PROJECTION PERIOD =
   94517.
   ANNUAL NET MIGRATION RATE PER 1000 SPECIFIED FOR FIRST PROJECTION
   PERIOD =     .000
 ANNUAL NET MIGRATION (MIG) IMPLIED BY MIGRATION NUMBER (IMMNO) AND/OR
   MIGRATION RATE (EMRATE) SPECIFIED FOR FIRST PROJECTION PERIOD =
 94517.
   APPROX ANNUAL RATE PER 1000 POPULATION (MIGR) =     .502
 CRUDE BIRTH RATE PER 1000 (CBR) FOR FIRST PROJECTION PERIOD = 13.566
 CRUDE DEATH RATE PER 1000 (CDR) FOR FIRST PROJECTION PERIOD = 10.145
 AVERAGE ANNUAL POPULATION GROWTH RATE PER 1000 FOR PREVIOUS TEN YEARS
   = 1000((POPBASE/POPPREV(IR))**.1-1) =   5.61
 PROJECTED POPULATION GROWTH RATE (GIVEN SPECIFIED PARAMETERS):
   1000((POPPROJ/POPBASE)**.2-1) =   4.46
   APPROX. ANNUAL POPULATION GROWTH RATE PER 1000, BASED ON CBR,
    CDR, AND MIGR = CBR-CDR+MIGR =   3.92

 PARAMETERS FOR RACE = OTHER
 TOTAL FERTILITY RATE(S)...
     2.334
 FERTILITY AGE DISTRIBUTION(S)...
       .221 .312 .251 .143 .058 .015
 INFANT MORTALITY RATE(S)...
       22.62
```

EXPECTATION OF LIFE AT BIRTH CORRESPONDING TO IMR FOR FIRST PROJECTION PERIOD = 70.99

BASE-YEAR POPULATION AND SURVIVAL PROBABILITIES FOR FIRST PROJECTION PERIOD...

	MALE	FEMALE	MALE	FEMALE
0			.9675	.9757
0-4	1877369.	1835841.	.9941	.9956
5-9	1853497.	1812620.	.9969	.9979
10-14	1907445.	1873191.	.9961	.9976
15-19	2120155.	2083971.	.9939	.9963
20-24	1979773.	2049399.	.9928	.9952
25-29	1699098.	1835929.	.9923	.9941
30-34	1376902.	1538372.	.9907	.9926
35-39	1029998.	1173778.	.9871	.9898
40-44	858427.	984677.	.9802	.9850
45-49	749421.	883003.	.9683	.9773
50-54	702424.	849665.	.9491	.9655
55-59	629071.	748175.	.9196	.9462
60-64	496786.	614948.	.8756	.9122
65-69	420986.	548787.	.8091	.8541
70-74	301172.	401392.	.7136	.7629
75+	360145.	567618.	.4691	.5074
TOTAL	18362669.	19801366.		

TOTAL BASE-YEAR POPULATION (POPBASE) = 38164035.

CRUDE BIRTH RATE FOR BASE YEAR = 22.80

CRUDE DEATH RATE FOR BASE YEAR = 7.80

INFANT MORTALITY RATE FOR BASE YEAR = 21.10

POPULATION (POPPREV) TEN YEARS PRIOR TO BASE YEAR = 25137000.

AVERAGE CRUDE BIRTH RATE FOR PREVIOUS TEN YEARS = 21.77

AVERAGE CRUDE DEATH RATE FOR PREVIOUS TEN YEARS = 8.33

AVERAGE INFANT MORTALITY RATE FOR PREVIOUS TEN YEARS = 24.19

ANNUAL EXTERNAL MIGRATION RATE(S) (PER 1000) (EMRATE)...

.000

ANNUAL EXTERNAL MIGRATION NUMBER(S) (IMMNO)...

888003.

TOTAL FERTILITY RATE (TFREST) ESTIMATED FROM BASE-YEAR BIRTH RATE = 2.335

TOTAL FERTILITY RATE (TFR) SPECIFIED FOR FIRST PROJECTION PERIOD = 2.334

GENERAL FERTILITY RATE (BIRTH RATE (BRFF) PER 1000 FEMALES AGED 15-44)

FOR BASE YEAR = 90.02

ESTIMATE OF ANNUAL NET EXTERNAL MIGRATION NUMBER (BASED ON BIRTH RATE

AND DEATH RATE FOR PREVIOUS TEN YEARS) = 888003.

ESTIMATED ANNUAL RATE PER 1000 = 29.199

ANNUAL NET MIGRATION NUMBER SPECIFIED FOR FIRST PROJECTION PERIOD = 888003.

ANNUAL NET MIGRATION RATE PER 1000 SPECIFIED FOR FIRST PROJECTION PERIOD = .000

ANNUAL NET MIGRATION (MIG) IMPLIED BY MIGRATION NUMBER (IMMNO) AND/OR MIGRATION RATE (EMRATE) SPECIFIED FOR FIRST PROJECTION PERIOD =

888003.
APPROX ANNUAL RATE PER 1000 POPULATION (MIGR) = 23.268
CRUDE BIRTH RATE PER 1000 (CBR) FOR FIRST PROJECTION PERIOD = 20.621
CRUDE DEATH RATE PER 1000 (CDR) FOR FIRST PROJECTION PERIOD = 7.636
AVERAGE ANNUAL POPULATION GROWTH RATE PER 1000 FOR PREVIOUS TEN YEARS
= 1000((POPBASE/POPPREV(IR))**.1-1) = 42.64
PROJECTED POPULATION GROWTH RATE (GIVEN SPECIFIED PARAMETERS):
1000((POPPROJ/POPBASE)**.2-1) = 34.74
APPROX. ANNUAL POPULATION GROWTH RATE PER 1000, BASED ON CBR,
CDR, AND MIGR = CBR-CDR+MIGR = 36.25

TOTAL POPULATION (ALL RACES) = 226504825.

ESTIMATE OF ANNUAL NET EXTERNAL MIGRATION NUMBER (BASED ON BIRTH RATE AND
DEATH RATE FOR PREVIOUS TEN YEARS; TOTAL FOR ALL RACES IN THE MODEL)
= 939359.
ESTIMATED ANNUAL RATE PER 1000 = 4.402

Listing 4. PROJ Run for Example 2 (National Population Projection, Two-Race Model)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: PROJ
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   12:17: 5

 PARAMETER FILE NAME: US802.DAT
 GENERAL POPULATION DESCRIPTION:
 UNITED    STATES    RESIDENT    POPULATION    BY    RACE    (W/O)

 BASE YEAR: 1980

 NO OF FIVE-YEAR PERIODS TO PROJECT = 2

 YEAR: 1990

 DISTRIBUTIONAL ANALYSIS OF POPULATN

 TOTAL POPULATN =   250738546.

 DISTRIBUTION OF POPULATN
  BY AGE
   0-4      18669617.
   5-9      18806048.
  10-14     17101239.
  15-19     17460667.
  20-24     19000300.
  25-29     21967328.
  30-34     22058888.
  35-39     20138388.
  40-44     18001916.
  45-49     14192279.
  50-54     11705971.
  55-59     10862325.
  60-64     11041520.
  65-69     10298760.
  70-74      8064410.
  75+       11368890.

 DISTRIBUTION OF POPULATN
  BY SEX
 MALE      123028940.
 FEMALE    127709605.

 DISTRIBUTION OF POPULATN
  BY RACE
 WHITE     197443844.
 OTHER      53294702.
```

CROSSTABULATION OF POPULATN
 BY AGE AND SEX

	MALE	FEMALE
0-4	9492151.	9177466.
5-9	9556684.	9249364.
10-14	8735127.	8366112.
15-19	8915115.	8545552.
20-24	9682667.	9317633.
25-29	11135944.	10831384.
30-34	11007309.	11051579.
35-39	9985651.	10152737.
40-44	8867066.	9134850.
45-49	6942907.	7249371.
50-54	5685799.	6020171.
55-59	5209615.	5652710.
60-64	5180874.	5860647.
65-69	4692481.	5606280.
70-74	3550310.	4514099.
75+	4389239.	6979651.

CROSSTABULATION OF POPULATN
 BY AGE AND RACE

	WHITE	OTHER
0-4	13386385.	5283232.
5-9	13621659.	5184390.
10-14	12648435.	4452804.
15-19	13055499.	4405168.
20-24	14468046.	4532254.
25-29	16941640.	5025688.
30-34	17251096.	4807792.
35-39	15930166.	4208222.
40-44	14547949.	3453967.
45-49	11604716.	2587563.
50-54	9575698.	2130273.
55-59	9022988.	1839336.
60-64	9362446.	1679074.
65-69	8906125.	1392635.
70-74	7060025.	1004385.
75+	10060972.	1307918.

CROSSTABULATION OF POPULATN
 BY SEX AND RACE

	MALE	FEMALE
WHITE	97116269.	100327575.
OTHER	25912671.	27382030.

CROSSTABULATION OF POPULATN
 BY AGE, SEX, AND RACE

	WHITE	
	MALE	FEMALE
0-4	6808785.	6577600.

5-9	6925470.	6696189.
10-14	6486648.	6161786.
15-19	6690797.	6364702.
20-24	7400519.	7067527.
25-29	8607548.	8334093.
30-34	8649989.	8601107.
35-39	7966863.	7963303.
40-44	7239716.	7308232.
45-49	5738483.	5866234.
50-54	4701144.	4874554.
55-59	4377281.	4645708.
60-64	4439947.	4922499.
65-69	4080277.	4825848.
70-74	3124926.	3935098.
75+	3877875.	6183096.

	OTHER	
	MALE	FEMALE
0-4	2683366.	2599866.
5-9	2631214.	2553175.
10-14	2248479.	2204325.
15-19	2224318.	2180851.
20-24	2282148.	2250106.
25-29	2528396.	2497292.
30-34	2357320.	2450472.
35-39	2018788.	2189434.
40-44	1627350.	1826618.
45-49	1204425.	1383138.
50-54	984655.	1145617.
55-59	832334.	1007002.
60-64	740927.	938147.
65-69	612203.	780432.
70-74	425384.	579001.
75+	511364.	796554.

Listing 5. CHECK Run for Example 3 (State Population Projection, Single-Race Model)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: CHECK
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   12:22:47

 NAME OF PARAMETER FILE = AZ801.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA                     RESIDENT                      POPULATION

 BASE YEAR = 1980

 NO OF RACIAL/ETHNIC GROUPS = 1
 NO OF REGIONS =  0
 VITAL STATISTICS PARAMETER OPTION = 1
 LIFE TABLE OPTION = 1
 EXTERNAL MIGRATION OPTION = 1
 INTERNAL MIGRATION OPTION = 0
 SERVICE SYSTEM OPTION = 0
 NAME(S) OF RACE    ...
      ALL

 PARAMETERS FOR RACE = ALL
 TOTAL FERTILITY RATE(S)...
      2.129
 FERTILITY AGE DISTRIBUTION(S)...
       .147 .312 .312 .166 .052 .011
 INFANT MORTALITY RATE(S)...
       13.56
 EXPECTATION OF LIFE AT BIRTH CORRESPONDING TO IMR FOR FIRST
   PROJECTION PERIOD = 74.44
 BASE-YEAR POPULATION AND SURVIVAL PROBABILITIES FOR FIRST PROJECTION
PERIOD...
                     MALE      FEMALE        MALE    FEMALE
         0                                  .9811    .9867
        0-4        109075.     104808.      .9972    .9981
        5-9        107650.     103417.      .9983    .9990
       10-14       111583.     107990.      .9976    .9988
       15-19       128283.     123734.      .9963    .9982
       20-24       133486.     130297.      .9957    .9976
       25-29       119140.     116911.      .9955    .9970
       30-34       104855.     102909.      .9945    .9959
       35-39        80333.      82540.      .9920    .9939
       40-44        66836.      68279.      .9866    .9901
       45-49        61538.      63533.      .9769    .9839
       50-54        60295.      66454.      .9601    .9743
       55-59        61155.      71352.      .9340    .9583
       60-64        57682.      66718.      .8938    .9287
```

```
      65-69        53009.      61835.      .8312    .8757
      70-74        39867.      47409.      .7393    .7893
      75+          43155.      62087.      .4922    .5307
      TOTAL      1337942.    1380273.
 TOTAL BASE-YEAR POPULATION (POPBASE) =   2718215.
 CRUDE BIRTH RATE FOR BASE YEAR =  18.40
 CRUDE DEATH RATE FOR BASE YEAR =   7.80
 INFANT MORTALITY RATE FOR BASE YEAR =  12.40
 POPULATION (POPPREV) TEN YEARS PRIOR TO BASE YEAR =   1770900.
 AVERAGE CRUDE BIRTH RATE FOR PREVIOUS TEN YEARS =  18.32
 AVERAGE CRUDE DEATH RATE FOR PREVIOUS TEN YEARS =   7.71
 AVERAGE INFANT MORTALITY RATE FOR PREVIOUS TEN YEARS =  14.94
 ANNUAL EXTERNAL MIGRATION RATE(S) (PER 1000) (EMRATE)...
         .000
 ANNUAL EXTERNAL MIGRATION NUMBER(S) (IMMNO)...
         71507.
 TOTAL FERTILITY RATE (TFREST) ESTIMATED FROM BASE-YEAR BIRTH RATE =
2.129
 TOTAL FERTILITY RATE (TFR) SPECIFIED FOR FIRST PROJECTION PERIOD =
2.129
   GENERAL FERTILITY RATE (BIRTH RATE (BRFF) PER 1000 FEMALES AGED
15-44)
    FOR BASE YEAR =  80.07
 ESTIMATE OF ANNUAL NET EXTERNAL MIGRATION NUMBER (BASED  ON BIRTH
RATE
   AND DEATH RATE FOR PREVIOUS TEN YEARS) =     71507.
   ESTIMATED ANNUAL RATE PER 1000 =   33.170
 ANNUAL NET MIGRATION NUMBER SPECIFIED FOR FIRST PROJECTION PERIOD =
   71507.
   ANNUAL NET MIGRATION RATE PER 1000 SPECIFIED FOR FIRST PROJECTION
   PERIOD =     .000
 ANNUAL NET MIGRATION (MIG) IMPLIED BY MIGRATION NUMBER (IMMNO) AND/OR
   MIGRATION RATE (EMRATE) SPECIFIED FOR FIRST PROJECTION PERIOD =
 71507.
   APPROX ANNUAL RATE PER 1000 POPULATION (MIGR) =   26.307
 CRUDE BIRTH RATE PER 1000 (CBR) FOR FIRST PROJECTION PERIOD = 16.896
 CRUDE DEATH RATE PER 1000 (CDR) FOR FIRST PROJECTION PERIOD =  9.272
 AVERAGE ANNUAL POPULATION GROWTH RATE PER 1000 FOR PREVIOUS TEN YEARS
   = 1000((POPBASE/POPPREV(IR))**.1-1) =  43.78
 PROJECTED POPULATION GROWTH RATE (GIVEN SPECIFIED PARAMETERS):
   1000((POPPROJ/POPBASE)**.2-1) =  32.50
   APPROX. ANNUAL POPULATION GROWTH RATE PER 1000, BASED ON CBR,
    CDR, AND MIGR = CBR-CDR+MIGR =  33.93
```

Listing 6. PROJ Run for Example 3 (State Population Projection, Single-Race Model)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: PROJ
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   12:22:57

 PARAMETER FILE NAME: AZ801.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA                     RESIDENT                        POPULATION

 BASE YEAR: 1980

 NO OF FIVE-YEAR PERIODS TO PROJECT = 2

 YEAR: 1990

 DISTRIBUTIONAL ANALYSIS OF POPULATN

 TOTAL POPULATN =     3694625.

 DISTRIBUTION OF POPULATN
  BY AGE
   0-4        308528.
   5-9        309834.
  10-14       265533.
  15-19       262196.
  20-24       272382.
  25-29       312138.
  30-34       326384.
  35-39       291639.
  40-44       255842.
  45-49       199194.
  50-54       163155.
  55-59       147819.
  60-64       144704.
  65-69       142762.
  70-74       121020.
  75+         171493.

 DISTRIBUTION OF POPULATN
  BY SEX
 MALE        1827212.
 FEMALE      1867413.

 CROSSTABULATION OF POPULATN
  BY AGE AND SEX
               MALE        FEMALE
   0-4        156914.     151614.
```

5-9	157507.	152327.
10-14	135307.	130226.
15-19	133601.	128596.
20-24	138207.	134175.
25-29	158591.	153548.
30-34	164894.	161490.
35-39	146991.	144649.
40-44	128908.	126934.
45-49	97980.	101214.
50-54	80273.	82882.
55-59	71925.	75893.
60-64	67382.	77322.
65-69	63623.	79139.
70-74	53404.	67616.
75+	71705.	99788.

Listing 7. CHECK Run for Example 4 (State Population Projection, Three-Race, 14-Region Model)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: CHECK
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   12:52: 1

 NAME OF PARAMETER FILE = AZ803C.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA   RESIDENT   POPULATION   BY   COUNTY   AND   RACE   (W/I/O)

 BASE YEAR = 1980

 NO OF RACIAL/ETHNIC GROUPS = 3
 NO OF REGIONS = 14
 VITAL STATISTICS PARAMETER OPTION = 1
 LIFE TABLE OPTION = 1
 EXTERNAL MIGRATION OPTION = 1
 INTERNAL MIGRATION OPTION = 1
 SERVICE SYSTEM OPTION = 0
 NAME(S) OF RACE    ...
      WHITE
      AMERIND
      OTHER
 NAME(S) OF REGION  ...
      APACHE
      COCHISE
      COCONINO
      GILA
      GRAHAM
      GREENLEE
      MARICOPA
      MOHAVE
      NAVAJO
      PIMA
      PINAL
      STA.CRUZ
      YAVAPAI
      YUMA

 PARAMETERS FOR RACE = WHITE
 TOTAL FERTILITY RATE(S)...
      2.232
 FERTILITY AGE DISTRIBUTION(S)...
       .130 .312 .326 .170 .051 .011
 INFANT MORTALITY RATE(S)...
       11.70
 EXPECTATION OF LIFE AT BIRTH CORRESPONDING TO IMR FOR FIRST
   PROJECTION PERIOD = 75.14
```

BASE-YEAR POPULATION AND SURVIVAL PROBABILITIES FOR FIRST PROJECTION PERIOD...

	MALE	FEMALE	MALE	FEMALE
0			.9839	.9889
0-4	79351.	76208.	.9978	.9986
5-9	80415.	76578.	.9986	.9992
10-14	85306.	82032.	.9979	.9991
15-19	99026.	95899.	.9968	.9986
20-24	106315.	104137.	.9963	.9981
25-29	96311.	95364.	.9962	.9975
30-34	87382.	85981.	.9953	.9966
35-39	68203.	69718.	.9930	.9947
40-44	56493.	57394.	.9880	.9911
45-49	52916.	54059.	.9786	.9852
50-54	53052.	58170.	.9624	.9761
55-59	55155.	64721.	.9370	.9608
60-64	53162.	61749.	.8976	.9321
65-69	49283.	57527.	.8357	.8801
70-74	37022.	44379.	.7446	.7947
75+	39590.	57863.	.4970	.5354
TOTAL	1098982.	1141779.		

TOTAL BASE-YEAR POPULATION (POPBASE) = 2240761.
CRUDE BIRTH RATE FOR BASE YEAR = 18.90
CRUDE DEATH RATE FOR BASE YEAR = 8.80
INFANT MORTALITY RATE FOR BASE YEAR = 11.70
POPULATION (POPPREV) TEN YEARS PRIOR TO BASE YEAR = 1604948.
AVERAGE CRUDE BIRTH RATE FOR PREVIOUS TEN YEARS = 18.90
AVERAGE CRUDE DEATH RATE FOR PREVIOUS TEN YEARS = 8.80
AVERAGE INFANT MORTALITY RATE FOR PREVIOUS TEN YEARS = 11.70
ANNUAL EXTERNAL MIGRATION RATE(S) (PER 1000) (EMRATE)...
.000
ANNUAL EXTERNAL MIGRATION NUMBER(S) (IMMNO)...
44535.
POPULATION BY REGION...

	BASE YEAR	TEN YEARS PRIOR
APACHE	11902.	7525.
COCHISE	73261.	59027.
COCONINO	49235.	34141.
GILA	30147.	25662.
GRAHAM	17085.	14201.
GREENLEE	9357.	9793.
MARICOPA	1307455.	914610.
MOHAVE	53477.	24738.
NAVAJO	32543.	26893.
PIMA	442888.	326416.
PINAL	61849.	58141.
STA.CRUZ	16515.	13091.
YAVAPAI	65322.	35713.
YUMA	69725.	54997.
TOTAL	2240761.	1604948.

TOTAL FERTILITY RATE (TFREST) ESTIMATED FROM BASE-YEAR BIRTH RATE = 2.232

TOTAL FERTILITY RATE (TFR) SPECIFIED FOR FIRST PROJECTION PERIOD = 2.232
GENERAL FERTILITY RATE (BIRTH RATE (BRFF) PER 1000 FEMALES AGED 15-44)
FOR BASE YEAR = 83.29
ESTIMATE OF ANNUAL NET EXTERNAL MIGRATION NUMBER (BASED ON BIRTH RATE
AND DEATH RATE FOR PREVIOUS TEN YEARS) = 44535.
ESTIMATED ANNUAL RATE PER 1000 = 23.836
ANNUAL NET MIGRATION NUMBER SPECIFIED FOR FIRST PROJECTION PERIOD = 44535.
ANNUAL NET MIGRATION RATE PER 1000 SPECIFIED FOR FIRST PROJECTION PERIOD = .000
ANNUAL NET MIGRATION (MIG) IMPLIED BY MIGRATION NUMBER (IMMNO) AND/OR MIGRATION RATE (EMRATE) SPECIFIED FOR FIRST PROJECTION PERIOD = 44535.
APPROX ANNUAL RATE PER 1000 POPULATION (MIGR) = 19.875
ESTIMATES (BY REGION) OF THE ANNUAL INTERNAL MIGRATION NUMBER AND RATE (PER
1000) BASED ON THE EXTERNAL MIGRATION ESTIMATE:

	AMOUNT	RATE APPROX	RATE EXACT
APACHE :	106.	8.874	11.257
COCHISE :	-692.	-9.450	-10.599
COCONINO:	119.	2.411	2.920
GILA :	-430.	-14.259	-15.539
GRAHAM :	-207.	-12.143	-13.399
GREENLEE:	-327.	-34.897	-34.043
MARICOPA:	2309.	1.766	2.130
MOHAVE :	1433.	26.796	39.480
NAVAJO :	-379.	-11.634	-12.877
PIMA :	-972.	-2.194	-2.576
PINAL :	-1462.	-23.642	-24.442
STA.CRUZ:	-133.	-8.073	-9.132
YAVAPAI :	1170.	17.909	24.387
YUMA :	-534.	-7.661	-8.687
TOTAL :	0.		

SPECIFIED AND IMPLIED VALUES (BY REGION) OF THE ANNUAL INTERNAL MIGRATION
NUMBER AND RATE (PER 1000):

	SPECIFIED		IMPLIED	
	AMOUNT	RATE	AMOUNT	RATE
APACHE :	106.	.000	106.	8.906
COCHISE :	0.	-10.599	-776.	-10.599
COCONINO:	119.	.000	119.	2.417
GILA :	0.	-15.539	-468.	-15.539
GRAHAM :	0.	-13.399	-229.	-13.399
GREENLEE:	0.	-34.043	-319.	-34.043
MARICOPA:	2309.	.000	2309.	1.766
MOHAVE :	1433.	.000	1433.	26.797
NAVAJO :	0.	-12.877	-419.	-12.877
PIMA :	0.	-2.576	-1141.	-2.576

```
 PINAL   :        0. -24.442    -1512. -24.442
 STA.CRUZ:        0.  -9.132     -151.  -9.132
 YAVAPAI :     1170.    .000     1170.  17.911
 YUMA    :        0.  -8.687     -606.  -8.687
 CRUDE BIRTH RATE PER 1000 (CBR) FOR FIRST PROJECTION PERIOD = 17.463
 CRUDE DEATH RATE PER 1000 (CDR) FOR FIRST PROJECTION PERIOD =  9.938
 AVERAGE ANNUAL POPULATION GROWTH RATE PER 1000 FOR PREVIOUS TEN YEARS
   = 1000((POPBASE/POPPREV(IR))**.1-1) =  33.94
 PROJECTED POPULATION GROWTH RATE (GIVEN SPECIFIED PARAMETERS):
   1000((POPPROJ/POPBASE)**.2-1) =  26.75
   APPROX. ANNUAL POPULATION GROWTH RATE PER 1000, BASED ON CBR,
    CDR, AND MIGR = CBR-CDR+MIGR =  27.40

 PARAMETERS FOR RACE = AMERIND
 TOTAL FERTILITY RATE(S)...
      3.487
 FERTILITY AGE DISTRIBUTION(S)...
       .221 .312 .251 .143 .058 .015
 INFANT MORTALITY RATE(S)...
       16.20
 EXPECTATION OF LIFE AT BIRTH CORRESPONDING TO IMR FOR FIRST
   PROJECTION PERIOD = 73.43
 BASE-YEAR POPULATION AND SURVIVAL PROBABILITIES FOR FIRST PROJECTION
PERIOD...
                    MALE      FEMALE        MALE    FEMALE
         0                                 .9772    .9835
        0-4          9853.       9732.     .9963    .9973
        5-9          9288.       9237.     .9979    .9987
       10-14         9575.       9465.     .9972    .9985
       15-19         9931.       9973.     .9956    .9977
       20-24         7250.       7979.     .9949    .9969
       25-29         5681.       6237.     .9946    .9961
       30-34         4817.       4988.     .9934    .9949
       35-39         3524.       4054.     .9906    .9927
       40-44         3120.       3522.     .9848    .9886
       45-49         2532.       3103.     .9744    .9820
       50-54         2123.       2579.     .9569    .9717
       55-59         1758.       2122.     .9298    .9548
       60-64         1362.       1555.     .8885    .9239
       65-69         1154.       1382.     .8248    .8694
       70-74          928.        916.     .7318    .7816
       75+           1349.       1409.     .4855    .5239
       TOTAL        74245.      78253.
 TOTAL BASE-YEAR POPULATION (POPBASE) =    152498.
 CRUDE BIRTH RATE FOR BASE YEAR =  33.20
 CRUDE DEATH RATE FOR BASE YEAR =   6.50
 INFANT MORTALITY RATE FOR BASE YEAR =  16.20
 POPULATION (POPPREV) TEN YEARS PRIOR TO BASE YEAR =     95812.
 AVERAGE CRUDE BIRTH RATE FOR PREVIOUS TEN YEARS =  33.20
 AVERAGE CRUDE DEATH RATE FOR PREVIOUS TEN YEARS =   6.50
 AVERAGE INFANT MORTALITY RATE FOR PREVIOUS TEN YEARS =  16.20
 ANNUAL EXTERNAL MIGRATION RATE(S) (PER 1000) (EMRATE)...
```

.000
ANNUAL EXTERNAL MIGRATION NUMBER(S) (IMMNO)...
2462.
POPULATION BY REGION...

	BASE YEAR	TEN YEARS PRIOR
APACHE	39024.	24518.
COCHISE	489.	307.
COCONINO	20904.	13134.
GILA	5083.	3194.
GRAHAM	2740.	1721.
GREENLEE	229.	144.
MARICOPA	22788.	14317.
MOHAVE	1462.	919.
NAVAJO	32122.	20182.
PIMA	14880.	9349.
PINAL	8487.	5332.
STA.CRUZ	57.	36.
YAVAPAI	997.	626.
YUMA	3236.	2033.
TOTAL	152498.	95812.

TOTAL FERTILITY RATE (TFREST) ESTIMATED FROM BASE-YEAR BIRTH RATE = 3.487
TOTAL FERTILITY RATE (TFR) SPECIFIED FOR FIRST PROJECTION PERIOD = 3.487
GENERAL FERTILITY RATE (BIRTH RATE (BRFF) PER 1000 FEMALES AGED 15-44)
FOR BASE YEAR = 137.76
ESTIMATE OF ANNUAL NET EXTERNAL MIGRATION NUMBER (BASED ON BIRTH RATE
AND DEATH RATE FOR PREVIOUS TEN YEARS) = 2462.
ESTIMATED ANNUAL RATE PER 1000 = 20.873
ANNUAL NET MIGRATION NUMBER SPECIFIED FOR FIRST PROJECTION PERIOD = 2462.
ANNUAL NET MIGRATION RATE PER 1000 SPECIFIED FOR FIRST PROJECTION PERIOD = .000
ANNUAL NET MIGRATION (MIG) IMPLIED BY MIGRATION NUMBER (IMMNO) AND/OR MIGRATION RATE (EMRATE) SPECIFIED FOR FIRST PROJECTION PERIOD = 2462.
APPROX ANNUAL RATE PER 1000 POPULATION (MIGR) = 16.144
ESTIMATES (BY REGION) OF THE ANNUAL INTERNAL MIGRATION NUMBER AND RATE (PER 1000) BASED ON THE EXTERNAL MIGRATION ESTIMATE:

	AMOUNT	RATE APPROX	RATE EXACT
APACHE :	0.	.000	.001
COCHISE :	0.	.054	.070
COCONINO:	0.	-.002	-.003
GILA :	0.	-.010	-.013
GRAHAM :	0.	.021	.027
GREENLEE:	0.	-.062	-.079
MARICOPA:	0.	.002	.002
MOHAVE :	0.	-.035	-.045

```
 NAVAJO  :        0.   -.001   -.001
 PIMA    :        0.   -.001   -.001
 PINAL   :        0.    .003    .004
 STA.CRUZ:        0.   -.380   -.486
 YAVAPAI :        0.    .046    .059
 YUMA    :        0.    .004    .006
 TOTAL   :        0.
 SPECIFIED AND IMPLIED VALUES (BY REGION) OF THE ANNUAL INTERNAL
MIGRATION
   NUMBER AND RATE (PER 1000):
                 SPECIFIED          IMPLIED
              AMOUNT    RATE    AMOUNT    RATE
 APACHE  :        0.    .000        0.    .000
 COCHISE :        0.    .000        0.    .000
 COCONINO:        0.    .000        0.    .000
 GILA    :        0.    .000        0.    .000
 GRAHAM  :        0.    .000        0.    .000
 GREENLEE:        0.    .000        0.    .000
 MARICOPA:        0.    .000        0.    .000
 MOHAVE  :        0.    .000        0.    .000
 NAVAJO  :        0.    .000        0.    .000
 PIMA    :        0.    .000        0.    .000
 PINAL   :        0.    .000        0.    .000
 STA.CRUZ:        0.    .000        0.    .000
 YAVAPAI :        0.    .000        0.    .000
 YUMA    :        0.    .000        0.    .000
 CRUDE BIRTH RATE PER 1000 (CBR) FOR FIRST PROJECTION PERIOD = 28.208
 CRUDE DEATH RATE PER 1000 (CDR) FOR FIRST PROJECTION PERIOD =  5.230
 AVERAGE ANNUAL POPULATION GROWTH RATE PER 1000 FOR PREVIOUS TEN YEARS
   = 1000((POPBASE/POPPREV(IR))**.1-1) =  47.57
 PROJECTED POPULATION GROWTH RATE (GIVEN SPECIFIED PARAMETERS):
   1000((POPPROJ/POPBASE)**.2-1) =  37.84
   APPROX. ANNUAL POPULATION GROWTH RATE PER 1000, BASED ON CBR,
    CDR, AND MIGR = CBR-CDR+MIGR =  39.12

 PARAMETERS FOR RACE = OTHER
 TOTAL FERTILITY RATE(S)...
      2.346
 FERTILITY AGE DISTRIBUTION(S)...
       .221 .312 .251 .143 .058 .015
 INFANT MORTALITY RATE(S)...
       21.10
 EXPECTATION OF LIFE AT BIRTH CORRESPONDING TO IMR FOR FIRST
   PROJECTION PERIOD = 71.57
 BASE-YEAR POPULATION AND SURVIVAL PROBABILITIES FOR FIRST PROJECTION
PERIOD...
                    MALE      FEMALE        MALE    FEMALE
         0                                 .9698    .9775
        0-4         19871.      18868.      .9946    .9960
        5-9         17947.      17602.      .9971    .9981
       10-14        16702.      16493.      .9963    .9978
       15-19        19326.      17862.      .9943    .9966
```

20-24	19921.	18181.	.9933	.9956
25-29	17148.	15310.	.9929	.9946
30-34	12656.	11940.	.9913	.9931
35-39	8606.	8768.	.9879	.9905
40-44	7223.	7363.	.9813	.9859
45-49	6090.	6371.	.9697	.9784
50-54	5120.	5705.	.9509	.9670
55-59	4242.	4509.	.9220	.9482
60-64	3158.	3414.	.8787	.9150
65-69	2572.	2926.	.8128	.8577
70-74	1917.	2114.	.7179	.7673
75+	2216.	2815.	.4730	.5113
TOTAL	164715.	160241.		

TOTAL BASE-YEAR POPULATION (POPBASE) = 324956.
CRUDE BIRTH RATE FOR BASE YEAR = 22.80
CRUDE DEATH RATE FOR BASE YEAR = 7.80
INFANT MORTALITY RATE FOR BASE YEAR = 21.10
POPULATION (POPPREV) TEN YEARS PRIOR TO BASE YEAR = 70140.
AVERAGE CRUDE BIRTH RATE FOR PREVIOUS TEN YEARS = 22.80
AVERAGE CRUDE DEATH RATE FOR PREVIOUS TEN YEARS = 7.80
AVERAGE INFANT MORTALITY RATE FOR PREVIOUS TEN YEARS = 21.10
ANNUAL EXTERNAL MIGRATION RATE(S) (PER 1000) (EMRATE)...
.000
ANNUAL EXTERNAL MIGRATION NUMBER(S) (IMMNO)...
22756.
POPULATION BY REGION...

	BASE YEAR	TEN YEARS PRIOR
APACHE	1182.	255.
COCHISE	11936.	2576.
COCONINO	4869.	1051.
GILA	1850.	399.
GRAHAM	3037.	656.
GREENLEE	1820.	393.
MARICOPA	178809.	38595.
MOHAVE	926.	200.
NAVAJO	2964.	640.
PIMA	73675.	15902.
PINAL	20582.	4443.
STA.CRUZ	3887.	839.
YAVAPAI	1826.	394.
YUMA	17593.	3797.
TOTAL	324956.	70140.

TOTAL FERTILITY RATE (TFREST) ESTIMATED FROM BASE-YEAR BIRTH RATE = 2.346
TOTAL FERTILITY RATE (TFR) SPECIFIED FOR FIRST PROJECTION PERIOD = 2.346
GENERAL FERTILITY RATE (BIRTH RATE (BRFF) PER 1000 FEMALES AGED 15-44)
FOR BASE YEAR = 93.28
ESTIMATE OF ANNUAL NET EXTERNAL MIGRATION NUMBER (BASED ON BIRTH RATE
AND DEATH RATE FOR PREVIOUS TEN YEARS) = 22756.

ESTIMATED ANNUAL RATE PER 1000 = 150.698
ANNUAL NET MIGRATION NUMBER SPECIFIED FOR FIRST PROJECTION PERIOD = 22756.
ANNUAL NET MIGRATION RATE PER 1000 SPECIFIED FOR FIRST PROJECTION PERIOD = .000
ANNUAL NET MIGRATION (MIG) IMPLIED BY MIGRATION NUMBER (IMMNO) AND/OR MIGRATION RATE (EMRATE) SPECIFIED FOR FIRST PROJECTION PERIOD = 22756.
APPROX ANNUAL RATE PER 1000 POPULATION (MIGR) = 70.028
ESTIMATES (BY REGION) OF THE ANNUAL INTERNAL MIGRATION NUMBER AND RATE (PER 1000) BASED ON THE EXTERNAL MIGRATION ESTIMATE:

	AMOUNT	RATE APPROX	RATE EXACT
APACHE :	0.	.012	.021
COCHISE :	0.	.003	.005
COCONINO:	0.	-.001	-.002
GILA :	0.	.018	.033
GRAHAM :	0.	-.017	-.031
GREENLEE:	0.	-.010	-.018
MARICOPA:	0.	.000	.000
MOHAVE :	0.	-.015	-.027
NAVAJO :	0.	-.009	-.016
PIMA :	0.	.001	.001
PINAL :	0.	-.003	-.005
STA.CRUZ:	0.	.000	-.001
YAVAPAI :	0.	.008	.014
YUMA :	0.	.002	.004
TOTAL :	0.		

SPECIFIED AND IMPLIED VALUES (BY REGION) OF THE ANNUAL INTERNAL MIGRATION NUMBER AND RATE (PER 1000):

	SPECIFIED AMOUNT	SPECIFIED RATE	IMPLIED AMOUNT	IMPLIED RATE
APACHE :	0.	.000	0.	.000
COCHISE :	0.	.000	0.	.000
COCONINO:	0.	.000	0.	.000
GILA :	0.	.000	0.	.000
GRAHAM :	0.	.000	0.	.000
GREENLEE:	0.	.000	0.	.000
MARICOPA:	0.	.000	0.	.000
MOHAVE :	0.	.000	0.	.000
NAVAJO :	0.	.000	0.	.000
PIMA :	0.	.000	0.	.000
PINAL :	0.	.000	0.	.000
STA.CRUZ:	0.	.000	0.	.000
YAVAPAI :	0.	.000	0.	.000
YUMA :	0.	.000	0.	.000

CRUDE BIRTH RATE PER 1000 (CBR) FOR FIRST PROJECTION PERIOD = 20.349
CRUDE DEATH RATE PER 1000 (CDR) FOR FIRST PROJECTION PERIOD = 5.571
AVERAGE ANNUAL POPULATION GROWTH RATE PER 1000 FOR PREVIOUS TEN YEARS = 1000((POPBASE/POPPREV(IR))**.1-1) = 165.70

```
 PROJECTED POPULATION GROWTH RATE (GIVEN SPECIFIED PARAMETERS):
   1000((POPPROJ/POPBASE)**.2-1) =  73.94
   APPROX. ANNUAL POPULATION GROWTH RATE PER 1000, BASED ON CBR,
    CDR, AND MIGR = CBR-CDR+MIGR =  84.81

 TOTAL POPULATION (ALL RACES) =   2718215.

 ESTIMATE OF ANNUAL NET EXTERNAL MIGRATION NUMBER (BASED ON BIRTH RATE
AND
    DEATH RATE FOR PREVIOUS TEN YEARS; TOTAL FOR ALL RACES IN THE
MODEL)
    =     69311.
    ESTIMATED ANNUAL RATE PER 1000 =   32.163
```

Listing 8. PROJ Run for Example 4 (State Population Projection, Three-Race, 14-Region Model)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: PROJ
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   12:53:32

 PARAMETER FILE NAME: AZ803C.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA   RESIDENT   POPULATION   BY   COUNTY   AND   RACE   (W/I/O)

 BASE YEAR: 1980

 NO OF FIVE-YEAR PERIODS TO PROJECT = 2

 YEAR: 1990

 DISTRIBUTIONAL ANALYSIS OF POPULATN

 TOTAL POPULATN =     3735219.

 DISTRIBUTION OF POPULATN
  BY RACE
 WHITE       2886323.
 AMERIND      228240.
 OTHER        620656.

 DISTRIBUTION OF POPULATN
  BY REGION
 APACHE        72497.
 COCHISE       97683.
 COCONINO      97171.
 GILA          40759.
 GRAHAM        26383.
 GREENLEE      11039.
 MARICOPA    1893992.
 MOHAVE        83827.
 NAVAJO        84127.
 PIMA         649633.
 PINAL        101590.
 STA.CRUZ      24075.
 YAVAPAI       95609.
 YUMA         108068.

 CROSSTABULATION OF POPULATN
  BY REGION AND RACE
               WHITE       AMERIND     OTHER
 APACHE        15397.      55256.       1844.
 COCHISE       78373.        692.      18618.
```

COCONINO	59977.	29599.	7595.
GILA	30676.	7197.	2886.
GRAHAM	17766.	3880.	4737.
GREENLEE	7876.	324.	2839.
MARICOPA	1582814.	32267.	278911.
MOHAVE	80313.	2070.	1444.
NAVAJO	34020.	45483.	4623.
PIMA	513643.	21069.	114920.
PINAL	57469.	12017.	32104.
STA.CRUZ	17931.	81.	6063.
YAVAPAI	91349.	1412.	2848.
YUMA	76044.	4582.	27442.

Listing 9. CHECK Run for Example 5 (Projection of the Hispanic Population)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: CHECK
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   12:59:28

 NAME OF PARAMETER FILE = AZ80HC.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA  RESIDENT  POPULATION  BY  HISPANIC  STATUS  AND  REGION

 BASE YEAR = 1980

 NO OF RACIAL/ETHNIC GROUPS = 2
 NO OF REGIONS = 14
 VITAL STATISTICS PARAMETER OPTION = 1
 LIFE TABLE OPTION = 1
 EXTERNAL MIGRATION OPTION = 1
 INTERNAL MIGRATION OPTION = 1
 SERVICE SYSTEM OPTION = 0
 NAME(S) OF RACE    ...
      HISPANIC
      NON HISP
 NAME(S) OF REGION  ...
      APACHE
      COCHISE
      COCONINO
      GILA
      GRAHAM
      GREENLEE
      MARICOPA
      MOHAVE
      NAVAJO
      PIMA
      PINAL
      STA.CRUZ
      YAVAPAI
      YUMA

 PARAMETERS FOR RACE = HISPANIC
 TOTAL FERTILITY RATE(S)...
      3.190
 FERTILITY AGE DISTRIBUTION(S)...
       .221 .312 .251 .143 .058 .015
 INFANT MORTALITY RATE(S)...
       12.40
 EXPECTATION OF LIFE AT BIRTH CORRESPONDING TO IMR FOR FIRST
   PROJECTION PERIOD = 74.88
 BASE-YEAR POPULATION AND SURVIVAL PROBABILITIES FOR FIRST PROJECTION
```

PERIOD...

	MALE	FEMALE	MALE	FEMALE
0			.9829	.9881
0-4	27940.	26823.	.9976	.9984
5-9	25652.	25079.	.9985	.9991
10-14	24234.	23538.	.9978	.9990
15-19	26081.	24824.	.9966	.9985
20-24	23080.	22734.	.9961	.9979
25-29	20171.	19195.	.9959	.9973
30-34	15889.	15780.	.9950	.9963
35-39	11668.	12241.	.9926	.9944
40-44	9644.	10217.	.9875	.9907
45-49	8380.	9015.	.9780	.9847
50-54	7608.	8290.	.9616	.9754
55-59	6317.	6759.	.9359	.9599
60-64	4672.	5073.	.8962	.9309
65-69	3525.	3986.	.8340	.8784
70-74	2545.	2938.	.7427	.7926
75+	2840.	3963.	.4952	.5337
TOTAL	220246.	220455.		

TOTAL BASE-YEAR POPULATION (POPBASE) = 440701.
CRUDE BIRTH RATE FOR BASE YEAR = 29.70
CRUDE DEATH RATE FOR BASE YEAR = 7.80
INFANT MORTALITY RATE FOR BASE YEAR = 12.40
POPULATION (POPPREV) TEN YEARS PRIOR TO BASE YEAR = 293485.
AVERAGE CRUDE BIRTH RATE FOR PREVIOUS TEN YEARS = 29.70
AVERAGE CRUDE DEATH RATE FOR PREVIOUS TEN YEARS = 7.80
AVERAGE INFANT MORTALITY RATE FOR PREVIOUS TEN YEARS = 12.40
ANNUAL EXTERNAL MIGRATION RATE(S) (PER 1000) (EMRATE)...
.000
ANNUAL EXTERNAL MIGRATION NUMBER(S) (IMMNO)...
8159.
POPULATION BY REGION...

	BASE YEAR	TEN YEARS PRIOR
APACHE	1983.	1229.
COCHISE	22846.	16507.
COCONINO	7315.	4713.
GILA	7723.	6093.
GRAHAM	5457.	3957.
GREENLEE	5446.	4932.
MARICOPA	199003.	127590.
MOHAVE	2148.	994.
NAVAJO	4538.	3202.
PIMA	111418.	73728.
PINAL	26752.	19984.
STA.CRUZ	15229.	10396.
YAVAPAI	4205.	2267.
YUMA	26638.	17893.
TOTAL	440701.	293485.

TOTAL FERTILITY RATE (TFREST) ESTIMATED FROM BASE-YEAR BIRTH RATE = 3.190
TOTAL FERTILITY RATE (TFR) SPECIFIED FOR FIRST PROJECTION PERIOD =

3.190
GENERAL FERTILITY RATE (BIRTH RATE (BRFF) PER 1000 FEMALES AGED 15-44)
FOR BASE YEAR = 124.67
ESTIMATE OF ANNUAL NET EXTERNAL MIGRATION NUMBER (BASED ON BIRTH RATE
AND DEATH RATE FOR PREVIOUS TEN YEARS) = 6901.
ESTIMATED ANNUAL RATE PER 1000 = 19.592
ANNUAL NET MIGRATION NUMBER SPECIFIED FOR FIRST PROJECTION PERIOD = 8159.
ANNUAL NET MIGRATION RATE PER 1000 SPECIFIED FOR FIRST PROJECTION PERIOD = .000
ANNUAL NET MIGRATION (MIG) IMPLIED BY MIGRATION NUMBER (IMMNO) AND/OR MIGRATION RATE (EMRATE) SPECIFIED FOR FIRST PROJECTION PERIOD = 8159.
APPROX ANNUAL RATE PER 1000 POPULATION (MIGR) = 18.514
ESTIMATES (BY REGION) OF THE ANNUAL INTERNAL MIGRATION NUMBER AND RATE (PER 1000) BASED ON THE EXTERNAL MIGRATION ESTIMATE:

	AMOUNT	RATE APPROX	RATE EXACT
APACHE :	10.	5.193	6.697
COCHISE :	-145.	-6.362	-7.581
COCONINO:	18.	2.435	3.079
GILA :	-107.	-13.829	-15.731
GRAHAM :	-36.	-6.653	-7.913
GREENLEE:	-147.	-26.947	-28.458
MARICOPA:	555.	2.789	3.535
MOHAVE :	49.	22.846	34.036
NAVAJO :	-20.	-4.458	-5.378
PIMA :	53.	.475	.593
PINAL :	-244.	-9.114	-10.672
STA.CRUZ:	-29.	-1.877	-2.304
YAVAPAI :	60.	14.260	19.723
YUMA :	-17.	-.648	-.801
TOTAL :	0.		

SPECIFIED AND IMPLIED VALUES (BY REGION) OF THE ANNUAL INTERNAL MIGRATION NUMBER AND RATE (PER 1000):

	SPECIFIED		IMPLIED	
	AMOUNT	RATE	AMOUNT	RATE
APACHE :	10.	.000	10.	5.043
COCHISE :	0.	-7.581	-173.	-7.581
COCONINO:	18.	.000	18.	2.461
GILA :	0.	-15.731	-121.	-15.731
GRAHAM :	0.	-7.913	-43.	-7.913
GREENLEE:	0.	-28.458	-155.	-28.458
MARICOPA:	555.	.000	555.	2.789
MOHAVE :	49.	.000	49.	22.812
NAVAJO :	0.	-5.378	-24.	-5.378
PIMA :	53.	.000	53.	.476
PINAL :	0.	-10.672	-285.	-10.672

```
 STA.CRUZ:        0.  -2.304      -35.  -2.304
 YAVAPAI :       60.    .000       60.  14.269
 YUMA    :        0.   -.801      -21.   -.801
 CRUDE BIRTH RATE PER 1000 (CBR) FOR FIRST PROJECTION PERIOD = 26.087
 CRUDE DEATH RATE PER 1000 (CDR) FOR FIRST PROJECTION PERIOD =  4.570
 AVERAGE ANNUAL POPULATION GROWTH RATE PER 1000 FOR PREVIOUS TEN YEARS
   = 1000((POPBASE/POPPREV(IR))**.1-1) =  41.49
 PROJECTED POPULATION GROWTH RATE (GIVEN SPECIFIED PARAMETERS):
   1000((POPPROJ/POPBASE)**.2-1) =  38.40
   APPROX. ANNUAL POPULATION GROWTH RATE PER 1000, BASED ON CBR,
    CDR, AND MIGR = CBR-CDR+MIGR =  40.03

 PARAMETERS FOR RACE = NON HISP
 TOTAL FERTILITY RATE(S)...
      1.895
 FERTILITY AGE DISTRIBUTION(S)...
       .147 .312 .312 .166 .052 .011
 INFANT MORTALITY RATE(S)...
       12.40
 EXPECTATION OF LIFE AT BIRTH CORRESPONDING TO IMR FOR FIRST
   PROJECTION PERIOD = 74.88
 BASE-YEAR POPULATION AND SURVIVAL PROBABILITIES FOR FIRST PROJECTION
PERIOD...
                    MALE      FEMALE        MALE    FEMALE
         0                                 .9829    .9881
        0-4         81135.      77985.     .9976    .9984
        5-9         81998.      78338.     .9985    .9991
       10-14        87349.      84452.     .9978    .9990
       15-19       102202.      98910.     .9966    .9985
       20-24       110406.     107563.     .9961    .9979
       25-29        98969.      97716.     .9959    .9973
       30-34        88966.      87129.     .9950    .9963
       35-39        68665.      70299.     .9926    .9944
       40-44        57192.      58062.     .9875    .9907
       45-49        53158.      54518.     .9780    .9847
       50-54        52687.      58164.     .9616    .9754
       55-59        54838.      64593.     .9359    .9599
       60-64        53010.      61645.     .8962    .9309
       65-69        49484.      57849.     .8340    .8784
       70-74        37322.      44471.     .7427    .7926
       75+          40315.      58124.     .4952    .5337
       TOTAL      1117696.    1159818.
 TOTAL BASE-YEAR POPULATION (POPBASE) =   2277514.
 CRUDE BIRTH RATE FOR BASE YEAR =  16.20
 CRUDE DEATH RATE FOR BASE YEAR =   7.80
 INFANT MORTALITY RATE FOR BASE YEAR =  12.40
 POPULATION (POPPREV) TEN YEARS PRIOR TO BASE YEAR =   1477415.
 AVERAGE CRUDE BIRTH RATE FOR PREVIOUS TEN YEARS =  16.20
 AVERAGE CRUDE DEATH RATE FOR PREVIOUS TEN YEARS =   7.80
 AVERAGE INFANT MORTALITY RATE FOR PREVIOUS TEN YEARS =  12.40
 ANNUAL EXTERNAL MIGRATION RATE(S) (PER 1000) (EMRATE)...
         .000
```

ANNUAL EXTERNAL MIGRATION NUMBER(S) (IMMNO)...
63450.
POPULATION BY REGION...

	BASE YEAR	TEN YEARS PRIOR
APACHE	50125.	31069.
COCHISE	62840.	45403.
COCONINO	67693.	43613.
GILA	29357.	23162.
GRAHAM	17405.	12621.
GREENLEE	5960.	5398.
MARICOPA	1310049.	839932.
MOHAVE	53717.	24863.
NAVAJO	63091.	44513.
PIMA	420025.	277939.
PINAL	64166.	47932.
STA.CRUZ	5230.	3570.
YAVAPAI	63940.	34466.
YUMA	63916.	42934.
TOTAL	2277514.	1477415.

TOTAL FERTILITY RATE (TFREST) ESTIMATED FROM BASE-YEAR BIRTH RATE = 1.895
TOTAL FERTILITY RATE (TFR) SPECIFIED FOR FIRST PROJECTION PERIOD = 1.895
GENERAL FERTILITY RATE (BIRTH RATE (BRFF) PER 1000 FEMALES AGED 15-44)
FOR BASE YEAR = 71.00
ESTIMATE OF ANNUAL NET EXTERNAL MIGRATION NUMBER (BASED ON BIRTH RATE
AND DEATH RATE FOR PREVIOUS TEN YEARS) = 64622.
ESTIMATED ANNUAL RATE PER 1000 = 35.829
ANNUAL NET MIGRATION NUMBER SPECIFIED FOR FIRST PROJECTION PERIOD = 63450.
ANNUAL NET MIGRATION RATE PER 1000 SPECIFIED FOR FIRST PROJECTION PERIOD = .000
ANNUAL NET MIGRATION (MIG) IMPLIED BY MIGRATION NUMBER (IMMNO) AND/OR MIGRATION RATE (EMRATE) SPECIFIED FOR FIRST PROJECTION PERIOD = 63450.
APPROX ANNUAL RATE PER 1000 POPULATION (MIGR) = 27.859
ESTIMATES (BY REGION) OF THE ANNUAL INTERNAL MIGRATION NUMBER AND RATE (PER 1000) BASED ON THE EXTERNAL MIGRATION ESTIMATE:

	AMOUNT	RATE APPROX	RATE EXACT
APACHE :	151.	3.022	3.852
COCHISE :	-486.	-7.727	-9.138
COCONINO:	31.	.463	.579
GILA :	-431.	-14.684	-16.613
GRAHAM :	-139.	-8.002	-9.445
GREENLEE:	-160.	-26.903	-28.348
MARICOPA:	1035.	.790	.991
MOHAVE :	1045.	19.454	28.402
NAVAJO :	-375.	-5.950	-7.120

```
 PIMA    :     -573.  -1.363  -1.684
 PINAL   :     -660. -10.290 -11.968
 STA.CRUZ:      -19.  -3.549  -4.317
 YAVAPAI :      734.  11.479  15.632
 YUMA    :     -154.  -2.411  -2.955
 TOTAL   :        0.
 SPECIFIED AND IMPLIED VALUES (BY REGION) OF THE ANNUAL INTERNAL
MIGRATION
   NUMBER AND RATE (PER 1000):
                SPECIFIED          IMPLIED
              AMOUNT    RATE    AMOUNT    RATE
 APACHE  :      151.    .000      151.   3.012
 COCHISE :        0.  -9.138     -574.  -9.138
 COCONINO:       31.    .000       31.    .458
 GILA    :        0. -16.613     -488. -16.613
 GRAHAM  :        0.  -9.445     -164.  -9.445
 GREENLEE:        0. -28.348     -169. -28.348
 MARICOPA:     1035.    .000     1035.    .790
 MOHAVE  :     1045.    .000     1045.  19.454
 NAVAJO  :        0.  -7.120     -449.  -7.120
 PIMA    :        0.  -1.684     -707.  -1.684
 PINAL   :        0. -11.968     -768. -11.968
 STA.CRUZ:        0.  -4.317      -23.  -4.317
 YAVAPAI :      734.    .000      734.  11.480
 YUMA    :        0.  -2.955     -189.  -2.955
 CRUDE BIRTH RATE PER 1000 (CBR) FOR FIRST PROJECTION PERIOD = 15.027
 CRUDE DEATH RATE PER 1000 (CDR) FOR FIRST PROJECTION PERIOD =  9.939
 AVERAGE ANNUAL POPULATION GROWTH RATE PER 1000 FOR PREVIOUS TEN YEARS
   = 1000((POPBASE/POPPREV(IR))**.1-1) =  44.23
 PROJECTED POPULATION GROWTH RATE (GIVEN SPECIFIED PARAMETERS):
   1000((POPPROJ/POPBASE)**.2-1) =  31.55
   APPROX. ANNUAL POPULATION GROWTH RATE PER 1000, BASED ON CBR,
    CDR, AND MIGR = CBR-CDR+MIGR =  32.95

 TOTAL POPULATION (ALL RACES) =   2718215.

 ESTIMATE OF ANNUAL NET EXTERNAL MIGRATION NUMBER (BASED ON BIRTH RATE
AND
    DEATH RATE FOR PREVIOUS TEN YEARS; TOTAL FOR ALL RACES IN THE
MODEL)
    =     71553.
    ESTIMATED ANNUAL RATE PER 1000 =   33.191
```

Listing 10. PROJ Run for Example 5 (Projection of the Hispanic Population)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: PROJ
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   12:59:49

 PARAMETER FILE NAME: AZ80HC.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA  RESIDENT  POPULATION  BY  HISPANIC  STATUS  AND  REGION

 BASE YEAR: 1980

 NO OF FIVE-YEAR PERIODS TO PROJECT = 2

 YEAR: 1990

 DISTRIBUTIONAL ANALYSIS OF POPULATN

 TOTAL POPULATN =     3702132.

 DISTRIBUTION OF POPULATN
  BY RACE
 HISPANIC     647662.
 NON HISP    3054470.

 DISTRIBUTION OF POPULATN
  BY REGION
 APACHE         65014.
 COCHISE        98260.
 COCONINO       92212.
 GILA           38996.
 GRAHAM         26019.
 GREENLEE       11016.
 MARICOPA     1871693.
 MOHAVE         80664.
 NAVAJO         76668.
 PIMA          651822.
 PINAL         101675.
 STA.CRUZ       26575.
 YAVAPAI        92273.
 YUMA          111200.

 CROSSTABULATION OF POPULATN
  BY REGION AND RACE
               HISPANIC    NON HISP
 APACHE          2867.      62147.
 COCHISE        29228.      69032.
 COCONINO       10332.      81880.
```

GILA	9098.	29898.
GRAHAM	6958.	19061.
GREENLEE	5633.	5383.
MARICOPA	281931.	1589762.
MOHAVE	3602.	77062.
NAVAJO	5936.	70732.
PIMA	154500.	497322.
PINAL	33174.	68501.
STA.CRUZ	20544.	6031.
YAVAPAI	6584.	85688.
YUMA	36480.	74720.

Listing 11. CHECK Run for Example 6 (Rehabilitation Services, Projection of the Work-Disabled)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: CHECK
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   13:17:49

 NAME OF PARAMETER FILE = AZ803CD.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA   RESIDENT   POPULATION   BY   COUNTY   AND   RACE   (W/I/O)

 BASE YEAR = 1980

 NO OF RACIAL/ETHNIC GROUPS = 3
 NO OF REGIONS = 14
 VITAL STATISTICS PARAMETER OPTION = 1
 LIFE TABLE OPTION = 1
 EXTERNAL MIGRATION OPTION = 1
 INTERNAL MIGRATION OPTION = 1
 SERVICE SYSTEM OPTION = 1
 NAME(S) OF RACE    ...
      WHITE
      AMERIND
      OTHER
 NAME(S) OF REGION  ...
      APACHE
      COCHISE
      COCONINO
      GILA
      GRAHAM
      GREENLEE
      MARICOPA
      MOHAVE
      NAVAJO
      PIMA
      PINAL
      STA.CRUZ
      YAVAPAI
      YUMA

 PRINTOUT OF DEMOGRAPHIC PARAMETERS SUPPRESSED.

 TARGET/SERVICE POPULATION DESCRIPTION:
 WORK-DISABLED  POPULATION  (SEVERELY  AND  PARTIALLY  WORK-DISABLED)

 NO OF TARGET POPULATIONS =  2
 SERVICE POPULATION OPTION = 0
 NAME(S) OF TARG POP...
      WRKDISSV
```

WRKDISPT

TARGET POPULATION = WRKDISSV
TYPE OF STRATIFICATION = 2
INCIDENCE/PREVALENCE RATE(S)...

INDEX	RATE
1	.00000000
2	.00840000
3	.02100000
4	.02900000
5	.06300000
6	.11000000
7	.24200000
8	.00000000
9	.00000000

INDICES, BY STRATUM...

0-4	1
5-9	1
10-14	1
15-19	2
20-24	3
25-29	4
30-34	4
35-39	5
40-44	5
45-49	6
50-54	6
55-59	7
60-64	7
65-69	1
70-74	1
75+	1

TARGET POPULATION = WRKDISPT
TYPE OF STRATIFICATION = 2
INCIDENCE/PREVALENCE RATE(S)...

INDEX	RATE
1	.00000000
2	.01560000
3	.03900000
4	.07000000
5	.08300000
6	.12400000
7	.11800000
8	.00000000
9	.00000000

INDICES, BY STRATUM...

0-4	1
5-9	1
10-14	1
15-19	2
20-24	3

25-29	4
30-34	4
35-39	5
40-44	5
45-49	6
50-54	6
55-59	7
60-64	7
65-69	1
70-74	1
75+	1

Listing 12. PROJ Run for Example 6 (Rehabilitation Services, Projection of the Work-Disabled)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: PROJ
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   13:18: 6

 PARAMETER FILE NAME: AZ803CD.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA   RESIDENT   POPULATION   BY   COUNTY   AND   RACE   (W/I/O)

 BASE YEAR: 1980

 TARGET/SERVICE POPULATION DESCRIPTION:
 WORK-DISABLED  POPULATION  (SEVERELY  AND  PARTIALLY  WORK-DISABLED)

 NO OF FIVE-YEAR PERIODS TO PROJECT = 2

 YEAR: 1990

 DISTRIBUTIONAL ANALYSIS OF POPULATN

 TOTAL POPULATN =     3735219.

 DISTRIBUTION OF POPULATN
  BY AGE
   0-4        338816.
   5-9        338489.
  10-14       268314.
  15-19       263875.
  20-24       272520.
  25-29       312009.
  30-34       326222.
  35-39       290907.
  40-44       253597.
  45-49       196686.
  50-54       161169.
  55-59       145678.
  60-64       142066.
  65-69       139466.
  70-74       117950.
  75+         167454.

 DISTRIBUTIONAL ANALYSIS OF WRKDISSV

 TOTAL WRKDISSV =      169750.

 DISTRIBUTION OF WRKDISSV
  BY AGE
```

```
  0-4             0.
  5-9             0.
 10-14            0.
 15-19         2217.
 20-24         5723.
 25-29         9048.
 30-34         9460.
 35-39        18327.
 40-44        15977.
 45-49        21635.
 50-54        17729.
 55-59        35254.
 60-64        34380.
 65-69            0.
 70-74            0.
 75+              0.

DISTRIBUTIONAL ANALYSIS OF WRKDISPT

TOTAL WRKDISPT =      182943.

DISTRIBUTION OF WRKDISPT
 BY AGE
  0-4             0.
  5-9             0.
 10-14            0.
 15-19         4116.
 20-24        10628.
 25-29        21841.
 30-34        22836.
 35-39        24145.
 40-44        21049.
 45-49        24389.
 50-54        19985.
 55-59        17190.
 60-64        16764.
 65-69            0.
 70-74            0.
 75+              0.

TOTALS OF TARGET POPULATION(S)
WRKDISSV     169750.
WRKDISPT     182943.
```

Listing 13. CHECK Run for Example 7 (Projection of School Enrollment)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: CHECK
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   13:25:32

 NAME OF PARAMETER FILE = AZ803CE.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA   RESIDENT   POPULATION   BY   COUNTY   AND   RACE   (W/I/O)

 BASE YEAR = 1980

 NO OF RACIAL/ETHNIC GROUPS = 3
 NO OF REGIONS = 14
 VITAL STATISTICS PARAMETER OPTION = 1
 LIFE TABLE OPTION = 1
 EXTERNAL MIGRATION OPTION = 1
 INTERNAL MIGRATION OPTION = 1
 SERVICE SYSTEM OPTION = 1
 NAME(S) OF RACE    ...
      WHITE
      AMERIND
      OTHER
 NAME(S) OF REGION  ...
      APACHE
      COCHISE
      COCONINO
      GILA
      GRAHAM
      GREENLEE
      MARICOPA
      MOHAVE
      NAVAJO
      PIMA
      PINAL
      STA.CRUZ
      YAVAPAI
      YUMA

 PRINTOUT OF DEMOGRAPHIC PARAMETERS SUPPRESSED.

 TARGET/SERVICE POPULATION DESCRIPTION:
 ELEMENTARY  &  SECONDARY  SCHOOL  ENROLLMENT;  TEACHERS;  SALARIES

 NO OF TARGET POPULATIONS =  1
 SERVICE POPULATION OPTION = 2
 NO OF SERVICES =  1
 NO OF RESOURCES =  1
 NO OF COST CATEGORIES =  1
```

```
NAME(S) OF TARG POP...
     STUDENTS
NAME(S) OF SERV POP...
     ELEM/SEC
NAME(S) OF SERVICE ...
     TEACHING
NAME(S) OF RESOURCE...
     TEACHERS
NAME(S) OF COST    ...
     SALARIES
SERVICE PARAMETERS FOR SERVICE POPULATION = ELEM/SEC
     TEACHING      1.0000
RESOURCE PARAMETERS FOR SERVICE = TEACHING
     TEACHERS       .0500
COST PARAMETERS FOR RESOURCE = TEACHERS
     SALARIES  17200.0000

TARGET   POPULATION = STUDENTS
TYPE OF STRATIFICATION =  2
INCIDENCE/PREVALENCE RATE(S)...
 INDEX    RATE
   1     .14300000
   2     .95200000
   3     .96300000
   4     .71700000
   5     .21500000
   6     .09000000
   7     .06200000
   8     .00000000
   9     .00000000
INDICES, BY STRATUM...
       0-4     1
       5-9     2
      10-14    3
      15-19    4
      20-24    5
      25-29    6
      30-34    7
      35-39    8
      40-44    8
      45-49    8
      50-54    8
      55-59    8
      60-64    8
      65-69    8
      70-74    8
      75+      8

SERVICE  POPULATION = ELEM/SEC
TYPE OF STRATIFICATION =  2
SERVICE RATIO(S)...
 INDEX    RATE
```

```
   1    1.00000000
   2     .87400000
   3     .00000000
   4     .00000000
   5     .00000000
   6     .00000000
   7     .00000000
   8     .00000000
   9     .00000000
INDICES, BY STRATUM...
       0-4     1
       5-9     1
      10-14    1
      15-19    2
      20-24    3
      25-29    3
      30-34    3
      35-39    3
      40-44    3
      45-49    3
      50-54    3
      55-59    3
      60-64    3
      65-69    3
      70-74    3
      75+      3
```

Listing 14. PROJ Run for Example 7 (Projection of School Enrollment)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: PROJ
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   13:25:44

 PARAMETER FILE NAME: AZ803CE.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA   RESIDENT   POPULATION   BY   COUNTY   AND   RACE   (W/I/O)

 BASE YEAR: 1980

 TARGET/SERVICE POPULATION DESCRIPTION:
 ELEMENTARY  &  SECONDARY  SCHOOL  ENROLLMENT;  TEACHERS;  SALARIES

 NO OF FIVE-YEAR PERIODS TO PROJECT = 2

 YEAR: 1990

 DISTRIBUTIONAL ANALYSIS OF POPULATN

 TOTAL POPULATN =     3735219.

 DISTRIBUTION OF POPULATN
  BY AGE
   0-4        338816.
   5-9        338489.
  10-14       268314.
  15-19       263875.
  20-24       272520.
  25-29       312009.
  30-34       326222.
  35-39       290907.
  40-44       253597.
  45-49       196686.
  50-54       161169.
  55-59       145678.
  60-64       142066.
  65-69       139466.
  70-74       117950.
  75+         167454.

 DISTRIBUTION OF POPULATN
  BY REGION
 APACHE         72497.
 COCHISE        97683.
 COCONINO       97171.
 GILA           40759.
 GRAHAM         26383.
```

GREENLEE 11039.
MARICOPA 1893992.
MOHAVE 83827.
NAVAJO 84127.
PIMA 649633.
PINAL 101590.
STA.CRUZ 24075.
YAVAPAI 95609.
YUMA 108068.

DISTRIBUTIONAL ANALYSIS OF STUDENTS

TOTAL STUDENTS = 925175.

DISTRIBUTION OF STUDENTS
BY AGE
0-4 48451.
5-9 322241.
10-14 258386.
15-19 189199.
20-24 58592.
25-29 28081.
30-34 20226.
35-39 0.
40-44 0.
45-49 0.
50-54 0.
55-59 0.
60-64 0.
65-69 0.
70-74 0.
75+ 0.

DISTRIBUTION OF STUDENTS
BY REGION
APACHE 22833.
COCHISE 23786.
COCONINO 26060.
GILA 10332.
GRAHAM 6812.
GREENLEE 2769.
MARICOPA 457268.
MOHAVE 19512.
NAVAJO 24616.
PIMA 159357.
PINAL 26920.
STA.CRUZ 5960.
YAVAPAI 22237.
YUMA 27238.

DISTRIBUTIONAL ANALYSIS OF ELEM/SEC

TOTAL ELEM/SEC =   794438.

DISTRIBUTION OF ELEM/SEC
 BY AGE
  0-4   48451.
  5-9   322241.
 10-14   258386.
 15-19   165360.
 20-24   0.
 25-29   0.
 30-34   0.
 35-39   0.
 40-44   0.
 45-49   0.
 50-54   0.
 55-59   0.
 60-64   0.
 65-69   0.
 70-74   0.
 75+   0.

DISTRIBUTION OF ELEM/SEC
 BY REGION
APACHE   19933.
COCHISE   20393.
COCONINO   22522.
GILA   8897.
GRAHAM   5865.
GREENLEE   2377.
MARICOPA   392016.
MOHAVE   16710.
NAVAJO   21394.
PIMA   136725.
PINAL   23184.
STA.CRUZ   5112.
YAVAPAI   19040.
YUMA   23393.

DISTRIBUTIONAL ANALYSIS OF TEACHING

TOTAL TEACHING =   794438.

DISTRIBUTION OF TEACHING
 BY AGE
  0-4   48451.
  5-9   322241.
 10-14   258386.
 15-19   165360.
 20-24   0.
 25-29   0.
 30-34   0.
 35-39   0.

40-44	0.
45-49	0.
50-54	0.
55-59	0.
60-64	0.
65-69	0.
70-74	0.
75+	0.

DISTRIBUTION OF TEACHING
BY REGION

APACHE	19933.
COCHISE	20393.
COCONINO	22522.
GILA	8897.
GRAHAM	5865.
GREENLEE	2377.
MARICOPA	392016.
MOHAVE	16710.
NAVAJO	21394.
PIMA	136725.
PINAL	23184.
STA.CRUZ	5112.
YAVAPAI	19040.
YUMA	23393.

DISTRIBUTIONAL ANALYSIS OF TEACHERS

TOTAL TEACHERS = 39722.

DISTRIBUTION OF TEACHERS
BY AGE

0-4	2423.
5-9	16112.
10-14	12919.
15-19	8268.
20-24	0.
25-29	0.
30-34	0.
35-39	0.
40-44	0.
45-49	0.
50-54	0.
55-59	0.
60-64	0.
65-69	0.
70-74	0.
75+	0.

DISTRIBUTION OF TEACHERS
BY REGION

APACHE	997.

COCHISE	1020.
COCONINO	1126.
GILA	445.
GRAHAM	293.
GREENLEE	119.
MARICOPA	19601.
MOHAVE	836.
NAVAJO	1070.
PIMA	6836.
PINAL	1159.
STA.CRUZ	256.
YAVAPAI	952.
YUMA	1170.

DISTRIBUTIONAL ANALYSIS OF SALARIES

TOTAL SALARIES = 683216526.

DISTRIBUTION OF SALARIES
BY AGE

0-4	41667598.
5-9	277127660.
10-14	222212066.
15-19	142209203.
20-24	0.
25-29	0.
30-34	0.
35-39	0.
40-44	0.
45-49	0.
50-54	0.
55-59	0.
60-64	0.
65-69	0.
70-74	0.
75+	0.

DISTRIBUTION OF SALARIES
BY REGION

APACHE	17142535.
COCHISE	17538363.
COCONINO	19369276.
GILA	7650993.
GRAHAM	5044023.
GREENLEE	2044383.
MARICOPA	337133416.
MOHAVE	14370726.
NAVAJO	18399076.
PIMA	117583189.
PINAL	19938284.
STA.CRUZ	4396677.
YAVAPAI	16374272.

YUMA 20118045.

Listing 15. CHECK Run for Example 8 (Criminal Justice, Projection of Prison Admissions and Operating Cost)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: CHECK
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   13:29: 1

 NAME OF PARAMETER FILE = AZ803CP.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA   RESIDENT   POPULATION   BY   COUNTY   AND   RACE   (W/I/O)

 BASE YEAR = 1980

 NO OF RACIAL/ETHNIC GROUPS = 3
 NO OF REGIONS = 14
 VITAL STATISTICS PARAMETER OPTION = 1
 LIFE TABLE OPTION = 1
 EXTERNAL MIGRATION OPTION = 1
 INTERNAL MIGRATION OPTION = 1
 SERVICE SYSTEM OPTION = 1
 NAME(S) OF RACE    ...
      WHITE
      AMERIND
      OTHER
 NAME(S) OF REGION  ...
      APACHE
      COCHISE
      COCONINO
      GILA
      GRAHAM
      GREENLEE
      MARICOPA
      MOHAVE
      NAVAJO
      PIMA
      PINAL
      STA.CRUZ
      YAVAPAI
      YUMA

 PRINTOUT OF DEMOGRAPHIC PARAMETERS SUPPRESSED.

 TARGET/SERVICE POPULATION DESCRIPTION:
 PRISON   ADMISSIONS;   PRISON   CELLS;   OBLIGATED   OPERATING   COST

 NO OF TARGET POPULATIONS =  1
 SERVICE POPULATION OPTION = 2
 NO OF SERVICES =  1
 NO OF RESOURCES =  1
```

```
NO OF COST CATEGORIES =  1
NAME(S) OF TARG POP...
     ADMIS'NS
NAME(S) OF SERV POP...
     SENTYR
NAME(S) OF SERVICE ...
     INCARC'N
NAME(S) OF RESOURCE...
     CELL
NAME(S) OF COST    ...
     OP COST
SERVICE PARAMETERS FOR SERVICE POPULATION = SENTYR
     INCARC'N      1.0000
RESOURCE PARAMETERS FOR SERVICE = INCARC'N
     CELL          1.0000
COST PARAMETERS FOR RESOURCE = CELL
     OP COST   16000.0000

TARGET   POPULATION = ADMIS'NS
TYPE OF STRATIFICATION =  5
INCIDENCE/PREVALENCE RATE(S)...
 INDEX    RATE
   1     .00000000
   2     .00200000
   3     .00400000
   4     .00300000
   5     .00100000
   6     .00030000
   7     .00007000
   8     .00020000
   9     .00002000
INDICES, BY STRATUM...
        MALE
       0-4     1
       5-9     1
      10-14    1
      15-19    2
      20-24    3
      25-29    4
      30-34    2
      35-39    5
      40-44    5
      45-49    5
      50-54    5
      55-59    6
      60-64    7
      65-69    7
      70-74    7
      75+      7
        FEMALE
       0-4     1
       5-9     1
```

```
      10-14    1
      15-19    8
      20-24    8
      25-29    8
      30-34    8
      35-39    7
      40-44    7
      45-49    7
      50-54    9
      55-59    9
      60-64    1
      65-69    1
      70-74    1
      75+      1

SERVICE  POPULATION = SENTYR
TYPE OF STRATIFICATION =  3
SERVICE RATIO(S)...
MALE    3.00000000
FEMALE  2.30000000
```

Listing 16. PROJ Run for Example 8 (Criminal Justice, Projection of Prison Admissions and Operating Cost)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: PROJ
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   13:29:55

 PARAMETER FILE NAME: AZ803CP.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA   RESIDENT   POPULATION   BY   COUNTY   AND   RACE   (W/I/O)

 BASE YEAR: 1980

 TARGET/SERVICE POPULATION DESCRIPTION:
 PRISON   ADMISSIONS;   PRISON   CELLS;   OBLIGATED   OPERATING   COST

 NO OF FIVE-YEAR PERIODS TO PROJECT = 2

 YEAR: 1990

 DISTRIBUTIONAL ANALYSIS OF POPULATN

 TOTAL POPULATN =     3735219.

 DISTRIBUTION OF POPULATN
  BY SEX
 MALE        1849940.
 FEMALE      1885279.

 DISTRIBUTIONAL ANALYSIS OF ADMIS'NS

 TOTAL ADMIS'NS =        2262.

 DISTRIBUTION OF ADMIS'NS
  BY SEX
 MALE           2118.
 FEMALE          145.

 DISTRIBUTIONAL ANALYSIS OF SENTYR

 TOTAL SENTYR   =        6686.

 DISTRIBUTION OF SENTYR
  BY SEX
 MALE           6353.
 FEMALE          333.

 DISTRIBUTIONAL ANALYSIS OF INCARC'N
```

```
TOTAL INCARC'N =        6686.

DISTRIBUTION OF INCARC'N
 BY SEX
MALE           6353.
FEMALE          333.

DISTRIBUTIONAL ANALYSIS OF CELL

TOTAL CELL     =        6686.

DISTRIBUTION OF CELL
 BY SEX
MALE           6353.
FEMALE          333.

DISTRIBUTIONAL ANALYSIS OF OP COST

TOTAL OP COST  =   106971223.

DISTRIBUTION OF OP COST
 BY SEX
MALE      101648203.
FEMALE      5323019.
```

Listing 17. CHECK Run for Example 9 (Health Care, Projection of the Need for Short-Term and Long-Term Beds)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: CHECK
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   13:32:33

 NAME OF PARAMETER FILE = AZ803CH.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA   RESIDENT   POPULATION   BY   COUNTY   AND   RACE   (W/I/O)

 BASE YEAR = 1980

 NO OF RACIAL/ETHNIC GROUPS = 3
 NO OF REGIONS = 14
 VITAL STATISTICS PARAMETER OPTION = 1
 LIFE TABLE OPTION = 1
 EXTERNAL MIGRATION OPTION = 1
 INTERNAL MIGRATION OPTION = 1
 SERVICE SYSTEM OPTION = 1
 NAME(S) OF RACE    ...
      WHITE
      AMERIND
      OTHER
 NAME(S) OF REGION  ...
      APACHE
      COCHISE
      COCONINO
      GILA
      GRAHAM
      GREENLEE
      MARICOPA
      MOHAVE
      NAVAJO
      PIMA
      PINAL
      STA.CRUZ
      YAVAPAI
      YUMA

 PRINTOUT OF DEMOGRAPHIC PARAMETERS SUPPRESSED.

 TARGET/SERVICE POPULATION DESCRIPTION:
 NEED FOR SHORT-TERM & LONG-TERM BEDS (LONG-TERM: NURSING, PSYCH,
MENTAL HAND.)
 NO OF TARGET POPULATIONS =  4
 SERVICE POPULATION OPTION = 0
 NAME(S) OF TARG POP...
      ST BEDS
```

```
     NH BEDS
     PSY BEDS
     MH BEDS

TARGET   POPULATION = ST BEDS
TYPE OF STRATIFICATION =  2
INCIDENCE/PREVALENCE RATE(S)...
 INDEX    RATE
   1     .00142000
   2     .00056000
   3     .00175000
   4     .00242000
   5     .00255000
   6     .00428000
   7     .01114000
   8     .00000000
   9     .00000000
INDICES, BY STRATUM...
       0-4     1
       5-9     2
      10-14    2
      15-19    3
      20-24    3
      25-29    4
      30-34    4
      35-39    5
      40-44    5
      45-49    6
      50-54    6
      55-59    6
      60-64    6
      65-69    7
      70-74    7
      75+      7

TARGET   POPULATION = NH BEDS
TYPE OF STRATIFICATION =  5
INCIDENCE/PREVALENCE RATE(S)...
 INDEX    RATE
   1     .00015000
   2     .00120000
   3     .01100000
   4     .06300000
   5     .01200000
   6     .09700000
   7     .00000000
   8     .00000000
   9     .00000000
INDICES, BY STRATUM...
        MALE
       0-4     1
       5-9     1
```

```
      10-14    1
      15-19    1
      20-24    2
      25-29    2
      30-34    2
      35-39    2
      40-44    2
      45-49    2
      50-54    2
      55-59    2
      60-64    2
      65-69    3
      70-74    3
      75+      4
        FEMALE
       0-4     1
       5-9     1
      10-14    1
      15-19    1
      20-24    2
      25-29    2
      30-34    2
      35-39    2
      40-44    2
      45-49    2
      50-54    2
      55-59    2
      60-64    2
      65-69    5
      70-74    5
      75+      6

TARGET   POPULATION = PSY BEDS
TYPE OF STRATIFICATION =  2
INCIDENCE/PREVALENCE RATE(S)...
 INDEX    RATE
   1     .00046000
   2     .00024000
   3     .00020000
   4     .00000000
   5     .00000000
   6     .00000000
   7     .00000000
   8     .00000000
   9     .00000000
INDICES, BY STRATUM...
       0-4     1
       5-9     1
      10-14    1
      15-19    1
      20-24    2
      25-29    2
```

```
      30-34    2
      35-39    2
      40-44    2
      45-49    2
      50-54    2
      55-59    2
      60-64    2
      65-69    3
      70-74    3
      75+      3

TARGET   POPULATION = MH BEDS
TYPE OF STRATIFICATION =  2
INCIDENCE/PREVALENCE RATE(S)...
 INDEX    RATE
   1     .00092000
   2     .00095000
   3     .00024000
   4     .00000000
   5     .00000000
   6     .00000000
   7     .00000000
   8     .00000000
   9     .00000000
INDICES, BY STRATUM...
       0-4     1
       5-9     1
      10-14    1
      15-19    1
      20-24    2
      25-29    2
      30-34    2
      35-39    2
      40-44    2
      45-49    2
      50-54    2
      55-59    2
      60-64    2
      65-69    3
      70-74    3
      75+      3
```

Listing 18. PROJ Run for Example 9 (Health Care, Projection of the Need for Short-Term and Long-Term Beds)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: PROJ
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   13:32:50

 PARAMETER FILE NAME: AZ803CH.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA   RESIDENT   POPULATION   BY   COUNTY   AND   RACE   (W/I/O)

 BASE YEAR: 1980

 TARGET/SERVICE POPULATION DESCRIPTION:
 NEED FOR SHORT-TERM & LONG-TERM BEDS (LONG-TERM: NURSING, PSYCH,
MENTAL HAND.)
 NO OF FIVE-YEAR PERIODS TO PROJECT = 2

 DISTRIBUTIONAL ANALYSIS OF POPULATN

 TOTAL POPULATN =     2718215.

 TOTALS OF TARGET POPULATION(S)
 ST BEDS        8883.
 NH BEDS       13025.
 PSY BEDS        837.
 MH BEDS        2337.

 YEAR: 1981

 DISTRIBUTIONAL ANALYSIS OF POPULATN

 TOTAL POPULATN =     2819125.

 TOTALS OF TARGET POPULATION(S)
 ST BEDS        9219.
 NH BEDS       13656.
 PSY BEDS        867.
 MH BEDS        2423.

 YEAR: 1982

 DISTRIBUTIONAL ANALYSIS OF POPULATN

 TOTAL POPULATN =     2920035.

 TOTALS OF TARGET POPULATION(S)
 ST BEDS        9555.
 NH BEDS       14287.
```

PSY BEDS 897.
MH BEDS 2510.

YEAR: 1983

DISTRIBUTIONAL ANALYSIS OF POPULATN

TOTAL POPULATN = 3020944.

TOTALS OF TARGET POPULATION(S)
ST BEDS 9891.
NH BEDS 14918.
PSY BEDS 927.
MH BEDS 2596.

YEAR: 1984

DISTRIBUTIONAL ANALYSIS OF POPULATN

TOTAL POPULATN = 3121854.

TOTALS OF TARGET POPULATION(S)
ST BEDS 10227.
NH BEDS 15549.
PSY BEDS 957.
MH BEDS 2682.

YEAR: 1985

DISTRIBUTIONAL ANALYSIS OF POPULATN

TOTAL POPULATN = 3222764.

TOTALS OF TARGET POPULATION(S)
ST BEDS 10563.
NH BEDS 16180.
PSY BEDS 986.
MH BEDS 2768.

YEAR: 1986

DISTRIBUTIONAL ANALYSIS OF POPULATN

TOTAL POPULATN = 3325255.

TOTALS OF TARGET POPULATION(S)
ST BEDS 10889.
NH BEDS 16852.
PSY BEDS 1018.
MH BEDS 2857.

YEAR: 1987

DISTRIBUTIONAL ANALYSIS OF POPULATN

TOTAL POPULATN =   3427746.

TOTALS OF TARGET POPULATION(S)
ST BEDS   11214.
NH BEDS   17523.
PSY BEDS   1050.
MH BEDS   2945.

YEAR: 1988

DISTRIBUTIONAL ANALYSIS OF POPULATN

TOTAL POPULATN =   3530237.

TOTALS OF TARGET POPULATION(S)
ST BEDS   11539.
NH BEDS   18195.
PSY BEDS   1082.
MH BEDS   3034.

YEAR: 1989

DISTRIBUTIONAL ANALYSIS OF POPULATN

TOTAL POPULATN =   3632728.

TOTALS OF TARGET POPULATION(S)
ST BEDS   11864.
NH BEDS   18867.
PSY BEDS   1114.
MH BEDS   3122.

YEAR: 1990

DISTRIBUTIONAL ANALYSIS OF POPULATN

TOTAL POPULATN =   3735219.

TOTALS OF TARGET POPULATION(S)
ST BEDS   12189.
NH BEDS   19538.
PSY BEDS   1146.
MH BEDS   3211.

Listing 19. CHECK Run for Example 10 (Social Services, Projection of Counselors and Budget Needed to Provide Social Services to the Elderly Population)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: CHECK
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   13:36:38

 NAME OF PARAMETER FILE = AZ803CS.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA   RESIDENT   POPULATION   BY   COUNTY   AND   RACE   (W/I/O)

 BASE YEAR = 1980

 NO OF RACIAL/ETHNIC GROUPS = 3
 NO OF REGIONS = 14
 VITAL STATISTICS PARAMETER OPTION = 1
 LIFE TABLE OPTION = 1
 EXTERNAL MIGRATION OPTION = 1
 INTERNAL MIGRATION OPTION = 1
 SERVICE SYSTEM OPTION = 1
 NAME(S) OF RACE    ...
      WHITE
      AMERIND
      OTHER
 NAME(S) OF REGION  ...
      APACHE
      COCHISE
      COCONINO
      GILA
      GRAHAM
      GREENLEE
      MARICOPA
      MOHAVE
      NAVAJO
      PIMA
      PINAL
      STA.CRUZ
      YAVAPAI
      YUMA

 PRINTOUT OF DEMOGRAPHIC PARAMETERS SUPPRESSED.

 TARGET/SERVICE POPULATION DESCRIPTION:
 SOCIAL SERVICES FOR THE ELDERLY; 8 SERVICES, 3 RESOURCES, 3 COST
CATEGORIES
 NO OF TARGET POPULATIONS =  1
 SERVICE POPULATION OPTION = 2
 NO OF SERVICES =  7
```

```
NO OF RESOURCES =  3
NO OF COST CATEGORIES =  3
NAME(S) OF TARG POP...
     ELDERLY
NAME(S) OF SERV POP...
     ELDR(SV)
NAME(S) OF SERVICE ...
     COUNSLNG
     CHORE SV
     HOMEMAKR
     SUBSCARE
     DAY CARE
     TRANSPRT
     OTHER
NAME(S) OF RESOURCE...
     COUNSELR
     PURCHSVC
     PAYMENTS
NAME(S) OF COST    ...
     DIRCTSV$
     PURCHSV$
     PAYMENT$
SERVICE PARAMETERS FOR SERVICE POPULATION = ELDR(SV)
     COUNSLNG      2.0000
     CHORE SV     16.0000
     HOMEMAKR    750.0000
     SUBSCARE     12.0000
     DAY CARE      7.0000
     TRANSPRT     10.0000
     OTHER        10.0000
RESOURCE PARAMETERS FOR SERVICE = COUNSLNG
     COUNSELR      1.0000
     PURCHSVC       .0000
     PAYMENTS       .0000
RESOURCE PARAMETERS FOR SERVICE = CHORE SV
     COUNSELR       .0000
     PURCHSVC      1.0000
     PAYMENTS       .0000
RESOURCE PARAMETERS FOR SERVICE = HOMEMAKR
     COUNSELR       .0000
     PURCHSVC      1.0000
     PAYMENTS       .0000
RESOURCE PARAMETERS FOR SERVICE = SUBSCARE
     COUNSELR       .0000
     PURCHSVC      1.0000
     PAYMENTS       .0000
RESOURCE PARAMETERS FOR SERVICE = DAY CARE
     COUNSELR       .0000
     PURCHSVC      1.0000
     PAYMENTS       .0000
RESOURCE PARAMETERS FOR SERVICE = TRANSPRT
     COUNSELR       .0000
```

```
     PURCHSVC       .5000
     PAYMENTS       .5000
RESOURCE PARAMETERS FOR SERVICE = OTHER
     COUNSELR       .0000
     PURCHSVC       .5000
     PAYMENTS       .5000
COST PARAMETERS FOR RESOURCE = COUNSELR
     DIRCTSV$     15.0000
     PURCHSV$       .0000
     PAYMENT$       .0000
COST PARAMETERS FOR RESOURCE = PURCHSVC
     DIRCTSV$       .0000
     PURCHSV$      1.0000
     PAYMENT$       .0000
COST PARAMETERS FOR RESOURCE = PAYMENTS
     DIRCTSV$       .0000
     PURCHSV$       .0000
     PAYMENT$      1.0000

TARGET   POPULATION = ELDERLY
TYPE OF STRATIFICATION =  2
INCIDENCE/PREVALENCE RATE(S)...
 INDEX    RATE
   1     .00000000
   2    1.00000000
   3     .00000000
   4     .00000000
   5     .00000000
   6     .00000000
   7     .00000000
   8     .00000000
   9     .00000000
INDICES, BY STRATUM...
       0-4     1
       5-9     1
      10-14    1
      15-19    1
      20-24    1
      25-29    1
      30-34    1
      35-39    1
      40-44    1
      45-49    1
      50-54    1
      55-59    1
      60-64    1
      65-69    2
      70-74    2
      75+      2

SERVICE  POPULATION = ELDR(SV)
TYPE OF STRATIFICATION =  2
```

SERVICE RATIO(S)...

INDEX	RATE
1	.00000000
2	.03000000
3	.05000000
4	.07000000
5	.00000000
6	.00000000
7	.00000000
8	.00000000
9	.00000000

INDICES, BY STRATUM...

0-4	1
5-9	1
10-14	1
15-19	1
20-24	1
25-29	1
30-34	1
35-39	1
40-44	1
45-49	1
50-54	1
55-59	1
60-64	1
65-69	2
70-74	3
75+	4

Listing 20. PROJ Run for Example 10 (Social Services, Projection of Counselors and Budget Needed to Provide Social Services to the Elderly Population)

```
 DESTINY PLANNING AND FORECASTING COMPUTER PROGRAM PACKAGE, VERSION
1.0

 PROGRAM NAME: PROJ
 DATE OF RUN (DD/MM/YYYY):  5/ 6/1995
 TIME OF RUN (HH:MM:SS):   13:36:48

 PARAMETER FILE NAME: AZ803CS.DAT
 GENERAL POPULATION DESCRIPTION:
 ARIZONA   RESIDENT   POPULATION   BY   COUNTY   AND   RACE   (W/I/O)

 BASE YEAR: 1980

 TARGET/SERVICE POPULATION DESCRIPTION:
 SOCIAL SERVICES FOR THE ELDERLY; 8 SERVICES, 3 RESOURCES, 3 COST
CATEGORIES
 NO OF FIVE-YEAR PERIODS TO PROJECT = 1

 YEAR: 1983

 DISTRIBUTIONAL ANALYSIS OF POPULATN

 TOTAL POPULATN =     3020944.

 DISTRIBUTION OF POPULATN
  BY SEX
 MALE        1490114.
 FEMALE      1530830.

 DISTRIBUTION OF POPULATN
  BY REGION
 APACHE        56418.
 COCHISE       86046.
 COCONINO      78946.
 GILA          37068.
 GRAHAM        23057.
 GREENLEE      10853.
 MARICOPA    1564786.
 MOHAVE        62054.
 NAVAJO        70367.
 PIMA         545662.
 PINAL         90021.
 STA.CRUZ      20673.
 YAVAPAI       73847.
 YUMA          91888.

 DISTRIBUTIONAL ANALYSIS OF ELDERLY
```

TOTAL ELDERLY =   344542.

DISTRIBUTION OF ELDERLY
 BY SEX
MALE   151885.
FEMALE   192658.

DISTRIBUTION OF ELDERLY
 BY REGION
APACHE   3592.
COCHISE   10119.
COCONINO   7908.
GILA   4198.
GRAHAM   2481.
GREENLEE   1232.
MARICOPA   186166.
MOHAVE   7886.
NAVAJO   5903.
PIMA   63245.
PINAL   9106.
STA.CRUZ   2345.
YAVAPAI   9390.
YUMA   10114.

DISTRIBUTIONAL ANALYSIS OF ELDR(SV)

TOTAL ELDR(SV) =   17254.

DISTRIBUTION OF ELDR(SV)
 BY SEX
MALE   7505.
FEMALE   9748.

DISTRIBUTION OF ELDR(SV)
 BY REGION
APACHE   181.
COCHISE   507.
COCONINO   396.
GILA   210.
GRAHAM   124.
GREENLEE   62.
MARICOPA   9322.
MOHAVE   395.
NAVAJO   296.
PIMA   3167.
PINAL   456.
STA.CRUZ   117.
YAVAPAI   470.
YUMA   506.

DISTRIBUTIONAL ANALYSIS OF COUNSLNG

TOTAL COUNSLNG = 34507.

DISTRIBUTION OF COUNSLNG
 BY SEX
MALE 15010.
FEMALE 19497.

DISTRIBUTION OF COUNSLNG
 BY REGION
APACHE 361.
COCHISE 1013.
COCONINO 793.
GILA 421.
GRAHAM 248.
GREENLEE 123.
MARICOPA 18645.
MOHAVE 790.
NAVAJO 592.
PIMA 6334.
PINAL 911.
STA.CRUZ 235.
YAVAPAI 941.
YUMA 1012.

DISTRIBUTIONAL ANALYSIS OF CHORE SV

TOTAL CHORE SV = 276057.

DISTRIBUTION OF CHORE SV
 BY SEX
MALE 120083.
FEMALE 155973.

DISTRIBUTION OF CHORE SV
 BY REGION
APACHE 2890.
COCHISE 8106.
COCONINO 6343.
GILA 3366.
GRAHAM 1988.
GREENLEE 987.
MARICOPA 149160.
MOHAVE 6322.
NAVAJO 4740.
PIMA 50668.
PINAL 7292.
STA.CRUZ 1878.
YAVAPAI 7527.
YUMA 8100.

DISTRIBUTIONAL ANALYSIS OF HOMEMAKR

TOTAL HOMEMAKR =   12940160.

DISTRIBUTION OF HOMEMAKR
 BY SEX
MALE   5628914.
FEMALE   7311246.

DISTRIBUTION OF HOMEMAKR
 BY REGION
APACHE   135452.
COCHISE   379987.
COCONINO   297316.
GILA   157762.
GRAHAM   93181.
GREENLEE   46267.
MARICOPA   6991865.
MOHAVE   296350.
NAVAJO   222174.
PIMA   2375079.
PINAL   341809.
STA.CRUZ   88026.
YAVAPAI   352815.
YUMA   379681.

DISTRIBUTIONAL ANALYSIS OF SUBSCARE

TOTAL SUBSCARE =   207043.

DISTRIBUTION OF SUBSCARE
 BY SEX
MALE   90063.
FEMALE   116980.

DISTRIBUTION OF SUBSCARE
 BY REGION
APACHE   2167.
COCHISE   6080.
COCONINO   4757.
GILA   2524.
GRAHAM   1491.
GREENLEE   740.
MARICOPA   111870.
MOHAVE   4742.
NAVAJO   3555.
PIMA   38001.
PINAL   5469.
STA.CRUZ   1408.
YAVAPAI   5645.
YUMA   6075.

DISTRIBUTIONAL ANALYSIS OF DAY CARE

TOTAL DAY CARE = 120775.

DISTRIBUTION OF DAY CARE
BY SEX

MALE	52537.
FEMALE	68238.

DISTRIBUTION OF DAY CARE
BY REGION

APACHE	1264.
COCHISE	3547.
COCONINO	2775.
GILA	1472.
GRAHAM	870.
GREENLEE	432.
MARICOPA	65257.
MOHAVE	2766.
NAVAJO	2074.
PIMA	22167.
PINAL	3190.
STA.CRUZ	822.
YAVAPAI	3293.
YUMA	3544.

DISTRIBUTIONAL ANALYSIS OF TRANSPRT

TOTAL TRANSPRT = 172535.

DISTRIBUTION OF TRANSPRT
BY SEX

MALE	75052.
FEMALE	97483.

DISTRIBUTION OF TRANSPRT
BY REGION

APACHE	1806.
COCHISE	5066.
COCONINO	3964.
GILA	2103.
GRAHAM	1242.
GREENLEE	617.
MARICOPA	93225.
MOHAVE	3951.
NAVAJO	2962.
PIMA	31668.
PINAL	4557.
STA.CRUZ	1174.
YAVAPAI	4704.
YUMA	5062.

DISTRIBUTIONAL ANALYSIS OF OTHER

TOTAL OTHER   =   172535.

DISTRIBUTION OF OTHER
 BY SEX
MALE   75052.
FEMALE   97483.

DISTRIBUTION OF OTHER
 BY REGION
APACHE   1806.
COCHISE   5066.
COCONINO   3964.
GILA   2103.
GRAHAM   1242.
GREENLEE   617.
MARICOPA   93225.
MOHAVE   3951.
NAVAJO   2962.
PIMA   31668.
PINAL   4557.
STA.CRUZ   1174.
YAVAPAI   4704.
YUMA   5062.

TOTALS OF SERVICE(S)
COUNSLNG   34507.
CHORE SV   276057.
HOMEMAKR   12940160.
SUBSCARE   207043.
DAY CARE   120775.
TRANSPRT   172535.
OTHER   172535.

DISTRIBUTION OF SERVICE(S)
 BY SERVED POPULATION(S)
           COUNSLNG   CHORE SV   HOMEMAKR   SUBSCARE   DAY CARE
 TRANSPRT   OTHER
ELDR(SV)   34507.   276057.   12940160.   207043.   120775.
   172535.   172535.
TOTAL   34507.   276057.   12940160.   207043.   120775.
   172535.   172535.

DISTRIBUTIONAL ANALYSIS OF COUNSELR

TOTAL COUNSELR =   34507.

DISTRIBUTION OF COUNSELR
 BY SEX
MALE   15010.
FEMALE   19497.

DISTRIBUTION OF COUNSELR

```
 BY REGION
APACHE          361.
COCHISE        1013.
COCONINO        793.
GILA            421.
GRAHAM          248.
GREENLEE        123.
MARICOPA      18645.
MOHAVE          790.
NAVAJO          592.
PIMA           6334.
PINAL           911.
STA.CRUZ        235.
YAVAPAI         941.
YUMA           1012.

DISTRIBUTIONAL ANALYSIS OF PURCHSVC

TOTAL PURCHSVC =    13716570.

DISTRIBUTION OF PURCHSVC
 BY SEX
MALE        5966649.
FEMALE      7749921.

DISTRIBUTION OF PURCHSVC
 BY REGION
APACHE       143580.
COCHISE      402786.
COCONINO     315155.
GILA         167228.
GRAHAM        98772.
GREENLEE      49043.
MARICOPA    7411377.
MOHAVE       314131.
NAVAJO       235504.
PIMA        2517584.
PINAL        362317.
STA.CRUZ      93307.
YAVAPAI      373984.
YUMA         402462.

DISTRIBUTIONAL ANALYSIS OF PAYMENTS

TOTAL PAYMENTS =      172535.

DISTRIBUTION OF PAYMENTS
 BY SEX
MALE          75052.
FEMALE        97483.

DISTRIBUTION OF PAYMENTS
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 BY REGION
APACHE         1806.
COCHISE        5066.
COCONINO       3964.
GILA           2103.
GRAHAM         1242.
GREENLEE        617.
MARICOPA      93225.
MOHAVE         3951.
NAVAJO         2962.
PIMA          31668.
PINAL          4557.
STA.CRUZ       1174.
YAVAPAI        4704.
YUMA           5062.

TOTALS OF RESOURCE(S)
COUNSELR      34507.
PURCHSVC   13716570.
PAYMENTS     172535.

DISTRIBUTION OF RESOURCE(S)
 BY SERVED POPULATION(S)
           COUNSELR    PURCHSVC    PAYMENTS
ELDR(SV)      34507.   13716570.     172535.
TOTAL         34507.   13716570.     172535.

DISTRIBUTION OF RESOURCE(S)
 BY SERVICE(S)
           COUNSELR    PURCHSVC    PAYMENTS
COUNSLNG      34507.          0.          0.
CHORE SV          0.     276057.          0.
HOMEMAKR          0.   12940160.          0.
SUBSCARE          0.     207043.          0.
DAY CARE          0.     120775.          0.
TRANSPRT          0.      86268.      86268.
OTHER             0.      86268.      86268.
TOTAL         34507.   13716570.     172535.

DISTRIBUTIONAL ANALYSIS OF DIRCTSV$

TOTAL DIRCTSV$ =      517606.

DISTRIBUTION OF DIRCTSV$
 BY SEX
MALE         225157.
FEMALE       292450.

DISTRIBUTION OF DIRCTSV$
 BY REGION
APACHE         5418.
COCHISE       15199.
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COCONINO      11893.
GILA           6310.
GRAHAM         3727.
GREENLEE       1851.
MARICOPA     279675.
MOHAVE        11854.
NAVAJO         8887.
PIMA          95003.
PINAL         13672.
STA.CRUZ       3521.
YAVAPAI       14113.
YUMA          15187.

DISTRIBUTIONAL ANALYSIS OF PURCHSV$

TOTAL PURCHSV$ =    13716570.

DISTRIBUTION OF PURCHSV$
 BY SEX
MALE        5966649.
FEMALE      7749921.

DISTRIBUTION OF PURCHSV$
 BY REGION
APACHE       143580.
COCHISE      402786.
COCONINO     315155.
GILA         167228.
GRAHAM        98772.
GREENLEE      49043.
MARICOPA    7411377.
MOHAVE       314131.
NAVAJO       235504.
PIMA        2517584.
PINAL        362317.
STA.CRUZ      93307.
YAVAPAI      373984.
YUMA         402462.

DISTRIBUTIONAL ANALYSIS OF PAYMENT$

TOTAL PAYMENT$ =      172535.

DISTRIBUTION OF PAYMENT$
 BY SEX
MALE          75052.
FEMALE        97483.

DISTRIBUTION OF PAYMENT$
 BY REGION
APACHE         1806.
COCHISE        5066.
```

COCONINO	3964.
GILA	2103.
GRAHAM	1242.
GREENLEE	617.
MARICOPA	93225.
MOHAVE	3951.
NAVAJO	2962.
PIMA	31668.
PINAL	4557.
STA.CRUZ	1174.
YAVAPAI	4704.
YUMA	5062.

TOTALS OF COST CATEGORY(IES)

DIRCTSV$	517606.
PURCHSV$	13716570.
PAYMENT$	172535.

DISTRIBUTION OF COST CATEGORY(IES)
BY SERVED POPULATION(S)

	DIRCTSV$	PURCHSV$	PAYMENT$
ELDR(SV)	517606.	13716570.	172535.
TOTAL	517606.	13716570.	172535.

DISTRIBUTION OF COST CATEGORY(IES)
BY SERVICE(S)

	DIRCTSV$	PURCHSV$	PAYMENT$
COUNSLNG	517606.	0.	0.
CHORE SV	0.	276057.	0.
HOMEMAKR	0.	12940160.	0.
SUBSCARE	0.	207043.	0.
DAY CARE	0.	120775.	0.
TRANSPRT	0.	86268.	86268.
OTHER	0.	86268.	86268.
TOTAL	517606.	13716570.	172535.

DISTRIBUTION OF COST CATEGORY(IES)
BY RESOURCE(S)

	DIRCTSV$	PURCHSV$	PAYMENT$
COUNSELR	517606.	0.	0.
PURCHSVC	0.	13716570.	0.
PAYMENTS	0.	0.	172535.
TOTAL	517606.	13716570.	172535.