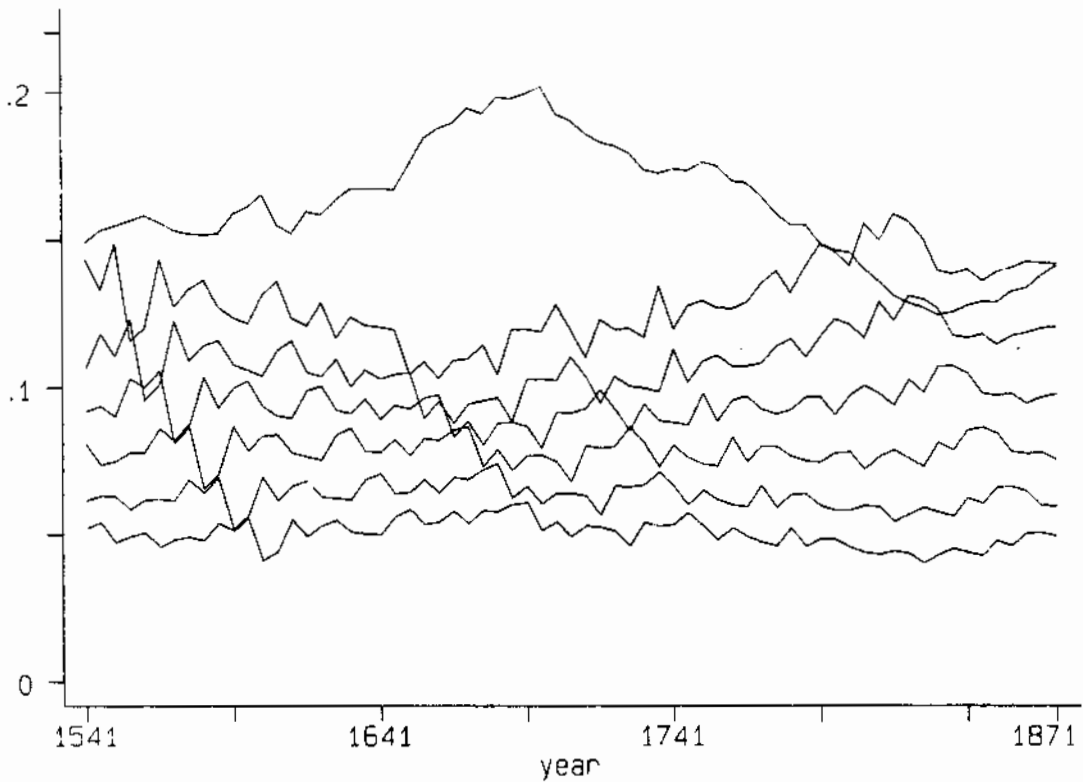


# POPULATE

## FROM BIRTHS AND DEATHS TO THE DEMOGRAPHY OF THE PAST, PRESENT, AND FUTURE



The Population Age Structure of England, 1541-1871

Robert McCaa

Hector Perez Brignoli

*POPULATE*<sup>(c)</sup>  
From Births and Deaths  
to the Demography of the Past, Present, and Future

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### Install POPULATE with PINSTALL or POPHERC

---

*For all systems, first*

Copy all files from the *POPULATE* disc to an empty floppy disc, or to a sub-directory of a hard disc. Files for Help (*POPULATE.HLP*), life tables (*POPULATE.LIF*), and installation settings (*POPULATE.INT*) must be readily available on the work disc (or subdirectory); otherwise, a message appears on the screen, and the program stops. The solution: copy all files from the original to the work disc, re-install the program, then *POPULATE*.

*Three installation options*

*POPULATE* will run fine with any of three types of systems: text-only, Hercules cards, and conventional PC compatible cards (CGA, EGA, VGA).

*Text-only systems*

For text-only systems, *POPULATE* is already installed; skip to the section on disc space and projection limits at the end of this chapter.

*HERCULES<sup>+</sup> systems*

These adapter cards shine with *POPULATE*, and installation is also simple: Run *POPHERC*. No further action is necessary. *POPULATE* produces crisp, speedy *HERCULES* graphics, but with two important conditions. First, it is possible that *POPULATE*'s Hercules graphics driver may conflict with other graphics programs. To avoid this, restart or reboot the computer after quitting *POPULATE*. Also, note that should a conventional adapter be installed, the *HERCULES* settings must be uninstalled. When a *HERCULES* card is replaced by a conventional card, run *UNHERC*, then install as follows. Second, with respect to printing, *HERCULES* screen displays do not conform to IBM standards. Printed copies of rough-and-ready graphics are not available in *HERCULES* mode. To obtain printed copy of *POPULATE* text displays, select Options Configure Adapter Mdpa (<ESC> OCAM <ESC>), then print normally. To return to *HERCULES* mode, select Options Configure Adapter heRcules (<ESC> OCAR <ESC>), and continue. This completes installation instructions for *HERCULES* systems. Skip to the section on disc space and projection limits at the end of this chapter.

*Conventional graphics systems*

For all other graphics adapter cards and monitors, run *PINSTALL*. Make selections from three menus (adapter, background, and graphics color):

1. confirm adapter type by pressing "Y" (Yes) (or experiment with one or more selections from the menu; see *PINSTALL* below)
2. select a background color on color systems, or monochrome for others
3. and, if desired on EGA and VGA systems, set custom colors for graphing *POPULATE*'s statistics.

If the screen display looks fine, tap Q to quit; if not, press I to re-install.

*Unknown/troublesome cards*

If the system is unknown, don't worry. First, try the three step installation. If the screen fills with streaks (you will not be able to see graphics or read text!), *POPHERC* is needed. Press Q (twice) to quit. Then run *POPHERC*. If the sign-on screen graphics look fine, yours is a Hercules adapter and no further installation is needed. If not, quit and run *UNHERC*, then *PINSTALL*. Try to install as a conventional card, selecting options from the adapter menu one at a time. If none produce acceptable

graphics (note the burst of graphics at the left of the sign-on screen), then choose MDPA, by pressing "M", and "Y"es; the program will produce tables of statistical results, quickly and effortlessly.

### Graphs and Lists

For text systems (vintage PCs and monochrome XTs), *POPULATE* computes lists of demographic statistics, but with a graphics card, results are graphed to the screen (and to a dot matrix printer, when desired). Before using *POPULATE*, the program must be tailored to the microcomputer on which it operates. When properly installed, a burst of graphics will radiate--in a rainbow on systems which support advanced colors graphics--from the lower left of the sign-on screen.

### Figure 1. Opening Screen

POPULATE<sup>(c)</sup>

Inverse Projection: Population Rates,  
Life Expectancy, Reproduction Ratios,  
and Age Structure

<sup>(c)</sup>Copyright 1986, 1988 R. McCaa and Hector Perez Brignoli

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POPULATE<sup>(c)</sup>

Version 2.2 February 27, 1989

Press E - England, H - Help, else continue

### Pinstall

To install *POPULATE* on a non-*HERCULES* graphics system, run *PINSTALL*. At the first menu, press *I* to install. The installation menu marks the adapter card in your machine with an "!", although some adapters cleverly disguise their true identity. Fortunately, by tapping a few keys, the user can easily experiment with the capabilities of the microcomputer without damaging any hardware.

---

Select adapter. Press Cga !Ega Mdpa heRcules Loega mOnoege Vga

---

Press *C*, *E*, *M*, *R*, or *V*, for *CGA*, *EGA*, *MDPA*, *heRcules* and *VGA*, respectively (or *L* or *O* for special varieties of *Ega*). If yours is a graphics system, but you are in doubt about which kind, search for the optimal configuration by pressing each of the keys in turn. Then press the hotkey of the option that performs best and tap *Yes* to confirm your selection. On high resolution systems, *POPULATE* will tickle as many as 786,432

individual pixels, or as few as 64,000--all automatically set by a selection from the adapter menu.

---

Select !Color Monochrome, else continue

---

### Monochrome

Continue installation by selecting Color or Monochrome (monochrome may be desirable for some PCs, XTs or 16 shades of gray systems). Tap C to select color, or M for monochrome. For monochrome systems, installation is completed by pressing <spacebar> to return to the opening screen. At this point, press I to re-install, or Q to quit.

### Tiny, black holes

Selecting "color" for a system which cannot display 16 colors will produce some graphics which are visible only as tiny dark holes. The solution here is to select Monochrome. If color is selected, and the condition appears while POPULATE is active, simply select Options Configure Monochrome (press <ESC> OCM <ESC>) and the new settings are automatically installed.

### Background Color

On color systems, press C for color, then select a background hue, by pressing any key to view up to 16 colors in succession. The burst of graphics at the lower left of the screen (Figure 1) illustrates how POPULATE's graphics and color will appear. Keep tapping the <SPACEBAR>--the prompt will be invisible with some colors--until what you see is what you want. Confirm the selection by pressing Y.

### Color graphics

Unless you wish to change the default colors for individual statistics on advanced graphics systems (EGA, VGA), installation is now complete. Press <SPACEBAR> to skip this section, otherwise a menu appears with the default colors for each statistic.

### Rainbow Colors

On an IBM-AT like machine, with an EGA, or VGA card and color monitor, statistics will be displayed in a rainbow effect, each statistic represented by a different color.

---

Statistics: ■Pop ■Br ■Dr ■Migr ■Grr ■Nrr ■K ■Life ■Oq ■Cwr ■Age  
Life A■ B■ C■ D■ E■ F■ G■ I■ J■ K■ M■ O■ P■ R■ S■

---

### Color statistics

To change a color from the above menu, press the desired statistic's hotkey (for example, L for life expectancy), then choose a color from the displayed palette, by tapping its key (AB...RS). When each statistic is colored the way you want, tap <SPACEBAR> to return to the main menu.

---

Quit? Press Q again to quit else to continue

---

### Finish

Color and graphics installation is now complete. Press Q to quit. Neither PINSTALL nor POPHERC will be needed again unless the computer's adapter card is changed, the initiation file deleted, or a new version of POPULATE is installed.

*Hardware Requirements:* Most IBM-PC compatibles will work fine with this program, as long as 512k memory is available.  
 Machine: IBM-PC Compatible 512k memory.  
 Adapter Card:  
 Tables: MDPA, CGA, EGA, *HERCULES*, or VGA cards.  
 Graphics, Color: CGA, EGA, *HERCULES* or VGA.  
 Printer: graphics: 100% IBM-PC compatible dot-matrix and MDPA-VGA card; any printer for text.  
 System: MS-DOS 2.0 or higher.

*Disc space* *POPULATE* reads data and automatically writes results to files as projections are made. However automatic filing may be toggled off, by tapping Options File. Should disc space become exhausted, the program notes the condition on the screen, and completes the current projection. No further information will be written to disc. To avoid disappointment, have at least 150k available for the results file before starting. Only the tireless modeler will need more than that in a single run.

*Projection Limits* The program accommodates up to 640 years of population history with as many as five projections immediately available for display as tables or graphics. When the time series under examination consists of only 150 years, up to thirty projections can be instantaneously examined. When the limit of available computer memory is reached, the program sends a note to the screen, then simply recycles the space allocated to the first model, and projection continues.

*Performance:* *POPULATE* is fast, but its quickness varies according to the speed of the computer's central processor (CPU), disc operations, the number of years being projected (up to 640 years), and the complexity of the model (number of age groups, interpolations, adjustments, etc.). Where a hard disc is not available and filed output is not needed, performance can be improved greatly by not filing results to disc (Option File File).

Standard - *The population history of England, 1541-1871*<sup>2</sup>

CPU	Projection time (seconds)
8088 IBM-XT Model 1	60
80286 IBM-AT	26
80286 IBM PS-2/50	16
80386 IBM PS-2/80	8
80386 SUN 386i	8

<sup>2</sup>E. A. Wrigley and R. S. Schofield, *The Population History of England, 1541-1871: A Reconstruction*, (Cambridge, Mass: Harvard University Press, 1981), pp. 219, 496-502.

## 1. Introduction.

### Basics

*POPULATE* is designed to be used with minimal reference to this text. To fully understand both the operation of the program as well as its features and flaws, five sections are developed here:

1. Introduction: Why *POPULATE*, Hotkeys, Help, Common Commands, Speed Populating, and a note on method.
2. Two experiments:
  - a. The English demographic revolution, 1541-1871.
  - b. How *POPULATE* projects with so few data.
3. Detailed description of each menu, action, and feature.
4. Instructions for preparing data.
5. Glossary: definition of terms, from Active to Zoom.

### Before Populating

Before beginning *POPULATE*, always log onto the work disc (A:<ENTER>) or subdirectory (C:\Populate<ENTER>) so that the program will have ready reference to lifetables (*POPULATE.LIF*), help screens (*POPULATE.HLP*), installation settings (*POPULATE.INI*), data files (*xxx.POP*), etc.

### Features

### Why POPULATE?

What can counts of births and deaths reveal about life expectancy, fertility, age structure or population size? A lot with *POPULATE*. *POPULATE* computes population size, life expectancy, reproduction ratios, and even age structure, when estimates of births and deaths are the only data at hand. Based on Ronald Lee's inverse method of population projection,<sup>3</sup> *POPULATE* uses real data--whenever possible--and fills in with information from models--when necessary--to compute population censuses at five year intervals. Once a projection is complete, the program makes it possible to quickly construct alternative scenarios to query: what if...conditions were different? *POPULATE* answers with sets of demographic estimates enticed from a time series of births and deaths under varying assumptions--all easily specified according to what you know or are willing to guess.

### Uncertainty and flexibility

Lee's method of projection requires that assumptions be made about the size of the initial population and its age and mortality structure, although not its level. *POPULATE* makes possible the rapid re-examination of estimates by varying one or all of the assumptions, as well as taking into account migration, birth or death under-registration, and age-specific patterns of fertility or migration. Thus, where knowledge is uncertain--the case for most places before 1900 and after, say, 1995--this approach "sacrifices" extreme accuracy for flexibility. Students use the program to develop an understanding of population dynamics, to assess the effects of counterfactuals, or even project populations into the future under various scenarios. Researchers turn to *POPULATE* to compute consistent

<sup>3</sup>R. Lee, "Inverse Projection and Back Projection: Comparative Results and Sensitivity Tests For England," *Population Studies*, 39 (1985) 233-248; "Estimating Series of Vital Rates and Age Structures from Baptisms and Burials: A New Technique with Applications to Pre-industrial England", *Population Studies*, 28 (1974) 495-512; and *Econometric Studies of Topics in Demographic History* (New York: Arno Press, 1978). For a discussion in Spanish with applications to Latin American populations see: Héctor Pérez Brignoli, "Nuevas Perspectivas de la Demografía Histórica en América Latina", *Latin American Population History Newsletter*, No. 12, Fall 1986.

estimates, test data accuracy, and weigh alternative hypotheses about demographic densities and structures.

*Demographic snapshots of the past.* With *POPULATE*, the historian can select among estimates of population size and structure or mortality and fertility regimes to bring a larger picture into focus, expose inconsistencies, and measure the fragility of the results. *POPULATE* helps reveal the impossible and provides the tools for making all settings consistent. When the entire picture does not add up, the program's demographics help find out why or why not.

*Demographics of the future?* Demographers project, but do not predict. *POPULATE* does not predict either, but it does allow futurologists--licensed or not--to specify a set of conditions to see what the world or a piece of it might look like. Authorities often present a single demographic view of the future. This program allows you to imagine what the setting might be, then project to see what difference it might make. When specialists harness sophisticated tools to simple, politically inoffensive, or plainly unrealistic projections, the non-specialist may turn to *POPULATE*, trading technical sophistication for simplicity, the inoffensive for intuition, inquisitiveness and intelligence.

*Tutorials* are included with the program. Use them to become familiar with *POPULATE*'s features. New lessons are easily created by simply turning the recorder on and putting the program through its paces. The recordings are saved to disc with the corresponding dataset and are automatically recalled to aid the student in analyzing specific demographic issues.

### Structure

*Menus* The program is completely menu driven. To activate a command or select a feature, simply tap the first letter (hotkey) of words appearing on the command line at the bottom of the screen. Descriptive command names help the beginner or infrequent user to obtain results easily. The opening screen (Figure 1) offers three choices. Press "E" to begin a demonstration using data for England (1541-1871), tap "H" for Help, that is an introduction to *POPULATE*, or strike any other key to continue to the next prompt.

---

Press E - England, H - Help, else continue

---

*Vocabulary* The program's vocabulary is limited to 45 words and three types of commands: actions, display options, and statistics (Figure 2). The essential meaning of each word is summarized in this introduction and may be reviewed on the program's help screens. Chapters 3 and 4, "Composing Models" and "Displays", describe each in context, and Chapter 7, "Glossary", briefly defines them in alphabetical order.



Figure 2. Program Vocabulary

Actions	Display Options	Statistics
<ENTER>	Axis	Age (%)
<ESCAPE>	Chart	Birth rate
<SPACEBAR>	Configure	Child/woman ratio
Continue	File	Death rate
Edit	Graphics	Gross reproduction ratio
Help	Learn	Grouped ages (%)
If	Models	Infant mortality rate
If Age	Note	K (mortality variation)
If Constant	Print screen	Life expectancy at birth
If Lifetable	Restore	Net migration rate
If Variable	Statistics	Net reproduction ratio
Options	Tables	Sum ages (cumulative %)
Pause	View	Total population
Populate	Wipe	
Quit	Zoom	
Record		
Toggle		

### Automatic settings

All display and computing conditions are automatically set. The curious projectionist may customize colors, axes, and displays by stroking a few keys from the corresponding menus. Moreover, the program recalls the custom environment, so that in subsequent sessions, conditions are set from the start exactly the way they were left.

### Three core menus

The core of the program centers on three menus--Main, Options, If--each containing 8-10 commands. Commands unique to a single menu begin with the letters C, A, or P (*italicized below*). All other commands are common to the core menus.

- a. Common commands (invoked from two or more core menus: Main, Options, or If):

File Graphics Help If Learn Models Note Options Quit Record Statistics Tables View Wipe  
Zoom

- b. Main (*POPULATE*) menu:

*Populate* Graphics Tables IF *Chart* Help Learn Note Options View Wipe Quit

- c. Options menu:

Options Graphics Tables File Record *Axis Configure* Models Statistics View Zoom

- d. Models are defined by making selections from the If menu.

If Age *Constant Lifetable Variable* Quit Help

*Hotkeys*

To activate a command, press its hotkey, the first (capital) letter of its name. If the command is an action (example: *POPULATE*), pressing its key (either lower or upper case) immediately executes (e.g., pressing "P" at the main menu, projects the next model). If the command is a condition (or option), the feature is toggled on or off. "!" indicates that a condition is on; "." that it is off. Tap the corresponding hotkey to activate or toggle the command. The distinction between upper and lower case hotkeys becomes important only when the number of variables at hand exceeds 31, and then only on the "dessert" menu, listing variable names. Thus, for everyone expect the relentless projectionist, there is no difference between upper and lower case hotkeys.

*Help*

When in doubt, press H for help. A context-specific description of each menu and its commands is available by simply pressing H.

*Help menu*

Press H again to obtain a description of each help command (Figure 3). Examine any of the help commands listed by tapping the first letter of a help word. To return to the main menu, tap the <ESC> key. To skip over the current help screen press <TAB>. To view a different help screen tap the first letter of a help key word (Figure 3; remember the silly little ditty, Poblax Mexico + Gvd Styf \$, loosely translated as populate Mexico with good stiff pesos).

**Figure 3. Help Menu**


---

**P**opulate - Demographic modeling with minimal data and "What-ifs?"  
**O**ptions - File Record Axis Configure Menu Statistics View  
**B**asics - Populate menu  
**L**earn - Populate with a tutor (Experiment mode)  
**A**just - If Age, Constant, Lifetable, or Variable  
**R**esults - filed to disc, suitable for further analysis  
**M**emory - allocations for models and adjustments  
**E**dit - Use the point-and-press editor to modify quinquennial or age variables  
**X**ample - Example data file (see Populate disc): England.pop  
**I**F - If modeling assumptions (births, mortality, ages) were different, ...?  
**C**hart - Charts screen graphics to dot matrix printer  
**+D**atabase - Populate data for 32 Countries and Communities  
**G**raph - Quinquennial population statistics quickly graphed to the screen  
**V**iew - Graphics, Tables, Zoom, and other display features  
**D**ata - Three simple data input rules  
**S**tatistics - for each quinquennium defined  
**T**each - Prepare lessons for a student or assistant  
**Y**nstall - Install Populate for your monitor and adapter card  
**F**iles - Data are read from filename.[pop]; results written to filename.[out]  
**\$** - Thanks for your interest and to

---

## 9 Universal keys

The following commands may be activated at any menu: <ESC>, <SPACEBAR>, Help, Note, Quit, Wipe, {<CTRL> <SHIFT> <PRINT SCREEN>}, <!>, and <\>.

<ESC> - escape directly to the main menu.

<SPACEBAR> - space one step toward the main menu.

H - help.

N - type a note, comments or reactions to findings or whatever at almost any moment (except when editing or calculating).

Notes are filed with the statistical results from each model.

Q - Quit.

W - Wipe the screen, when it becomes cluttered.

{<CTRL> <SHIFT> <PRINT SCREEN>} - print text from any screen; depress the <CONTROL> and <SHIFT> keys simultaneously, then strike the <PRINT SCREEN> key. If the printer is on and properly connected, all text on the screen will be printed to paper. (Hercules users see "Print" in glossary.)

<!> - begin a lesson (and record keystrokes in a .LRN file), tap !. Tapping ! again, stops the recorder to end the lesson.

<\> - pause the lesson (or recorder), press \ again to restart.

## 15 common commands (and hotkeys)

The following commands, and their corresponding hotkeys, are common to core menus:

File - write statistics to the results file (toggle on or off).

Graphics - turn graphics on or off (not available on text systems).

Help - explain the current screen.

If - define a scenario for the next projection.

Learn - select a tutorial from the menu of available lessons.

Models - list the conditions which produced each projection (when there is more than 1 model).

Note - write a note to the results file.

Options - change screen display settings (axis, colors).

Quit - quit Populate; return to the operating system.

Record - when on, save each keystroke and comment to the XXX.LRN file for use as a tutorial in a subsequent session; R or <!> also toggles the recorder on/off; <\> pauses; press <\> again to restart the recorder.

Statistics - select demographic statistics to be displayed.

Tables - turn tables on or off.

View - choose a model to display statistics on the screen for a selected model.

Wipe - wipe the screen of all graphics and text.

Zoom - display statistics for selected years at specified intervals.

## Unique keys

There are three keys (CAP) on each menu which invoke commands specific to that menu. P is reserved to POPULATE.

Populate (main) menu:

Chart - chart graphics to paper

Populate - project the current model

## Options menu:

- Axis - change the vertical axis of any statistic
- Configure - reconfigure adapter, background and/or graphics colors for statistics

## If menu (these commands are invoked only from this menu):

- Age - change age structures for a specific period
- Constant - change initial population size or birth, death or migration rates by a specific factor for an entire projection
- Lifetable - select a mortality or age structure from the set of lifetables
- Variable - change the values for a selected variable at a specific moment

## Unassigned keys=continue

When an unassigned key or <SPACEBAR> is pressed, the cursor moves one step toward the main menu. The phrase "else continue" means strike <SPACEBAR> or an unassigned key to move toward the main menu.

## Enter key

When a prompt requests that a response be entered, key some data then press <ENTER>. In any instance where data are requested, the program will not continue, until <ENTER> or <RETURN> is pressed. Pressing <enter> with no data causes default values to be inserted. When in doubt, press enter.

## Results/Color

For each projection, POPULATE computes the following statistics at five year intervals (defined in Chapter 3; the default color on EGA and VGA systems is italicized):

total population	<i>rose</i>
annual crude birth rate	<i>blue</i>
annual crude death rate	<i>green</i>
annual net migration rate	<i>yellow</i>
gross reproduction ratio	<i>dark green</i>
net reproduction ratio	<i>white</i>
index of mortality variability	<i>orange</i>
life expectancy at birth	<i>pink</i>
infant mortality rate	<i>dark red</i>
child/woman ratio	<i>brown</i>
age structure	<i>dark blue, purple, ...</i>
cumulate age distribution	<i>rainbow</i>

## Speed Populating

A speedy way to learn the program is to start it up (after installing, if necessary, with PINSTALL or POPHERC, type POPULATE), select England at the opening screen (press E), and, after the projection is complete, play with the menus for 5-10 minutes, simply tapping each key on each menu to see what happens. When in doubt, press <SPACEBAR> or <ENTER>. All commands are single word mnemonic prompts, most of which are common to demography or nice word processors. There are no obscure or arbitrary control key sequences, nor natterings about cautions, errors, or mistakes. When you change your mind, tap a couple of keys to change the conditions, whether it is a matter of statistics to be viewed, a model to be projected, or the way color or graphics are displayed on the computer screen.

There are no "wrong" keystrokes or conditions. POPULATE allows you to define what is possible or impossible, whether it is a matter of negative

population size, infinite life expectancy, or zero birth rate. This flexibility or resilience is a matter of design, to encourage experimentation both with data and the study of populations.

#### A note on method

*POPULATE* is based on Lee's inverse projection method, but developed independently of his program, *INVERSE*. *POPULATE* will not exactly replicate results from *INVERSE*. Nevertheless, estimates from both programs are remarkably similar. Moreover, *POPULATE* produces estimates that uncannily parallel results from:

1. back-projection methods developed by E. A. Wrigley and R. Schofield in their path-breaking investigation of English population history
2. demographic rates for better documented places and periods
3. projections by the World Bank and other authorities.

#### Silly results

Careful study of Lee's method is necessary to appreciate fully its strengths and weaknesses.<sup>4</sup> Silly assumptions produce silly results. The cautious projectionist will distinguish the silly from the sound. Thus, *POPULATE* accommodates not only ZPG (zero population growth) but also ZB or ZD (zero births or zero deaths)! Faulty data or suppositions may be readily exposed by a single *If*. Sound data and reasonable assumptions should lead to insights on the basic demography of the past (and perhaps beyond--try *USA.POP* to peer into America's demographic future).

#### Features

The advantage of *POPULATE* is that it is fast and flexible. To adapt Lee's method to microcomputers, extreme accuracy is sacrificed for speed and flexibility. *POPULATE*'s projection algorithm is not as strong as Lee's nor is it as computationally accurate. While 512k microcomputers remain the standard, *POPULATE* is restricted to six digits for results (14 for computations). Nevertheless,\* within these limitations, *POPULATE* manages the population history of England from 1541 to 1871 with a very great number of models (unlimited when results are stored exclusively in computer memory) each made up of a complex variety of assumptions. Moreover the results of any of a dozen projections can be displayed instantly on the computer screen. Graphics or tables may be transferred to paper with a few menu-prompted key strokes. Presentation quality graphics are easily prepared from a results file with standard microcomputer software (*STATA*, *SPSSPC*<sup>+</sup>, *MS-CHART*, etc.).

<sup>4</sup>See footnote 3 for Lee's most important publications on the subject.

