

**DESTINY 2005**  
**Demographic Estimation, Forecasting and Analysis System**  
**USER'S MANUAL**  
INTERNATIONAL VERSION 3.0.01

December 26, 2005

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# I. Introduction

The DESTINY computer program package enables the user to make projections of phenomena that are related to population demographic characteristics. It does this using the procedure of synthetic estimation. Synthetic estimation is a procedure by which the future value of a quantity related to population demographic characteristics is estimated by estimating the relationship of the quantity to population demographic characteristics from historical data and evaluating that relationship (or a suitable modification of it) using projected (future) values of the population demographic characteristics.

Synthetic estimation is one of many tools used to assist planning for the future. Other techniques include time series analysis, econometric models, anticipation surveys, technological forecasting, "Delphi" techniques, and microsimulation. The method of synthetic estimation works well for forecasting quantities that are closely related to demographic characteristics, such as demand for teachers, hospital beds, and social services. For such applications, synthetic estimates work well. They are easy to understand, and, using appropriate computer software, easy to produce. The DESTINY system performs the data processing necessary to produce synthetic estimates. While the demographic theory underlying cohort-component population projection models is complicated, the synthetic estimates alone, as ratio estimates, are very easy to understand, even by nontechnical personnel. From this perspective, synthetic estimation has a significant advantage over alternative procedures, such as microsimulation, econometric, and time-series methods, which require advanced technical training to implement, whose estimation procedures are difficult to explain to lay persons, and whose functional form is usually not at all "transparent" (e.g., involving the inverse of a matrix, or its eigenvalues).

A word is in order concerning some of the terminology used in the realm of synthetic estimation. An "estimate" of an unknown numerical quantity is simply a statement or opinion about its value. There are lots of kinds of estimates in the field of statistics, of which synthetic estimates are just one example. A "projection" is an extrapolation of a quantity into future time, based on the values specified in a projection formula, or model. A "forecast" is an estimate of a value of some quantity at a future time, for which there is some confidence expressed about its likelihood of being close to the actual value, when that future time arrives. An analyst may make several projections, by specifying alternative values for various model parameters (fertility, mortality, migration, service-system parameters). None of these projections are forecasts until the analyst represents them as such. The United Nations regularly publishes three different projections of world and country populations – the "low variant," "medium variant," and "high variant" projections. None of these are represented as "forecasts." They are simply projections of what the population will be under the specified assumptions about fertility, mortality and migration. If someone agrees with one set of assumptions, such as those for the "medium variant" projection, then that projection becomes his forecast. The analyst does not have to specify a single projection as the forecast. He may produce a variety of projections, all under reasonable but different assumptions, and state that any of them are reasonable future outcomes. In this case, the forecast at a future point in time is not a single value, but a range of values. The responsibility of planners and managers is to recognize the range of likely variation

in the future, and to exercise prudent management procedures to cope with the future, whichever of these likely alternative futures is realized.

The original version of DESTINY was developed in 1981. It was programmed in the FORTRAN programming language and designed for use on microcomputers. That version included not only routines for calculating synthetic estimates, but also routines for making population projections based on the “cohort component” method. The cohort-component method of population projection projects a future value of population age-by-sex cohorts based on assumptions about the fertility, mortality, and migration characteristics of a population. This version of DESTINY is a much-simplified version of the original. It has been developed using the Microsoft Access database development system. This version is an “international” one, in which much of the complexity of the original version has been eliminated. The major simplification is elimination of the capability to construct cohort-component population projections. The reason for this simplification is that the World Bank releases, each year, a set of cohort-component projections for most countries of the world. The international version of the DESTINY system uses these projections as the basis for synthetic estimation. (The World Bank projections are contained in the *World Development Indicators* CD, which is issued each year.) The advantage of using World Bank population projections is not just to avoid the work involved in making the projection – which is considerable. The use of World Bank population projections as the basis for making synthetic estimates lends credibility to those estimates. From a political perspective, many users of synthetic estimates are more likely to accept synthetic estimates that are based on World Bank (or United Nations) population projections, than those based on the opinions of a local analyst, no matter how well-founded the latter may be (the “no one ever got fired for buying IBM” syndrome).

The World Bank population projections project the population of each country in five-year intervals from the present time to the year 2090. These projections specify the composition of the population by sex and five-year age intervals (“cohorts”). The original version of DESTINY included the ability to project populations not only by age and sex, but by race and region as well. Since the World Bank projections do not include race or regional breakdowns, this feature of the original DESTINY system has been removed from the international version.

The original version of DESTINY was written before the availability of mouse-and-windows-based microcomputer operating systems, and before the widespread availability of low-cost relational database development systems, such as Microsoft Access. The line-by-line model data entry was somewhat tedious and, because the model required specification of the population demographic characteristics (base-year population by age, sex, race and region; fertility data; mortality data; migration data), it could be time-consuming. The data entry in this new version is much reduced in quantity, since the World Bank population projections are contained in the model and it is therefore not necessary to specify any of the demographic data behind these projections. Furthermore, the limited data entry that remains (to specify the synthetic-estimation parameters) is accomplished by means of easy-to-use data-entry screens.

This *User’s Manual* describes how to install (set up) the DESTINY system on a Microsoft Windows-based microcomputer, and use it.

The *User’s Manual* for the FORTRAN version of DESTINY was 233 pages in length. Because of the simplification of this international version, and the ease of use of the system enabled by the Microsoft Access database system, this manual is much shorter. After describing how to

install the system on your computer, the use of the system will be documented by describing how to set up and examine the examples presented in the DESTINY *Description of Capabilities*.

## II. System Installation

The DESTINY system is designed for use with the Microsoft Access database system, version 2002 (or later). For DESTINY to work on your computer, MS Access, version 2002 or later, must be installed on your computer. If the system is downloaded from the Internet, you will also need to have WinZip (version 8.0 or later) installed on your computer, in order to decompress (“unzip”) the file.

The DESTINY system is included on a CD, or may be downloaded from the Foundation website, at Internet address <http://www.foundationwebsite.org> . If the system is installed from CD by running the “setup.exe” installation program, all files are copied to the c:\Program Files\Destiny2005\ folder or other folder specified by the user. If the system is downloaded from the Internet, it may be copied to this or any other folder the user specifies.

To install the system from CD, insert the CD in the CD drive, navigate in Windows Explorer to this drive, and double-click on the setup.exe file. (Alternatively, create a new folder of your choice and copy all of the files from the CD to that folder.)

If the system is downloaded from the Internet, create a new folder named “Program Files” in the c:\ folder, and download the files to this folder. The downloaded file is a “WinZip” compressed file. After copying the file to the desire folder decompress (“extract”) the WinZipped files (to that same folder).

After copying the DESTINY files to the desired folder, create a shortcut of the DESTINY program (called Destiny2005.mde) and paste it on your computer “desktop” screen. (To create a shortcut, simply right-click on the Destiny2005.mde file, click on “Create shortcut,” and cut-and-paste the created shortcut (named Shortcut to Destiny2005.mde) to the Windows desktop.

The DESTINY system requires about 105 megabytes of disk storage.

## III. How to Use the DESTINY System

The DESTINY system is started by double-clicking on the DESTINY shortcut on the Windows desktop (or by double-clicking on the Destiny2005.mde file in the folder in which the DESTINY system was installed. When the introductory screen opens, click on the “Go” button.

The next screen shows the major options of the DESTINY system:

- View historical time series data
- View World Bank population projection
- View United Nations population projection

- Specify, select, and run a cohort-component synthetic-estimation model
- Make analytical graphs
- Make long-term population projections
- View documentation

The output produced by each of these selections is as follows.

#### View Historical Time Series Data

As mentioned, the cohort-component population projections used in the DESTINY model are those distributed each year by the World Bank on its World Development Indicators CD. Those projections and other time series related to population projections may be viewed in graphical displays. The indicators selected from World Development Indicators 2005 CD include mainly population and vital statistics, but a few others are included as well (land use, energy use, environment, income, health, education). Graphs may be produced for 43 indicators and 208 countries. In one option, each of the indicators may be viewed for a single country; in the other option, a selected indicator may be viewed for each country.

#### View World Bank Population Projection

This button leads to detailed graphical displays of the World Bank cohort-component population projection. These projections are available for 193 countries. The projections depend on eleven different input parameters – vital statistics such as fertility rates, mortality rates, and migration rates. Each of the parameters on which the projection depends must be itself projected into the future. In this section, the user may display graphs showing the values of the various input parameters over the projection period, 2000-2090.

The World Bank cohort-component population projection is displayed in a number of graphs. These graphs show the total population of each country for each five year point of the projection period. They also show the age distribution by year or for all years.

#### View United Nations Population Projection

The World Bank CD contains a cohort-component population projection for a single set of assumptions about the input parameters (fertility rates, etc.). At the United Nations website are presented population projections for three different sets of demographic assumptions. These are referred to as the “low variant,” “medium variant,” and “high variant” projections. These projections are not used as the basis for the DESTINY synthetic estimation, because the UN website does not provide the age-by-sex breakdown of the population, as the World Bank WDI CD does. The UN population projections are included here for information only – they are not used in the DESTINY calculations.

#### Specify, Select, and Run a Cohort-Component Synthetic-Estimation Model

The next system option allows the user to construct and execute synthetic estimation models. Under the first option (“Specify a Cohort-Component Population-Projection Model (Data-Entry Screens)”) displays various data-entry screens which the user may use to specify parameters for a synthetic-estimation model. On the first screen, the user specifies “model meta data” – parameters that describe the major features of the model:

- ModelID: A unique integer (1,2,3,...) identifying the model
- CountryCode: The country code used by the World Bank, e.g., usa for the United States, zmb for Zambia (these codes are identified in the CountryCodes table)
- CountryModelNumber: An integer identifying a model within a particular country
- CohortComponentProjectionModel: In the international version of DESTINY, this is always equal to 1 (since only one cohort-component projection model is used, viz. the World Bank model)
- ModelDescription: A verbal description of the model, which will appear on all output graphs
- NTgtPop: Number of target populations (one, in the international version)
- NSerPop: Number of served populations (one, in the international version)
- NServices: Number of services in the model (up to 10)
- NResources: Number of resources in the model (up to 10)
- NCostCats: Number of cost categories (elements) in the model (up to 10)

After specifying the preceding “model metadata,” the user then proceeds to enter more detailed model data on the following screens. These data include the names for all model entities (target population, served population, services, resources, cost categories), and the parameters that define the target population, served population, service utilization, resource utilization, and cost. The nature of these parameters is described in the examples presented in the DESTINY *Description of Capabilities*. These data are obtained either from policy decisions or alternatives (e.g., the specification of a served population may be prescribed by law) or from historical data (e.g., unit costs of program services).

Target Population. The user must specify the incidence or prevalence of the target population, as a proportion (decimal number between zero and one) of the various age-by-sex cohorts of the general population. This may be done in a number of different ways, depending on the application. It is not necessary to specify separate incidence/prevalence ratios for each of the different age-by-sex cohorts of the population, by year. Instead, if the ratios are constant over some variables, the user can specify these parameters efficiently in eight different “stratification” tables: (1) one overall ratio; (2) ratio varies by age; (3) ratio varies by sex; (4) ratio varies by age and sex; (5) ratio varies by year; (6) ratio varies by year by age; (7) ratio varies by year by sex; and (8) ratio varies by year by age and sex.

Served Population. The user specifies the served proportion as a fraction of the target population, for each demographic category. As in the case of specification of the target population, this may be done using the same eight stratification tables described above.

Services. For each served population, the user specifies the average number of service units provided per case, for each type of service included in the model.

Resources. For each service, the user specifies the average number of resource units utilized per service unit.

Cost. For each cost category, the user specifies the average cost per resource unit.

The *Description of Capabilities* provides several examples of DESTINY runs. The first example is simply a projection of the general population (Zambia resident population). In this example, the values of the parameters (displayed in the Model Meta Data table of the Synthetic Estimation Model Data Entry Screen) are Model ID = 1, Country Code = zmb, Country Model Number = 1, Cohort Component Projection Model = 1, Model Description = "Zambia WDI2005 Population Projection", NTgtPop = 0, NSerPop = 0, NSer = 0, NRes = 0, and NCostCats = 0. The DESTINY system uses the projection period 2000-2015. For population, however, the World Bank projection extends to 2090. Hence, for projecting population, it may be of interest to display the complete World Bank projection (to 2090) than the truncated version used in DESTINY (to 2015) (as was done in the example presented in the *Description of Capabilities*).

The second example presented in the *Description of Capabilities* contains a full set of service-system parameters. In this example, the parameters displayed in the Model Meta Data table are: Model ID = 2, Country Code = zmb, Country Model Number = 2, Cohort Component Projection Model = 1, Model Description = "Zambia HIV/AIDS: VCT and CSM Services", NTgtPop = 1, NSerPop = 1, NSer = 1, NRes = 7, and NCostCats = 7. A detailed description of the target population, served population, services, resources and cost categories is presented in the *Description of Capabilities*.

The third example ("Zambia HIV/AIDS: ART Services") is very similar to the second, but with one service instead of two. The fourth example ("Zambia Basic-Schooling: Formal Education") contains one target population, one served population, one service (formal schooling), four resources (teachers, classrooms, desks, textbooks) and four cost categories (one for each resource).

In the examples, the cost categories corresponded to the resource types. It is not necessary to do this – it was done to keep the examples simple. In a real application, both the resource types and the cost categories would correspond generally to whatever categories were actually used, and they would usually not be matched one-to-one.

### Make analytical graphs

This option shows graphs in which historical World Bank data have been interpolated and extrapolated through the year 2015. There are several purposes in making these interpolations and extrapolations. First, they are presented to provide suggestions for projected values of projection model input parameters, such as fertility rates, for use in instances where the user wishes to construct his own cohort-component population projection model, to use as an alternative to the World Bank model (this feature is not included in the international version of DESTINY). Second, they are done to provide complete (uninterrupted) time series for use in time series analysis (e.g., smoothing of a time series, or comparison of two different time series) in which values are desired at every point in time (smoothing and time-series-analysis functions are not included in the international version). Finally, data series from international organizations such as the World Bank often have an ill-defined end point, with some series ending at one year and some at another. In order to have a complete set of statistics for the final year, it is useful to extrapolate available data for a year or two for the shorter series. Many of the vital statistics employed in making population projections fluctuate little from year to year, except for obvious trends. In such cases, a standard method for making a quick estimate a few years ahead is simply to linearly extrapolate the data. By this means, reasonable estimates are



easily and readily available for all indicators for, e.g., for 2003 or 2004 or 2005, for all countries, even though data may be missing for many countries for the last year or two.

### Make long-term population projections

The methodology of synthetic estimation based on cohort-component population projections is appropriate only for making short-term projections, such as to year 2015. For these short periods, it is reasonable to examine alternative futures in which the population “ages” in accordance with current trends in demographic phenomena (such as fertility, mortality and migration). Most countries, organizations and social programs have a five- or ten- year planning horizon, to which the useful time horizon of cohort-component population projection and synthetic estimation are appropriate, if not ideally suited.

As the planning horizon extends farther and farther into the future, the use of the cohort-component method becomes more and more difficult to justify. For long-term projections, e.g., several decades, the method is not appropriate, other than to demonstrate that extrapolation of current demographic trends eventually results in ridiculous population sizes (extremely small or extremely large). For long-term population projections, other methods are more appropriate.

The DESTINY system includes a facility for making long-term population projections. These projections are “resource-constrained” projections, in which the dependence of global population on the availability of petroleum supplies is taken into account. Many petrogeologists believe that global oil production is in the process of peaking, that it will soon start to decline noticeably, and that global oil reserves will be depleted by about 2050. Since the current large world population (over 6 billion) owes its existence to petroleum, and no comparable substitute has been found despite years of intensive searching, it is reasonable to project that global population will decline roughly in proportion to the decline in global oil production.

DESTINY includes long-term population projections for three different scenarios. In the first scenario, it is assumed that human population will continue in accordance with recent demographic trends. In the long run, this is not a reasonable scenario, since large human numbers owe their existence to petroleum availability, and this availability is about to decline with no comparable substitute resource in sight. This scenario is not considered realistic or likely – it is considered simply for comparison purposes. This population projection is similar to the World Bank projection, or to the United Nations “medium variant” projection. The other two scenarios considered for long-term population projections are: (1) As global oil supplies run out, all countries share equally in the remaining supply; and (2) As global oil supplies exhaust, the “rich” countries keep all of the oil to themselves.

Here follows a more detailed description of the long-term population projections, taken from the DESTINY program on-screen documentation.

“The following population projections take into account that global oil production is peaking (Hubbert's Curve, Hubbert's Peak), and that, as a result, world population will fall dramatically over the next few years. For the three scenarios considered, it is assumed that Hubbert's Peak occurs around 2010, and that global commercial oil production ceases by 2050. Refer to notes below. Scenario / Projection 1 shows a hypothetical (and unrealistic) “no-constraint” case, in which population growth continues in accordance with current growth-rate trends (Note A). Scenario 2 assumes that all countries share the dwindling oil supplies, that population declines

to a level supportable by low-productivity agriculture (Note B) by 2040, and to a sustainable primitive-agriculture population level (Note C) by 2050. For Scenario 3, it is assumed that the world's developed countries ("High Income OECD") keep all oil supply to themselves, starting in 2010. Their population continues at present levels (Note A) until 2030, declines slowly to a solar-energy low-level-of-living level (Note D) by 2040, and to a solar-energy high-level-of-living level (Note E) by 2050. The population of all other countries falls to low-productivity-agriculture levels (Note B) by 2020, to primitive-agriculture levels (Note C) by 2040, and to a hunter-gatherer level (Note F) by 2050. (Population in thousands, pop. growth rate as decimal fraction.) (These projections are based on historical data from the UN FAO State of Food and Agriculture 2003-2004 report (i.e., UN/SOFA data to 2003, our projection from 2003).)

"Notes: The various population levels are associated with the following energy-utilization cases.

- A. Max. high-agricultural-productivity population (10 persons/hectare of arable land, corresponding to global pop. of up to 14.0 billion).
- B. Max. low-agricultural-productivity population (1 person/hectare of arable land, corresponding to global pop. of 1.40 billion).
- C. Sustainable primitive-agricultural population (.2140 persons/hectare of arable land, corresponding to global pop. of 300 million).
- D. Max. solar-energy population, low level of living (.3567 persons/hectare of arable land, corresponding to global pop. of 500 million).
- E. Max. solar-energy population, high level of living (.003567 persons/hectare of arable land, corresponding to global pop. of 5 million).
- F. Sustainable hunter-gatherer population (.003567 persons/hectare of arable land, corresponding to global pop. of 5 million).
- G. "Minimal-Regret" population: a "solar civilization" consisting of a single-nation high-technology population of 5 million (Note E) and a globally-distributed primitive (hunter-gatherer) population of 5 million (Note F)."

#### [View documentation](#)

This screen points to documentation associated with DESTINY. It includes the *Description of Capabilities*, this *User's Manual*, the documentation for the FORTRAN version of DESTINY, and a case study (a population / environmental analysis of Trinidad and Tobago).