A BEGINNER'S GUIDE FOR UNDERSTANDING AND USING EPIMODEL - VERSION 2.1

A Computer Program for Estimation and Projection of

Adult AIDS Cases and Deaths
Pediatric HIV/AIDS, and Maternal AIDS Orphans
Adult TB Cases Related to HIV Infection

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PREFACE

EPIMODEL is a program for IBM-compatible microcomputers which was developed during the late 1980s. It was designed by Dr. James Chin[1] to estimate and make short-term projections of AIDS cases. In 1987, EPIMODEL was a simple spreadsheet. In 1988, Dr. Eric Brenner[2] wrote an EPIMODEL program in dBase. In 1989, Jeff Dean[3] wrote Version 1 of EPIMODEL in Turbo Pascal; he prepared the refined and upgraded Version 2 in late 1993 and Version 2.1 in early 1995.

EPIMODEL (Version 2) was supported with funding by the United States Agency for International Development (USAID) through the AIDSCAP project administered by Family Health International (FHI). Mike Sweat, PhD, Modeling Officer in the Policy Unit of AIDSCAP was the project monitor for FHI. The TB module of Version 2.1 was partially supported by the Support for Research and Analysis in Africa (SARA) project of USAID. An expanded version of the TB module that will also model TB cases in the absence of HIV and the increase of TB cases due to increased transmission of *Mycobacterium tuberculosis* infection (*Mtbc*) is being prepared and should be available in mid-to-late 1996.

EPIMODEL is a public domain program and may be freely copied. Many copies of EPIMODEL (Version 1) have been distributed since 1989. Version 2 resolved many problems noted with prior versions - specifically, the save projection feature of EPIMODEL was made functional. Version 2.1 was released in mid 1995 to resolve a problem noted in closure of the windows in the costing module. Version 2.1 has a revised pediatric module and also includes a new TB module.

NOTE! NOTE! NOTE! NOTE! **All prior versions of EPIMODEL should be discarded!**

[1]When he was Chief of the Surveillance, Forecasting, and Impact Assessment (SFI) unit of the Global Programme on AIDS (GPA), at the World Health Organization (WHO), in Geneva, Switzerland. Dr. Chin resigned from his position with WHO in May, 1992 and is now a Clinical Professor of Epidemiology with the School of Public Health, University of California at Berkeley, and an International Consultant on AIDS in developing countries.

[2]When he was a short-term consultant to SFI/GPA/WHO in Geneva, Switzerland. Dr. Brenner is now one of the State Epidemiologists in South Carolina.

[3]When he was a short-term consultant to SFI/GPA/WHO in Geneva, Switzerland. Jeff Dean is currently in the doctoral program in the Department of Computer Science and Engineering at the University of Washington in Seattle.

HOW TO USE THIS MANUAL

This manual is organized into the following major sections:

INTRODUCTION TO HIV/AIDS MODELING - A brief overview of the uses and limitation of methods for the estimation and projection of HIV infection and AIDS cases. This section is not essential for learning how to use EPIMODEL, but is helpful to place EPIMODEL in perspective when compared to other HIV/AIDS models.

INTRODUCTION TO EPIMODEL - A detailed description of the specific assumptions and estimates required for EPIMODEL, and how the model works in general.

TUTORIAL LESSONS FOR USING EPIMODEL - Each lesson consists of step by step instructions for using EPIMODEL with specific examples. Each lesson includes printed screen captures that show what should be on the computer screen as you proceed through the lesson.

Lesson 1. Installing and learning the basics of EPIMODEL.

Lesson 2. Other EPIMODEL options and estimation/projection of adult AIDS cases in sub-Saharan Africa.

Lesson 3. Advanced features of EPIMODEL - rates and scenarios.

Lesson 4. Using the costing module.

Lesson 5. Using the CHILD module.

Lesson 5A. Using the MFCHILD (Male:Female) module.

Lesson 6. Using the TB module.

SELECTED REFERENCES

APPENDIXES

A. The Window Menu

B. EPIMODEL Outputs

C. Natural History of HIV Infection and AIDS

D. Public Health Surveillance of HIV Infection and AIDS

INTRODUCTION TO HIV/AIDS MODELING

How many annual and cumulative HIV infections and AIDS cases (HIV/AIDS) have occurred, currently exist, and are likely to occur in the future? Reliable answers to these questions are needed to evaluate the spread of HIV/AIDS and to help plan for public health, health care, and social welfare programs vital to an appropriate response to this ever expanding pandemic. However, since the early 1980s, when AIDS was first recognized, there has been uncertainty about the future trends and ultimate dimensions of this pandemic. Uncertainty persists because of the difficulties in measuring, with any substantial degree of precision, the prevalence and more particularly the incidence of AIDS cases and HIV infections in any given population. As a result, many HIV/AIDS models using a variety of methods have been developed in an attempt to: (1) understand the dynamics and interrelationships of the major determinants of HIV transmission; and/or (2) develop reliable estimates and projections of HIV/AIDS.

HIV/AIDS Models

Many types of HIV/AIDS models have been developed over the past decade. Major components of all models include: (1) the assumptions and input parameters used; (2) the value or range of values used for the input parameters; and (3) mathematical inter-relationships between the parameters used in the model.

The results produced by any model should not be used to make program or policy decisions unless those making such decisions agree with the assumptions used, the values used for the input parameters, and understand how the model works. HIV/AIDS models can be classified into three types that range from the simplest to the most complex. The first two types are more empirical and extrapolation type models, while the last type has been called explanatory or deterministic type models. In general, the simpler extrapolation models are designed for short-term projections; the more complex models for evaluating determinants of the HIV/AIDS pandemic and for hypothesis testing.

Type I models use reported AIDS case data to make short-term (2 to 3 years) projections of AIDS cases. Such short-term projections have been made by statistical extrapolation and regression techniques applied to the observed temporal curve of reported AIDS cases. These models assume that after adjustment for reporting delays (and in some models, further adjustments for incomplete reporting), trends of reported cases during the next few years will remain essentially similar to those observed in the recent past. A profusion of such models has been described, but a major problem with these models is that many mathematical curves can fit the data equally well. Not only is there no way to choose the "best" among the various curves, but the fitted curves may lead to widely divergent projections, particularly if they are used to make projections for periods longer than 2 to 3 years. Type I models should be used only to project AIDS cases 2 to 3 year ahead, and only for populations for which AIDS case reporting is relatively timely, reliable, and complete.

Type II models use data on estimated HIV infections as well as progression rates from infection to AIDS to calculate the number of past AIDS cases and to provide short-term (3 to 5 years) projections of AIDS cases. **EPIMODEL which uses these variables is a Type II model developed for use in areas where AIDS case-reporting is known to be largely incomplete and unreliable.** A variation of this approach is the "back calculation" method that uses AIDS case reports with annual progression rates from infection to AIDS to estimate the number of annual HIV infections that have occurred. This method requires accurate, complete, and timely reporting of AIDS cases. However, because very few persons develop AIDS within two to three years after acquiring their infection, this method - even in areas where AIDS case reporting is considered reliable - cannot be used to estimate HIV infections that occurred during the past two to three years.

A simplified variation of this method uses an estimated ratio of HIV infections to AIDS cases to calculate total HIV infections. This ratio method requires, as does "back calculation," reliable estimates of AIDS cases that are generally not available in most developing countries. In addition, users of the ratio method must realize that the ratio of HIV infection to AIDS cases changes rapidly with time. The ratio falls from many thousands-to-one during the first few years of epidemic spread in a population, to less than ten-to-one after the first decade. This decline occurs whether HIV incidence is increasing or decreasing because most HIV-infected persons progress to AIDS within 10 to 20 years after contracting their infection. Within a few decades, the ratio of cumulative HIV infection to cumulative AIDS cases will get close to 1.

Type III models are more complex and incorporate biological and behavioral variables that describe the transmission and natural history of HIV infection to simulate the entire disease process. Many mathematically sophisticated Type III models have been developed to project the future course of HIV/AIDS epidemics in different areas and populations. These complex models usually use differential equations to describe biologic and behavioral variables important in the transmission and natural history of HIV infections to simulate the process from infection, progression to AIDS, and death.

These deterministic or simulation models include: the mathematical model(s) of Anderson and his associates; the demographic model developed by Bulatao of the World Bank; a Monte Carlo type model ("Simulaids") developed by Auvert of INSERM, Paris, and; a very detailed model - the Interagency Working Group (IWG) model - developed principally by Seitz of the University of Illinois. These models require, in varying degrees, extensive data sets on nearly all of the demographic, biologic, and behavioral variables considered to be important in the epidemiology and natural history of HIV infection. The major problem with these models, besides their complexity, is that most of the precise, detailed data sets they require to make projections are not available, even in those countries with the best data collection systems. The greatest value of such complex mathematical models may be to test hypotheses and to help in understanding the dynamic interrelationships between important biological and behavioral variables rather than for estimation and projection of HIV/AIDS prevalence in specific areas or populations.

Scenario/Modeling of HIV/AIDS

A simple scenario/modeling approach for estimation and projection of HIV infections and AIDS cases was developed at the World Health Organization (WHO) during the late 1980s. This scenario/modeling approach or method can be used in individual countries and for selected populations within countries to provide working estimates and short-term projections of HIV-related morbidity and mortality for policy development and public health planning. A scenario is an outline for any series of events, real or imagined. HIV/AIDS models can be considered highly structured scenario machines. HIV/AIDS scenarios can be made up or constructed with or without models to "fit" the observed HIV/AIDS data and trends. The following is an outline of the general methods used in this scenario/modeling approach to develop working estimates and projections of HIV infections and AIDS cases and deaths.

1. Assemble and analyze available HIV seroprevalence data to estimate the most recent pattern(s), prevalence, and trends of HIV infection for a specific population. The HIV/AIDS database compiled by the Center for International Research, U.S. Bureau of the Census (USBOC) is a valuable data source, but their computerized HIV data should be supplemented with additional and unpublished national HIV data.

2. Based on these data and other epidemiological observations, different HIV prevalence levels (i.e., scenarios) can be constructed to the year 2000 or beyond for specific populations. Optimistic or "best case" scenarios can be constructed to develop conservative estimates and projections for public health planning.

3. EPIMODEL, a Type II model can be used to derive annual and cumulative estimates and projections of AIDS cases and deaths based on the general HIV scenarios constructed.

EPIMODEL

EPIMODEL is a microcomputer program that uses epidemiologically derived estimates of the HIV epidemic curve along with progression rates from HIV infection to AIDS and subsequent death to calculate past, current, and short-term projections of AIDS cases and deaths. The basic assumptions used in EPIMODEL are that: annual HIV incidence is distributed along an epidemic curve that approximates a gamma distribution; and annual progression rates, from HIV infection to AIDS, derived from cohort studies of white males can be applied to other populations. The following is a more detailed description of the specific assumptions and estimates required for EPIMODEL, and how the model works:

(a) <u>The year widespread HIV spread began</u> - Available data indicate that widespread[4] HIV

epidemics were not found in any population until the late 1970s or early 1980s. Thus, lacking data to indicate otherwise, 1980 $\pm$ 2 years is the most likely starting point for extensive HIV spread in North America, sub-Saharan Africa, Western European countries, and many countries in Latin America, including the Caribbean. For South and Southeast Asian countries, extensive HIV spread was not documented until the late 1980s. In many Asian countries, HIV epidemics have, as of early 1995, not been documented.

(b) HIV point prevalence - HIV point prevalence in any specific population may be estimated from available HIV serological data, such as the "family of serosurveys" in the USA, and from computerized HIV databases. Estimates developed by national experts and/or national AIDS programs can also be used. Databases of both published and unpublished serologic data should be used when available. The year for which an HIV point prevalence estimate is made is considered the reference year.

© The year HIV prevalence was estimated (the reference year) - Specifications from (a) and (b) define the "age" of the epidemic.

(d) The shape of the HIV incidence curve - EPIMODEL uses for any HIV epidemic a cumulative HIV infection curve that characteristically is "S" shaped. Such a curve is characteristic of a single source epidemic with person-to-person transmission. EPIMODEL assumes that the distribution of HIV infection over time in any population will be skewed with a long right tail. Of the many curves that could satisfy these assumptions, a simple gamma function was selected: $\mathbf{t^{(p-1)}\, e^{-t} / (p-1)!}$ to describe the HIV incidence at time t. Parameter p defines the steepness of the HIV epidemic curve. A value of p = 5 is used since this gamma distribution for HIV infections provided the best empirical fit to the reported AIDS case curves in countries with reliable reporting systems. This empirical fit has been with the left half of the curve (i.e., the epidemic phase). Whether the gamma 5 curve will "fit" any HIV epidemic after it's peak (the right half of the curve) is unknown. EPIMODEL enables the user to switch from any gamma curve to develop scenarios where HIV prevalence falls to an endemic level after its epidemic peak.

(e) Where on the HIV epidemic (incidence) curve is the reference year? - This question can only be answered by analysis of all of the available epidemiological data. Such data and other observations may suggest that HIV incidence is generally increasing or decreasing. If extensive HIV spread has been noted for only a few years (less than five), then it can be assumed that the epidemic is still in its early phase and has not yet peaked, and thus, the reference year should be somewhere on the left half of the annual HIV epidemic curve. If epidemic spread has been noted for five to ten years, then the reference year may be shortly before, at, or shortly after the peak of the epidemic curve, and if the epidemic is more than ten years old, then the reference year may be beyond the peak. Epidemiological data and observations indicate that, as of 1995, in most countries in sub-Saharan Africa, annual HIV incidence may have already peaked, or is very near the peak especially in urban areas. In North America and many western European countries, epidemiological data suggests that annual HIV incidence peaked before the mid-1980s. In a few Southeast Asian countries,

epidemic spread of HIV was only noted starting in the late 1980s, and annual HIV incidence is believed to be still increasing. **For HIV/AIDS modeling, all available HIV/AIDS data needs to be collected and analyzed to estimate for any particular country or population -- where the HIV reference year may be on the epidemic curve.**

(f) Annual HIV-infected cohorts - Any HIV point prevalence estimate must underestimate total infections (i.e., cumulative incidence) that occurred during the epidemic, since those persons who developed AIDS and/or died would be omitted from the most recent point prevalence estimate (Figure 1, lower curve). EPIMODEL, therefore, adjusts the point-prevalence estimate upwards by using annual progression rates from HIV to AIDS to arrive at an estimate of cumulative HIV incidence from the time widespread transmission began to the prevalence estimate year (i.e., the reference year).

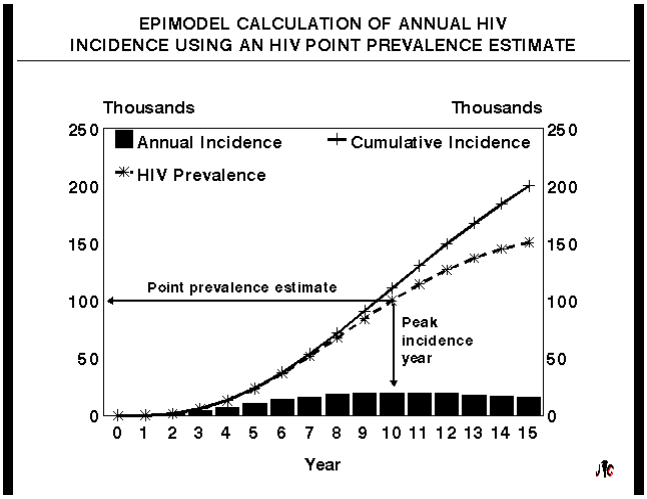


Figure 1

HIV cumulative incidence (upper curve in Figure 1) is then partitioned into annual cohorts of HIV-infected persons by use of the gamma function given above.

(g) Progression rates from HIV infection to AIDS - Neither the proportion of HIV- infected adults who will ultimately develop AIDS nor their annual progression rates are known precisely. Prospective cohort studies that followed HIV-infected homosexual men from their initial HIV infection showed that only about 3% developed AIDS within the first three years. After that, there appeared to be a steady 6% to 7% annual increase up to about year 10. As of early 1995, one of these cohort studies has estimated that over 75% of young and middle-aged white men infected with HIV have develop AIDS by year 17, after infection. About 90% or more of HIV-infected adults are expected to develop AIDS within 20 years after their infection.

Progression rates may be more rapid in developing country populations because of the presence of many other infectious diseases which may place additional stress on the immune system, but there are scant data to confirm or to refute this. Whether the natural history of HIV infection differs to any significant degree by race or gender is also not known, and the types of detailed studies needed to answer this question are difficult to plan and implement. In the early 1990s, several reports from female cohort studies suggested that progression rates to development of AIDS from initial HIV infection are similar to those reported for men. Some earlier reports suggested that pregnancy might accelerate clinical progression of HIV infection, but subsequent observations have not confirmed this.

Only age at time of HIV infection has been established as a host factor which may influence the rate of progression to AIDS. The average time from HIV infection to AIDS for men with hemophilia who were infected at age 35 or over is about 7-8 years; while for those males who were infected when they were less than 35 years old the average is approximately 12 years. Similar results were reported in 1992 for a cohort of women followed from acquisition of HIV infection to the onset of AIDS. The annual default progression rates used in EPIMODEL up to year 15 were extrapolated from published cohort studies. After 10 years, progression to AIDS in EPIMODEL is continued at the rate of 4% annually so that about 70% of an initial cohort are progressed to AIDS within 15 years: the model assumes that the rate will remain stable so that about 90% of infected adults will develop AIDS within 20 years. The default progression rates used in EPIMODEL assume that the median progression is 10 years. However, progression rates with medians of 6, 8, and 12 years are also available for use in EPIMODEL (Table 1 - next page)

Table 1
Cumulative Progression Rates From HIV Infection to AIDS
Available in EPIMODEL

Year after Infection	Median - 6 Years	Median - 8 Years	Median - 10 Years (DEF)	Median - 12 Years
1	0	0	0	0
2	0.006	0.01	0.005	0.004
3	0.2	0.04	0.03	0.025
4	0.3	0.13	0.09	0.08
5	0.4	0.21	0.15	0.13
6	0.5	0.31	0.22	0.19
7	0.59	0.4	0.29	0.25
8	0.68	0.5	0.36	0.31
9	0.77	0.6	0.43	0.37
10	0.86	0.7	0.5	0.43
11	0.9	0.76	0.54	0.47
12	0.9	0.81	0.58	0.5
13	0.9	0.86	0.62	0.53
14	0.9	0.9	0.66	0.57
15	0.9	0.9	0.7	0.6
16	0.9	0.9	0.74	0.64
17	0.9	0.9	0.78	0.67
18	0.9	0.9	0.82	0.71
19	0.9	0.9	0.86	0.74
20	0.9	0.9	0.9	0.78

Model Results According to Different Scenarios

To illustrate EPIMODEL, a hypothetical population with a point prevalence of 100,000 HIV-infected adults 10 years after the start of extensive HIV spread is used to estimate the number of AIDS cases that would have occurred up to the 10th year and to project AIDS cases for the next 3 to 4 years. In this first example, the point-prevalence, or reference year (year 10) is assumed to be the year of greatest annual incidence. The effects of stopping or continuing HIV transmission beyond the year of peak incidence (scenario 1), and shifting the point-prevalence year (reference year) to earlier or later points on the HIV epidemic or incidence curve (scenario 2) are modeled.

Figure 2 presents EPIMODEL results for the first scenario described above--HIV transmission is either continued or stopped after the 10th year. When HIV transmission is continued, there is a cumulative total of over 11,000 AIDS cases by year 10 and a total of about 40,000 by year 14. If HIV transmission stops after the 10th year, the cumulative total of AIDS cases shows no difference until year 13; by year 14, the total is still relatively close to that obtained when HIV transmission continued - 37,000 compared with 40,000. These numbers are presented in more detail in Table 2.

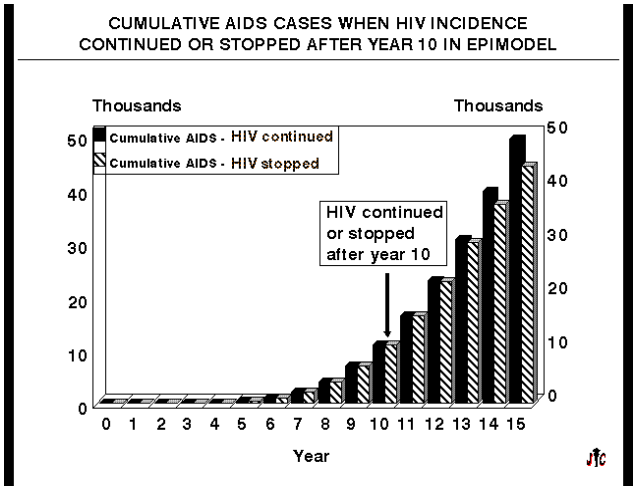


Figure 2

Table 2
Cumulative AIDS cases with HIV transmission continued or stopped after year 10

HIV Epidemic Year	HIV Transmission	
	Stopped	Continued
10	11000	11000
11	16000	16000
12	23000	23000
13	30000	31000
14	37000	40000

The effects of moving the point-prevalence (reference) year to earlier or later points on the HIV incidence curve (scenario 2) are shown in Figure 3. There is very little difference in projected cumulative AIDS cases when the reference year is taken to be three years before the peak incidence as compared with placement of the reference year at the point that coincides with peak annual incidence. When the reference year is moved to three years after the peak incidence, then a larger number of AIDS cases occur both during the first 10 years and for at least four years after that.

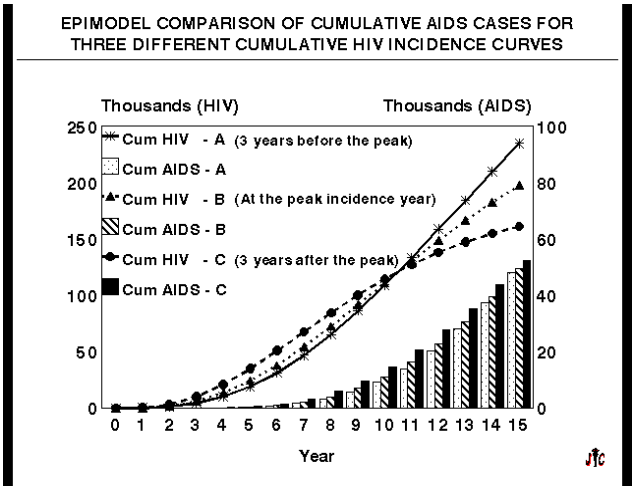


Figure 3

If projections are limited to 3 to 5 years beyond the point-prevalence (reference) year, the different results obtained by moving the reference year to earlier or later points on the incidence curve are of relatively minor importance for public health purposes (Table 3).

Table 3
Cumulative AIDS cases when the reference year is placed at different points on the curve

Year	CUM A: 3 years before peak	CUM B: At peak incidence	CUM C: 3 years after peak
10	9000	11000	14000
11	14000	16000	20000
12	21000	23000	27000
13	28000	31000	35000
14	38000	40000	44000

Major Limitations of EPIMODEL

EPIMODEL is a simple model that can provide AIDS control programs with reasonable insight into likely trends and numbers of AIDS cases over the short-term (3 to 5 years). **EPIMODEL was not designed to provide projections of HIV infection.** Short-term projections of AIDS cases are not greatly affected by stopping or continuing HIV transmission after a specific year since 80% to 90% of AIDS cases that will be occurring 3 to 5 years after the reference year will be in persons who were infected as of the reference year. However, major sources of potential error in this simple model must be constantly reviewed.

The greatest error could occur in estimating HIV point prevalence. The use of many data sets for analysis and extrapolation has resulted in US national HIV seroprevalence estimates that range from a low of about half a million to over 1.5 million. HIV seroprevalence estimates for sub-Saharan Africa and for S/SE Asia made in 1990 appear as of 1995 to be reasonably accurate. Current estimates of HIV seroprevalence for these regions also appear to have been projected accurately by the gamma curve used in EPIMODEL. Cumulative HIV incidence of about ten million in sub-Saharan Africa and about three million in S/SE Asia by 1995 were projected by the gamma curve used in EPIMODEL in 1989. These projections are very close to the January, 1995 WHO estimates derived from extrapolation of the available HIV serologic data for these regions.

Another possible source of error in producing estimates and projections with EPIMODEL is the annual progression rates from HIV infection to AIDS. The rates used were obtained from cohort studies of homosexual men and males with hemophilia. The magnitude of error that might result from using these progression rates is not known. If progression rates in developing countries are faster (i.e., a median of 6-8 years), then EPIMODEL's AIDS case estimates would be too low; if progression rates are slower, then the AIDS estimates would be too high.

A frequent criticism of EPIMODEL is that many curves can be 'drawn' through a single point (the point-prevalence year). While that argument is theoretically true, the epidemiologic basis upon which the model is formulated and the empirical data used rules out the majority of curves that can be drawn through the point chosen for the reference year. Furthermore, relatively small differences are obtained for **short-term** projection of AIDS cases when the HIV point prevalence for the reference year is placed at different points on the HIV epidemic curve. There are additional limitations of EPIMODEL. For example, the model:

- was not designed to project AIDS cases for periods longer than 3 to 5 years
- offers no additional insights about the epidemiologic features of the pandemic
- was not designed to predict future HIV infections
- cannot be used to predict consequences of behavioral and social changes
- is difficult to use in countries where extensive spread of HIV has not been noted (i.e., when the HIV prevalence in the high "risk groups" is still less than 1%)

In addition, it must be recognized that in any large area or population, the spread of HIV infection and the subsequent appearance of AIDS cases is usually the consequence of several epidemics, i.e., in different "risk groups" or different geographical areas. Each epidemic--whether it be among persons with multiple sex partners, injecting drug users, in urban or in rural areas--has its own starting point and intensity of spread (force of infection). Each epidemic should be modeled separately if sufficient epidemiologic data are available.

Finally, it should be kept in mind that EPIMODEL, and/or any other method or model for estimation and projection of HIV infections and AIDS cases, cannot be considered precisely accurate. EPIMODEL uses ***estimates*** of HIV seroprevalence, ***estimates*** of the shape and age of the HIV epidemic curve, and ***estimates*** of average progression rates from infection to AIDS and death to derive its output. All of these ***estimates*** have to be constantly reviewed, and revised, as additional data become available.

Projections of AIDS cases for longer-periods than 3 to 5 years can be produced by EPIMODEL by assuming that annual HIV infections beyond the reference year will continue along the gamma curve selected for use in EPIMODEL. However, longer-term projections of AIDS cases using EPIMODEL, or any other model, are less reliable because they depend on accurate projection of future HIV infections.

The basic module of EPIMODEL was designed to estimate and project adult AIDS cases and deaths. This module can, with the additional input of a population denominator, calculate annual incidence and prevalence rates for HIV infection. Other modules of EPIMODEL include a CHILD module that estimates and projects annual numbers of HIV-infected and uninfected infants born to HIV-infected women. This pediatric module also calculates pediatric AIDS cases and deaths, and the age of maternal orphans during the year of their mothers' death. Detailed costs such as medical care (hospital, drugs, laboratory, etc.) can be estimated and projected for any of the output columns of these modules. In 1995, a new TB module was added to estimate and project HIV-related TB cases.

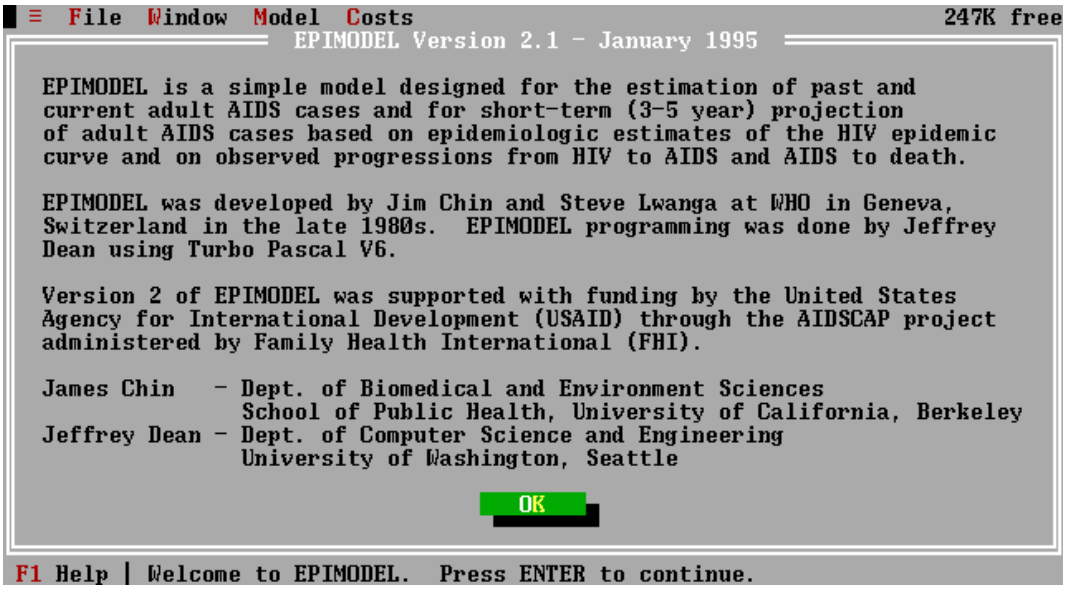
EPIMODEL has three primary screens: An output and options screen; an entry screen for inputting basic epidemiological parameters; and a graphics screen for estimating the shape and "age" of the HIV epidemic. In addition, EPIMODEL's costing module has two screens - one for viewing cost estimates and the other for making specific changes in the cost items. EPIMODEL is written in Turbo Pascal, and is provided on a 3.5" disk - it is about 350K in size. It requires an IBM compatible computer with at least 512K of memory, at least one floppy drive, and a CGA, EGA, or VGA compatible screen; 640K of memory and a hard-disk drive are recommended. EPIMODEL can be run from a floppy disk drive or from a hard disk. A mouse is helpful but not essential. A math co-processor is helpful, but not essential for the pediatric module. Since EPIMODEL only outputs text files, virtually all printers are capable of printing EPIMODEL outputs. In this manual, keys on the keyboard are indicated by "< >." Thus, <Enter> is the key labeled "Enter." Text and numbers which appear on the screen are shown in a shadowed font, and text or numerical entries that need to be typed, will also be underlined.

LESSON 1. Installing and Learning the Basics of EPIMODEL

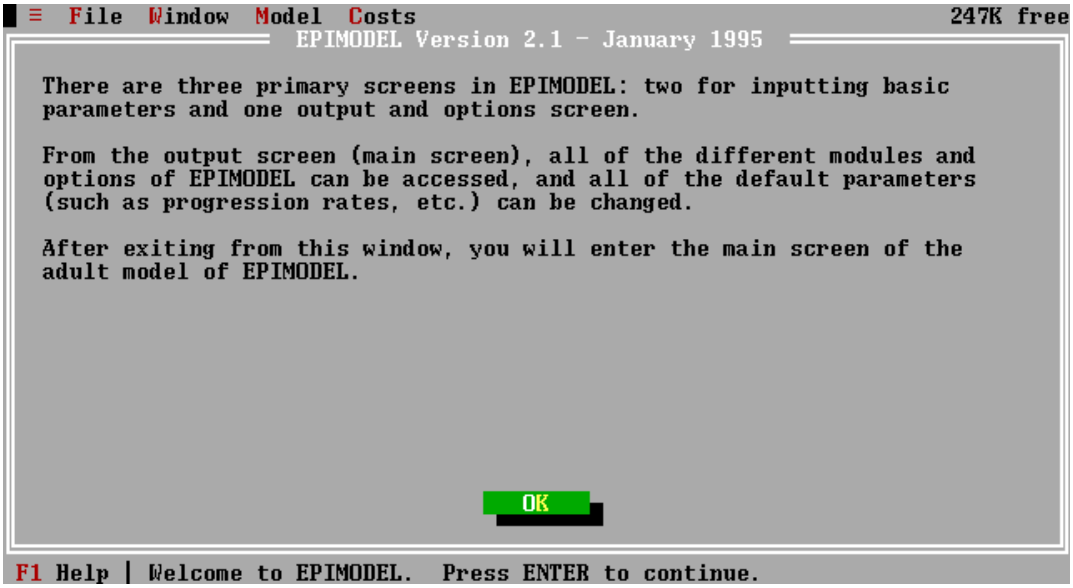
1. On the 3.5" disk provided, EPIMODEL is in a directory entitled EPIMODEL. Create an EPIMODEL directory in your hard drive and copy EPIMODEL into that directory. To start EPIMODEL, move to the EPIMODEL directory and type EPIMODEL, then press <Enter>.

2. The first two screens (**L1-1, L1-2**) are introductory screens with information on the development of EPIMODEL. You exit from these screens by pressing <Enter> or by clicking the mouse on the OK box at the bottom of these screens, and this will get you to the main screen of the adult module.

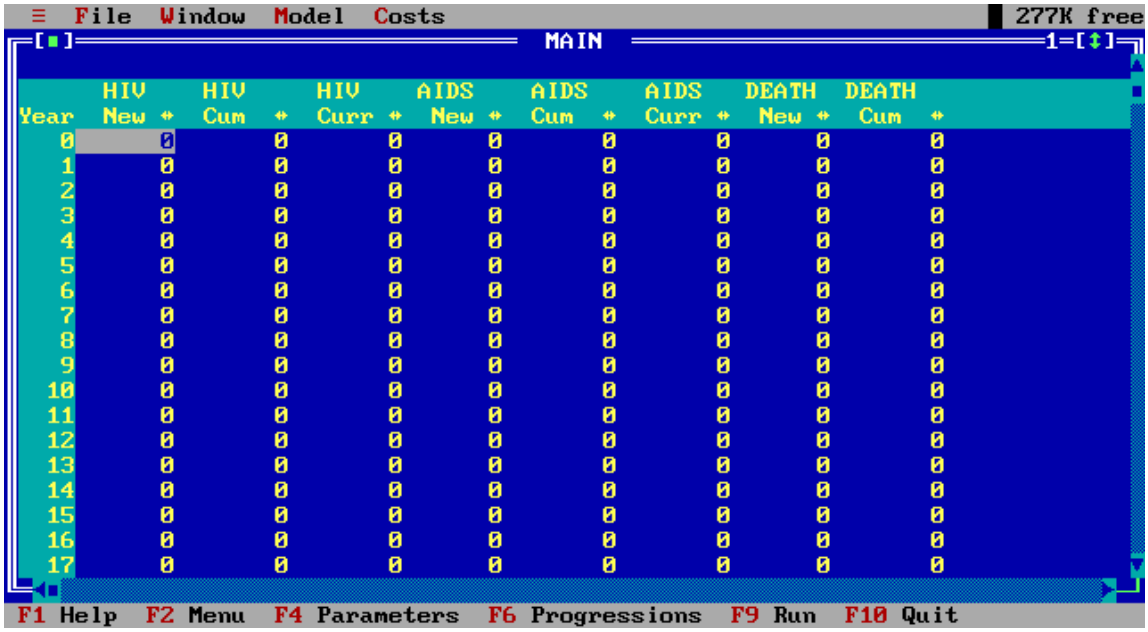
L1-1



L1-2



L1-3

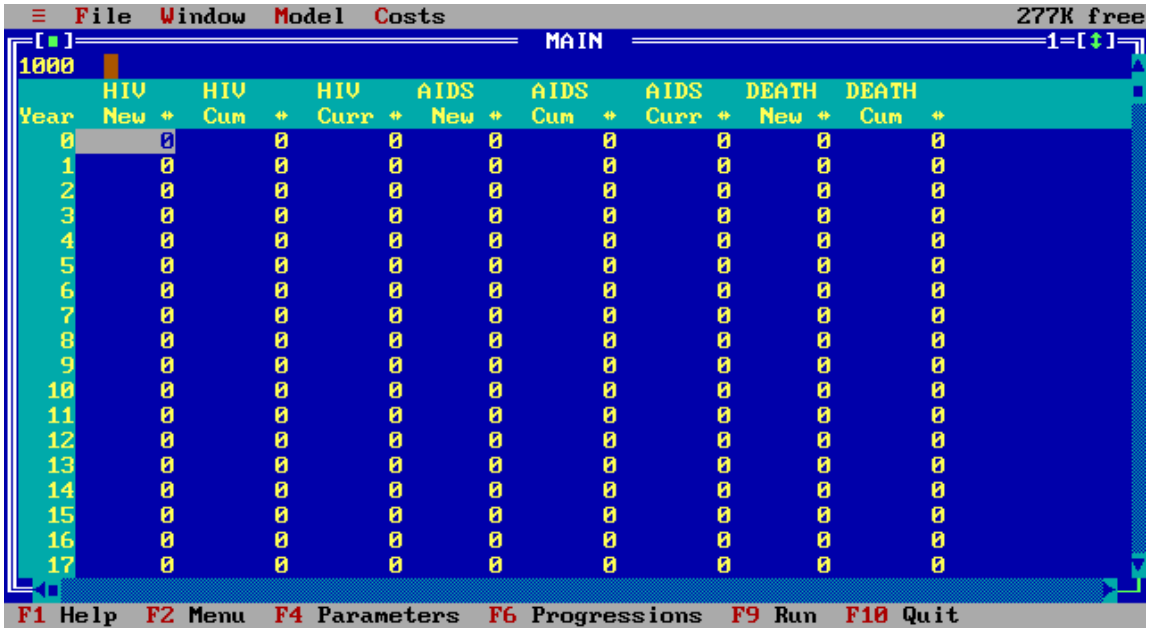


3. EPIMODEL's output screen (main screen - **L1-3**) shows the following columns:

* HIV New - annual number (incidence) of HIV infection
*HIV Cumulative - cumulative number (incidence) of total HIV infection
*HIV Current - prevalent HIV infections at the beginning of the year
(Cumulative HIV infections minus those infections that have progressed to AIDS)
*AIDS New - annual number (incidence) of AIDS cases
*AIDS CUMulative - cumulative number (incidence) of total AIDS cases
*AIDS CURRent - prevalent AIDS cases at the beginning of the year
(Cumulative AIDS cases minus those who have died)
*DEATH NEW - annual number (incidence) of AIDS deaths
*DEATH CUMulative - cumulative number (incidence) of total AIDS deaths

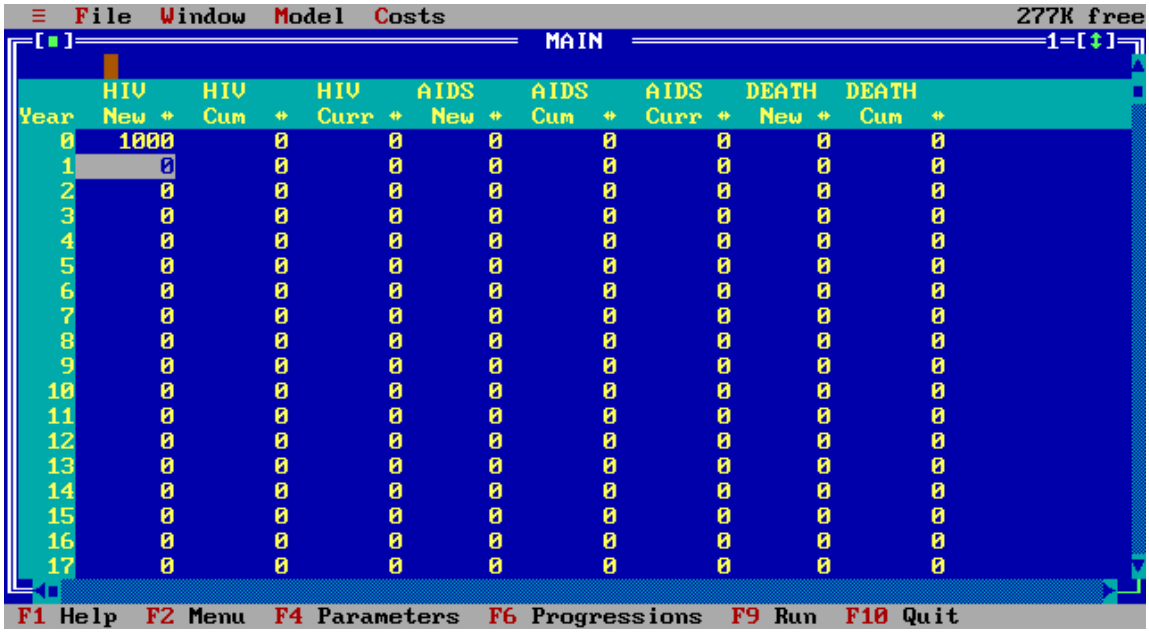
4. At the cursor prompt (upper left-hand corner of the main screen), type 1000 (**L1-4**).

L1-4



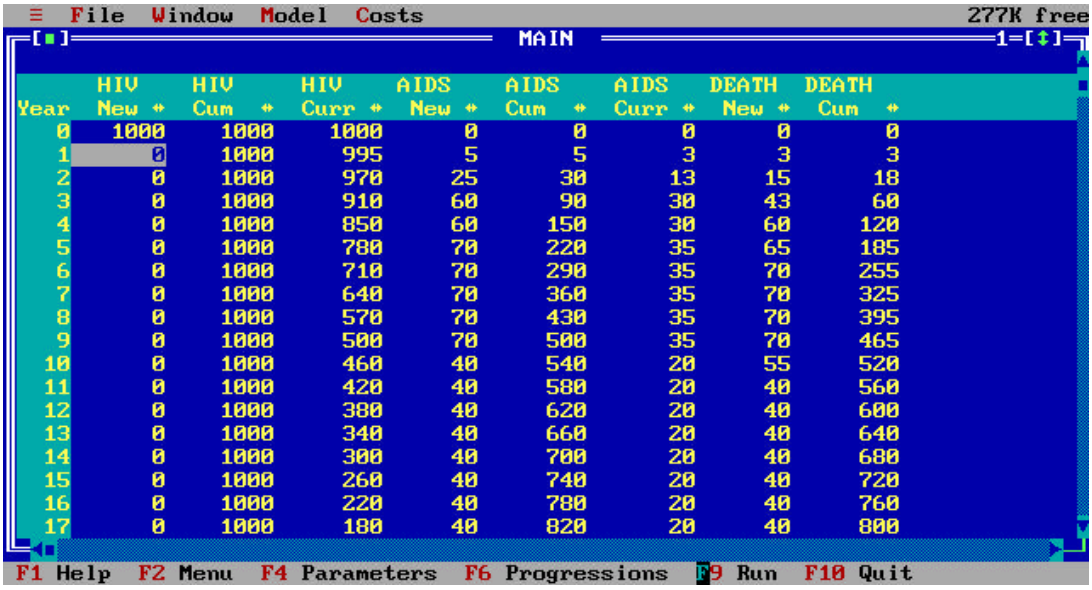
5. Press <Enter> - you will see that 1000 is entered in the HIV New column for year 0 (**L1-5**).

L1-5



6. Press <F9> or click the mouse on F9 shown on the bottom line of the screen and EPIMODEL will apply the model's default annual progression rates from HIV infection to AIDS and from AIDS to death to the cohort of 1000 HIV infections for the year 0. Annual AIDS cases and deaths that will result from the 1000 HIV infections in year 0 will be calculated and presented on the output screen (**L1-6**).

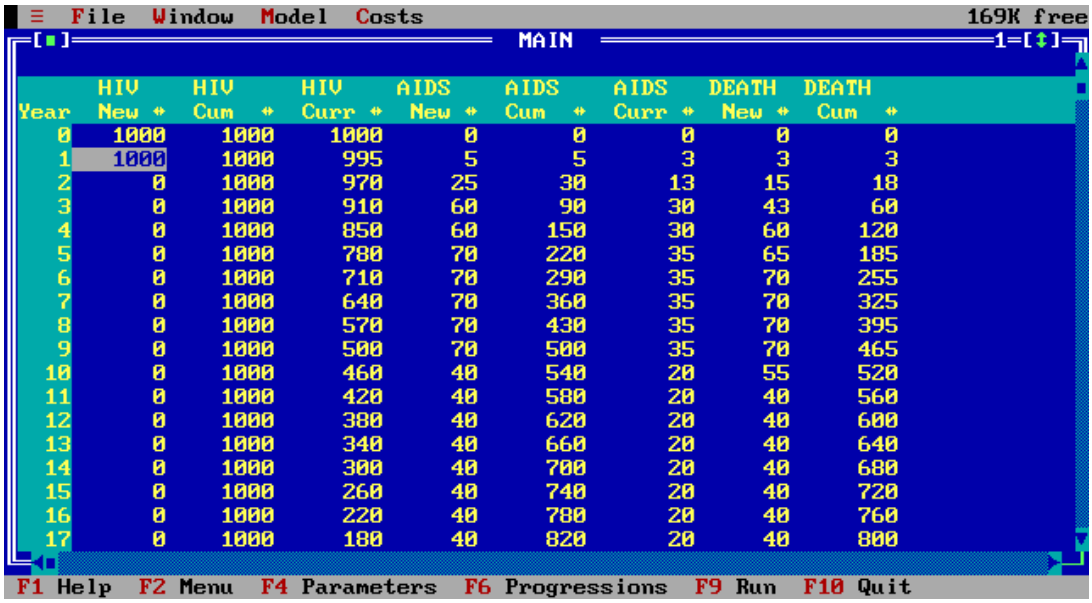
L1-6



Year	HIV New	HIV Cum	HIV Curr	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
0	1000	1000	1000	0	0	0	0	0
1	0	1000	995	5	5	3	3	3
2	0	1000	970	25	30	13	15	18
3	0	1000	910	60	90	30	43	60
4	0	1000	850	60	150	30	60	120
5	0	1000	780	70	220	35	65	185
6	0	1000	710	70	290	35	70	255
7	0	1000	640	70	360	35	70	325
8	0	1000	570	70	430	35	70	395
9	0	1000	500	70	500	35	70	465
10	0	1000	460	40	540	20	55	520
11	0	1000	420	40	580	20	40	560
12	0	1000	380	40	620	20	40	600
13	0	1000	340	40	660	20	40	640
14	0	1000	300	40	700	20	40	680
15	0	1000	260	40	740	20	40	720
16	0	1000	220	40	780	20	40	760
17	0	1000	180	40	820	20	40	800

7. Move the cursor to year 1 in the HIV New column and type 1000, press <Enter> and you will see that 1000 is entered in the HIV New column for year 1 (**L1-7**).

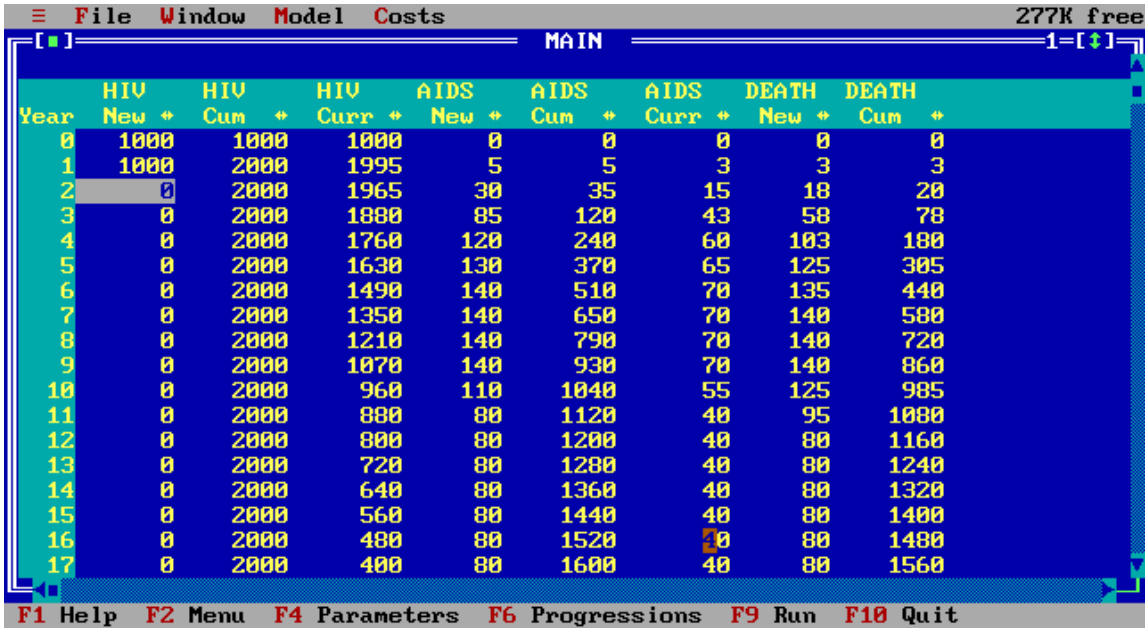
L1-7



Year	HIV New	HIV Cum	HIV Curr	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
0	1000	1000	1000	0	0	0	0	0
1	1000	1000	995	5	5	3	3	3
2	0	1000	970	25	30	13	15	18
3	0	1000	910	60	90	30	43	60
4	0	1000	850	60	150	30	60	120
5	0	1000	780	70	220	35	65	185
6	0	1000	710	70	290	35	70	255
7	0	1000	640	70	360	35	70	325
8	0	1000	570	70	430	35	70	395
9	0	1000	500	70	500	35	70	465
10	0	1000	460	40	540	20	55	520
11	0	1000	420	40	580	20	40	560
12	0	1000	380	40	620	20	40	600
13	0	1000	340	40	660	20	40	640
14	0	1000	300	40	700	20	40	680
15	0	1000	260	40	740	20	40	720
16	0	1000	220	40	780	20	40	760
17	0	1000	180	40	820	20	40	800

8. Press <F9> or click the mouse on F9 shown at the bottom line of the screen and EPIMODEL recalculates AIDS cases and deaths by including the 1000 additional HIV infections entered for year 1 (**L1-8**).

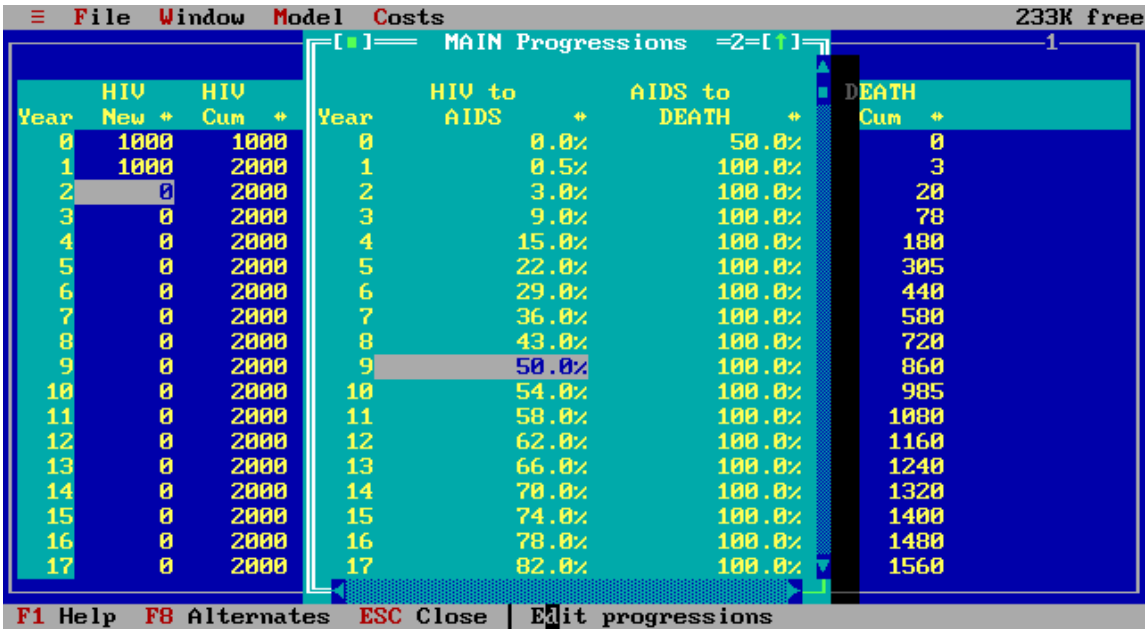
L1-8



Year	HIV New	HIV Cum	HIV Curr	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
0	1000	1000	1000	0	0	0	0	0
1	1000	2000	1995	5	5	3	3	3
2	0	2000	1965	30	35	15	18	20
3	0	2000	1880	85	120	43	58	78
4	0	2000	1760	120	240	60	103	180
5	0	2000	1630	130	370	65	125	305
6	0	2000	1490	140	510	70	135	440
7	0	2000	1350	140	650	70	140	580
8	0	2000	1210	140	790	70	140	720
9	0	2000	1070	140	930	70	140	860
10	0	2000	960	110	1040	55	125	985
11	0	2000	880	80	1120	40	95	1080
12	0	2000	800	80	1200	40	80	1160
13	0	2000	720	80	1280	40	80	1240
14	0	2000	640	80	1360	40	80	1320
15	0	2000	560	80	1440	40	80	1400
16	0	2000	480	80	1520	40	80	1480
17	0	2000	400	80	1600	40	80	1560

9. Press <F6> or click the mouse on F6 shown at the bottom line of the screen and a drop down window appears showing the annual default progression rates used in EPIMODEL - 50% of an annual infected cohort will progress to AIDS within 10 years, i.e., after the end of year 9 (**L1-9**).

L1-9

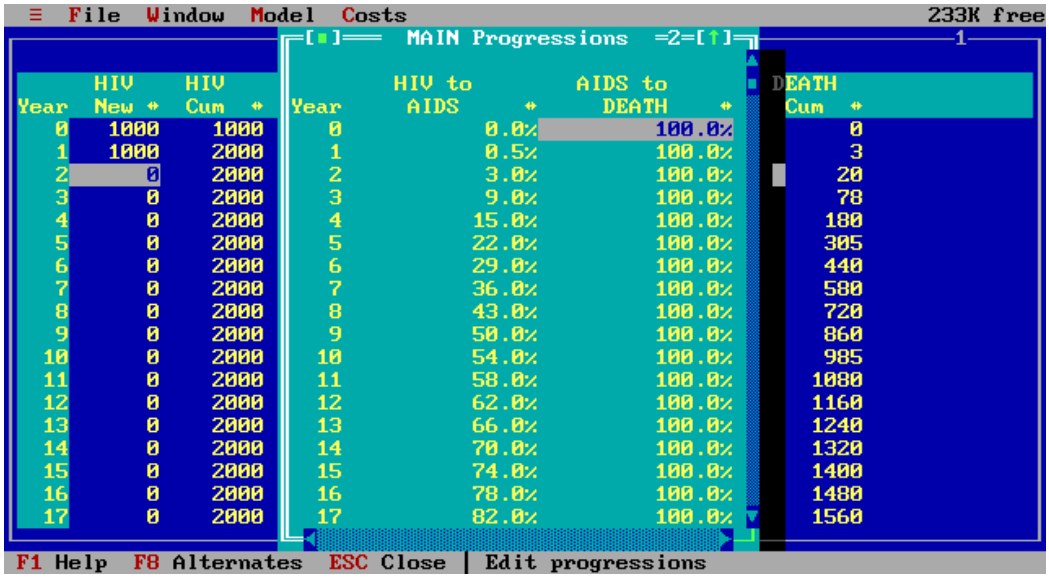


Year	HIV New	HIV Cum
0	1000	1000
1	1000	2000
2	0	2000
3	0	2000
4	0	2000
5	0	2000
6	0	2000
7	0	2000
8	0	2000
9	0	2000
10	0	2000
11	0	2000
12	0	2000
13	0	2000
14	0	2000
15	0	2000
16	0	2000
17	0	2000

Year	HIV to AIDS	AIDS to DEATH	DEATH Cum
0	0.0%	50.0%	0
1	0.5%	100.0%	3
2	3.0%	100.0%	20
3	9.0%	100.0%	78
4	15.0%	100.0%	180
5	22.0%	100.0%	305
6	29.0%	100.0%	440
7	36.0%	100.0%	580
8	43.0%	100.0%	720
9	50.0%	100.0%	860
10	54.0%	100.0%	985
11	58.0%	100.0%	1080
12	62.0%	100.0%	1160
13	66.0%	100.0%	1240
14	70.0%	100.0%	1320
15	74.0%	100.0%	1400
16	78.0%	100.0%	1480
17	82.0%	100.0%	1560

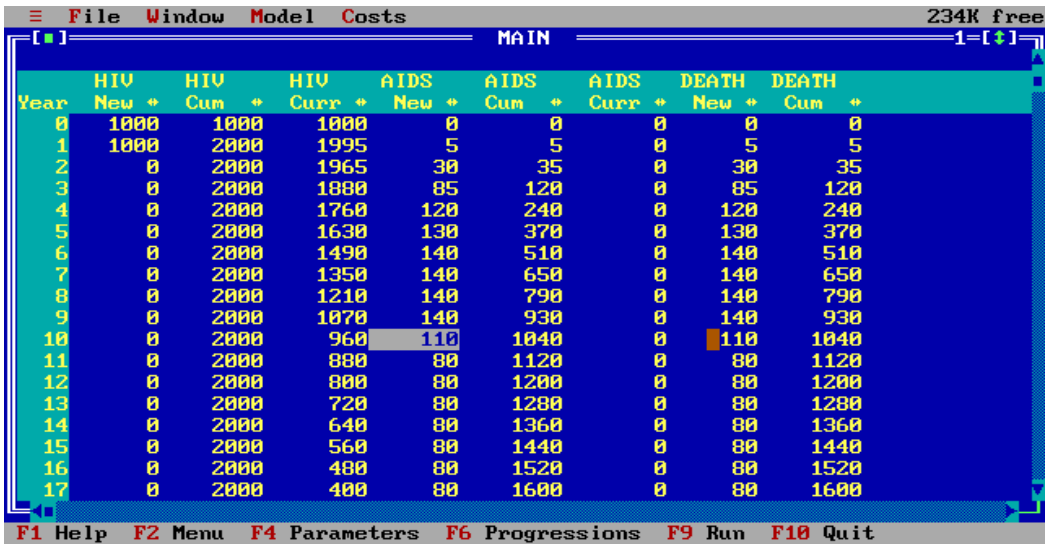
10. The annual default progression rates can be changed manually for any or all years by moving the cursor with the up or down arrow keys or by clicking the mouse on a specific year's rate and then typing in a new value[5] and pressing <Enter>. The survival period from AIDS to death can be changed similarly. Move the cursor to the top of the right column in the progression window and type in 1 and then press <Enter> (**L1-10**). This will result in all AIDS cases dying in the same year that they develop AIDS (i.e., no survival period) and the AIDS New and AIDS CUMulative columns will be the same as the DEATH New and DEATH CUMulative columns, since there will be no AIDS Current (prevalent) cases surviving from the previous year.

L1-10



11. This will be shown on the output screen (**L1-11**) after pressing the <Esc> key. Before going to the next step, re-enter the progression rate window and change the progression rate from AIDS to death in year 0 back to 50%.

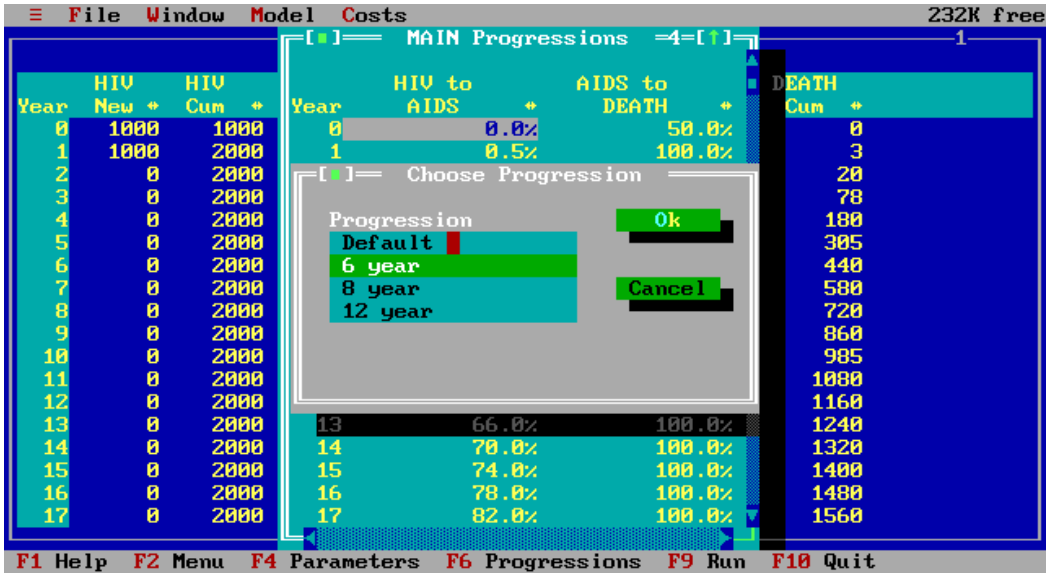
L1-11



12. A new feature of EPIMODEL (Version 2) enables easier changes in the progression rates from the default median value of 10 years to median values of 6, 8, or 12 years. To do this,

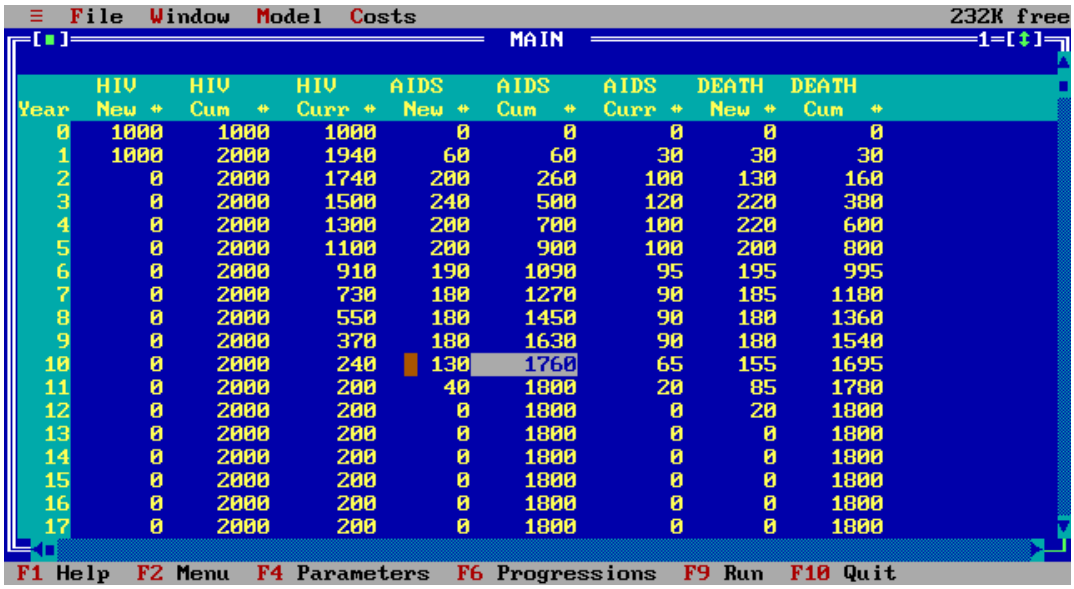
re-enter the progression rate window by pressing <F6> or clicking on F6 at the bottom line of the screen. With the annual default progression rates showing in the progression rate window, press <F8> or click the mouse on F8 at the bottom line of the screen and another window with alternate progression rates will appear (**L1-12**).

L1-12



13. Either move the cursor with the arrow keys or move the mouse to an alternate progression rate, then press <Enter> or click the mouse to select that rate. For now, select the progression rate with a median of 6 years and note how this almost doubles the number of AIDS cases by year 10 compared with the default rate - median of 10 years (**L1-13**).

L1-13

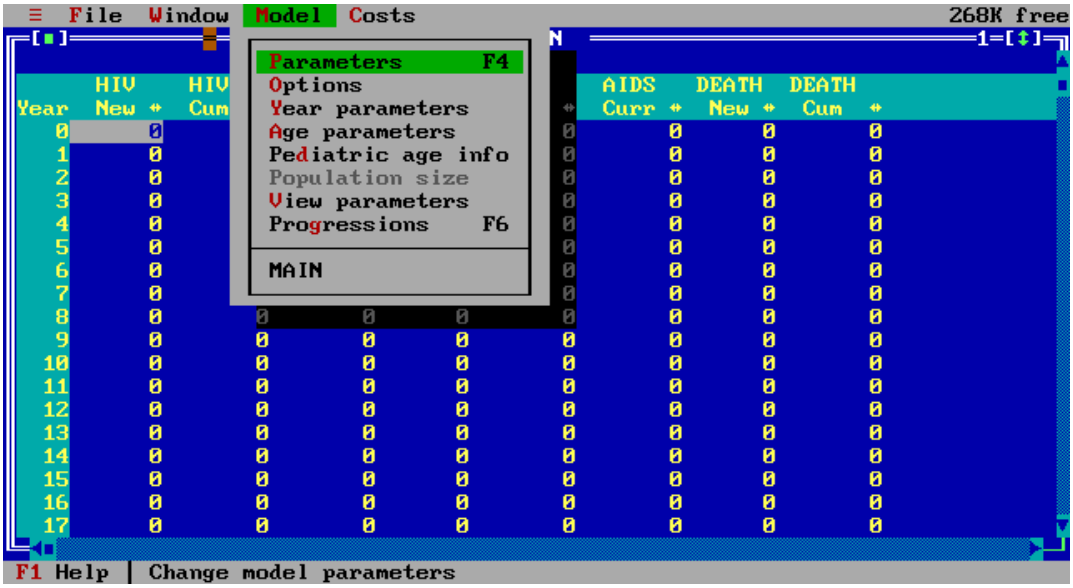


14. This concludes Lesson 1. Change the progression rates back to the default settings before continuing with lesson 2. If you exit or close EPIMODEL by pressing <F10>, all settings will revert to the default settings upon reopening EPIMODEL.

LESSON 2 - Other EPIMODEL Options and Use of EPIMODEL to Estimate and Project Adult AIDS Cases in sub-Saharan Africa.

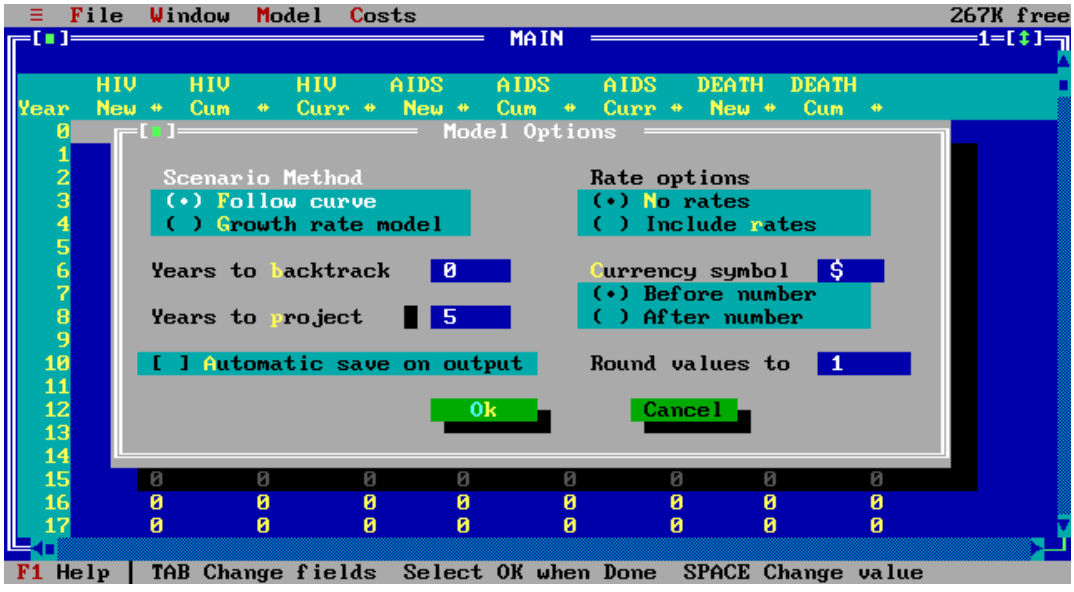
1. Open EPIMODEL and get to the output screen and then press the <Alt plus M> keys or click the mouse on Model shown at the top line of the screen to open the Model drop down menu (L2-1). Eight choices are listed. For now, we will only access Options.

L2-1



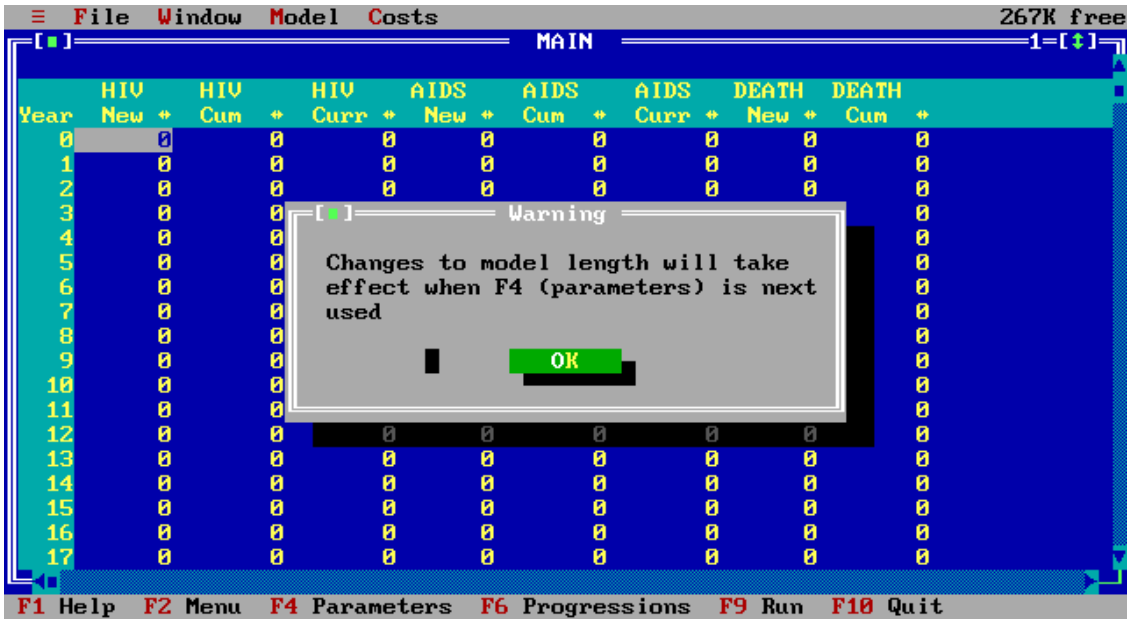
2. Move the cursor down to Options with the arrow key and press <Enter> or click the mouse on Options. Note all of the options available in this window (L2-2). Use the <Tab> key to move from one option to another or use the mouse. To change any of the option settings, you can use the up or down arrow keys within the selected option box to a specific option and then press <Enter> or click the mouse on any specific option.

L2-2



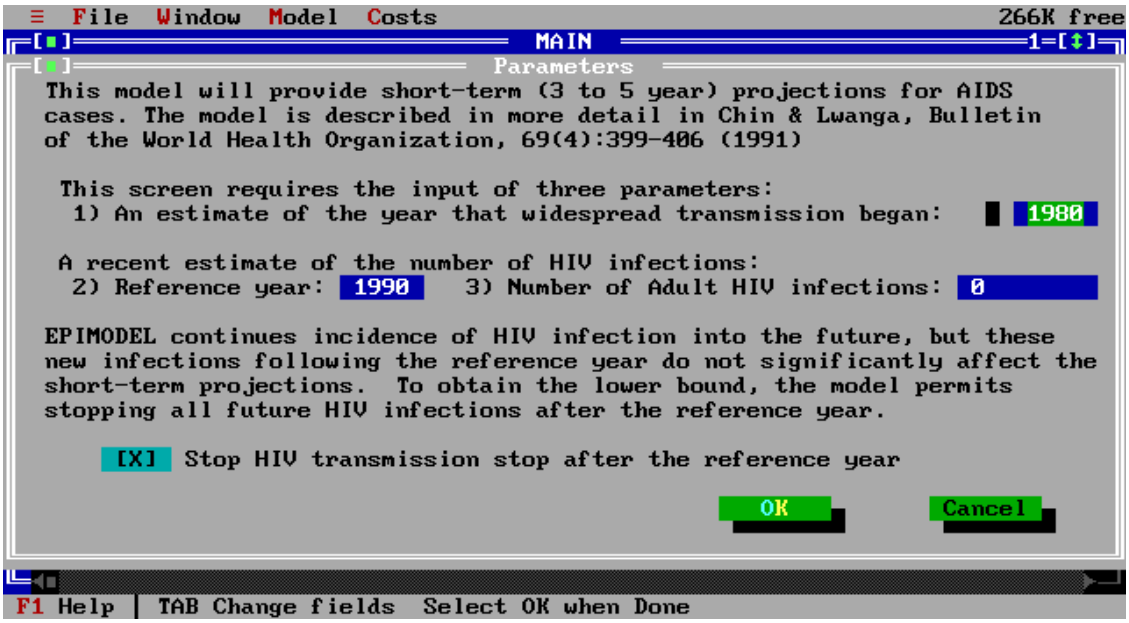
3. We will not change any of the options now except the Years to project option that is near the bottom left of the options window. The default setting is 5 years. For this run we will change it to 10 years. Move to this option by pressing the <Tab> or <Enter> key or by clicking the mouse in this option box. Change the Years to project from 5 to 10 by first deleting the 5 in this box and then typing in 10. Exit by pressing <Enter> with the cursor in the OK box or clicking on the OK box with the mouse. You will get a printed message that "The change to model length will take effect when F4 (parameters) is next used" (L2-3). Press <Enter> or click on the OK box to accept and continue. Now press <F4> or click the mouse on F4 at the last line on the bottom of the screen to access the main entry screen.

L2-3



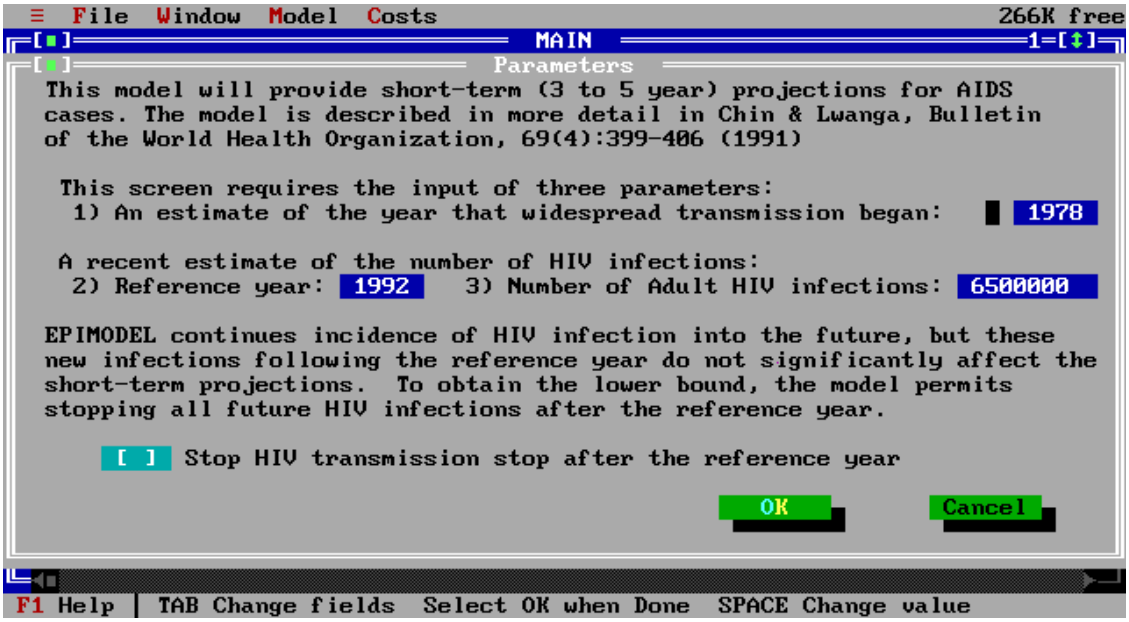
4. This screen (L2-4) is self explanatory and we will enter the specific values given in the next page for the input parameters requested.

L2-4



In box 1 - The default setting for An estimate of the year that widespread transmission began is 1980. To change the starting year for sub-Saharan Africa to 1978, we type 1978 then press <Enter>. The cursor will then move to Box 2 where the default setting for the Reference year is 1990. The reference year is the year for which an HIV point prevalence estimate is made. WHO estimated the 1992 HIV point prevalence in sub-Saharan Africa to be about 6.5 million. Thus, we will type 1992 in the reference year Box and then press <Enter>. The cursor will then move to Box 3 that is blank - Number of adult infections (for the reference year) - Type 6500000 then press <Enter>. The cursor will move to Box 4 that is an option box to Stop HIV infections after the reference year (in this run - 1992). For this run, we will continue HIV infections after 1992. We will remove the X in Box 4 by pressing (toggling) the <Space> bar. The complete input of parameters is shown in L2-5.

L2-5

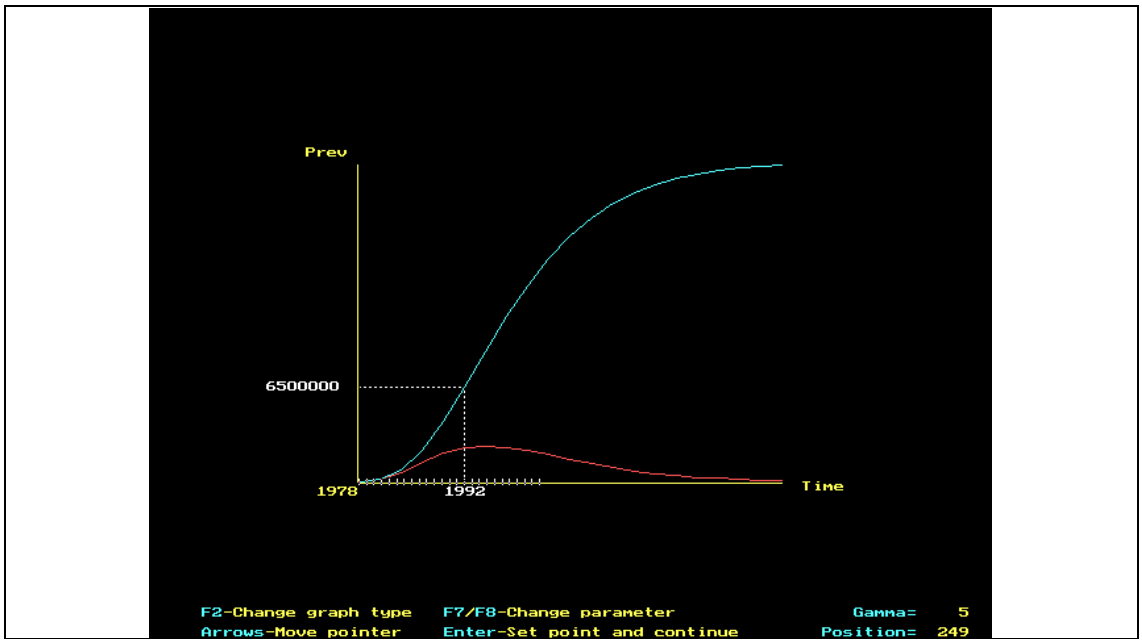


If you make a mistake and need to change any of the input parameters, you can cycle back to any of the input boxes by pressing the <Tab> key or by using the mouse. NOTE: If there is a "triangular" symbol at the end of any of the data entry Boxes, you may have inappropriately entered some numbers. Use the <TAB> key or click the mouse in that Box to re-access the Box. If you used the <TAB> key to recycle back, then just retype the correct data entry (the existing numbers will be automatically erased). However, if you have returned to this Box by using the mouse, then you will need to first delete all of the existing numbers before you retype the correct data entry. Failure to correct these inappropriate data entries (usually excessively large numbers) may cause the program to lock-up. When this happens, exit the program by pressing or clicking the mouse on <F10>. If this does not work, turn off the computer then restart (re-boot) your computer and begin EPIMODEL again.

Exit this screen (L2-5) by moving to the OK box and pressing <Enter> or by clicking the mouse on the OK box.

5. The next screen (L2-6) is a graphic presentation of the input parameters that were entered on the prior screen.

L2-6



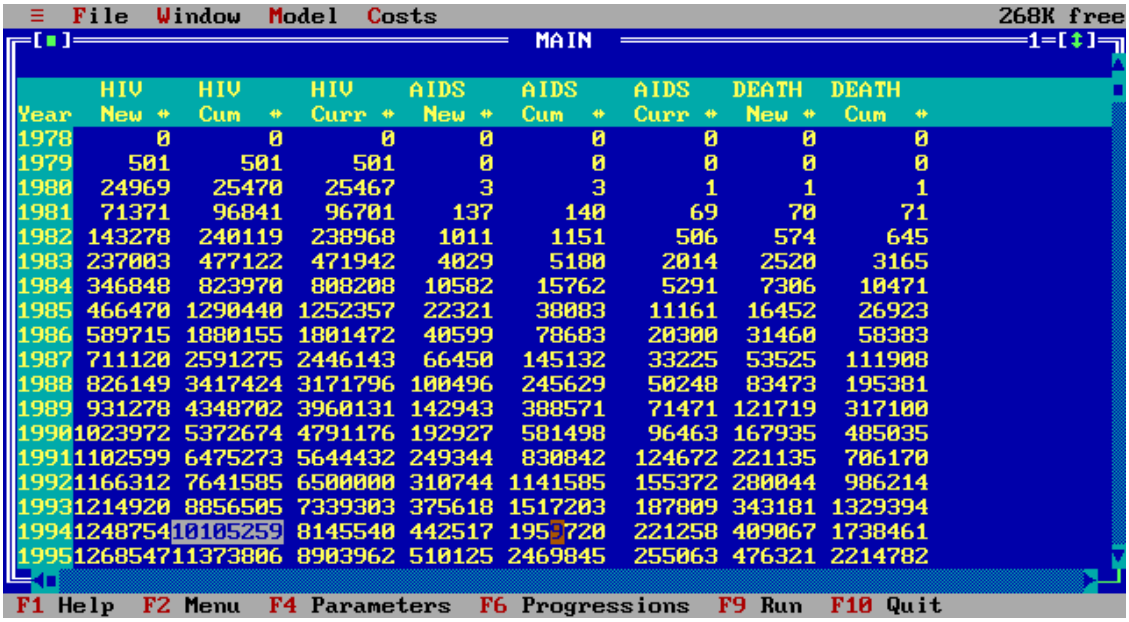
The default, as previously described, is a gamma 5 epidemic curve and the default setting for the reference year (1992 in this run) is about three years before the peak annual incidence point on the annual epidemic curve (the bottom curve). The top curve is the cumulative incidence curve. The exact position on the gamma 5 curve is shown in the bottom right corner of the screen as 249 which is to the left of the peak incidence point on the annual incidence curve. The reference year's position on this curve can be moved to the left or right by using the left or right arrow keys. Move the position of the reference year to the left and right, but return to position 249 when you are finished.

6. EPIMODEL also has an exponential curve which can be accessed by pressing the <F2> key. The exponential curve is not a useful or realistic curve for any long term projection of HIV infections since this curve results in a constant rate of increase of annual HIV infections. This curve is included in EPIMODEL only because of the initial observations and concerns regarding the rapid and almost exponential rate of increase of reported AIDS cases in the USA during the early-to-mid 1980s. Return to the gamma curves by pressing the <F2> key.

7. Pressing the <F7> key decreases the value and shape of the gamma curve on the screen and pressing the <F8>key increases the value and shape of the gamma curve. Regardless of the general shape of any gamma curve, each curve can be divided into its ascending left portion and descending right portion. When using any of the gamma curves in EPIMODEL, care must be taken to position the reference or HIV estimate year at the appropriate point on the gamma curve, i.e., the annual HIV incidence curve. The default position for the gamma 5 curve is to the left of the peak incidence part of the curve--position 249. The default gamma 5 curve can be changed to a lower or higher value (by pressing the <F7> or <F8> keys). However, in order to be at a comparable epidemic

point on the new gamma curve, we must also move the position of the reference or HIV estimate year to a point to the left of the peak incidence part of the new gamma curve. For a gamma 3 curve the reference year needs to be moved to a position about 137, and for the gamma 12 curve the comparable position for the reference year is about 370. Using these values, the left portion of the gamma 3 curve up to the point of peak incidence will result in a more rapid increase of annual HIV infections and the right side of the curve will result in a more rapid drop or decrease of annual infections compared to the higher gamma curves. In contrast, the left and right halves of the gamma 12 curve are almost identical and thus, the increases of annual HIV infections on the left half of the curve is equal to the annual decreases on the right half of the curve. Knowing how to change the value of the gamma curve will be needed later in this manual when low or high HIV scenarios are constructed. Return to the gamma 5 curve, position 249 when you are finished. Press <Enter> to exit to the output screen (L2-7).

L2-7

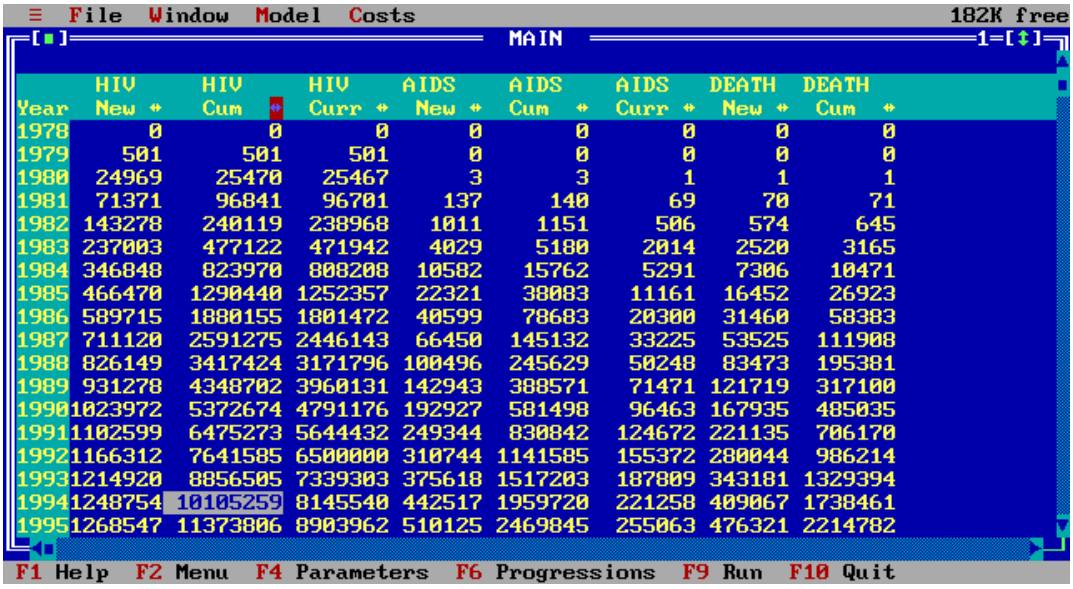


Year	HIV New	HIV Cum	HIV Curr	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
1978	0	0	0	0	0	0	0	0
1979	501	501	501	0	0	0	0	0
1980	24969	25470	25467	3	3	1	1	1
1981	71371	96841	96701	137	140	69	70	71
1982	143278	240119	238968	1011	1151	506	574	645
1983	237003	477122	471942	4029	5180	2014	2520	3165
1984	346848	823970	808208	10582	15762	5291	7306	10471
1985	466470	1290440	1252357	22321	38083	11161	16452	26923
1986	589715	1880155	1801472	40599	78683	20300	31460	58383
1987	711120	2591275	2446143	66450	145132	33225	53525	111908
1988	826149	3417424	3171796	100496	245629	50248	83473	195381
1989	931278	4348702	3960131	142943	388571	71471	121719	317100
1990	1023972	5372674	4791176	192927	581498	96463	167935	485035
1991	1102599	6475273	5644432	249344	830842	124672	221135	706170
1992	1166312	7641585	6500000	310744	1141585	155372	280044	986214
1993	1214920	8856505	7339303	375618	1517203	187809	343181	1329394
1994	1248754	10105259	8145540	442517	1959720	221258	409067	1738461
1995	1268547	11373806	8903962	510125	2469845	255063	476321	2214782

8. The cursor can be moved to highlight any of the cells in this output screen by use of the arrow keys or by clicking on any cell with the mouse. Note that the HIV Current (prevalent) number in 1992 is as entered - 6500000. EPIMODEL calculated what the HIV Cumulative incidence would have been in 1992 (over 7600000 HIV infections, and over 1 million cumulative AIDS cases had occurred by the end of 1992). EPIMODEL then apportioned the cumulative HIV incidence into annual incidence for each year back to the year the epidemic started (1978) according to the gamma 5 curve. Since we selected to project 10 years from the reference year (1992) the last year of this projection is 2002.

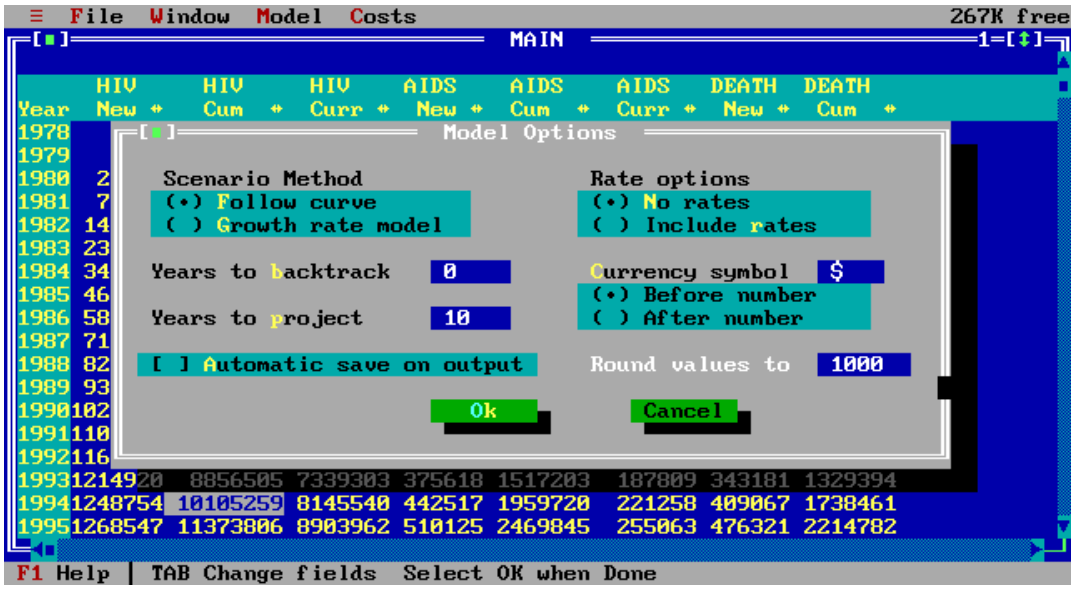
9. Move the cursor down to year 1994 and note that the numbers in columns 2 (HIV Cumulative incidence) and 3 (HIV Current or prevalent) run into each other. We can address this problem by using the mouse to click and hold on the arrow symbol between the columns at the top of the screen on the column headings line to drag a column to the right (L2-8).

L2-8



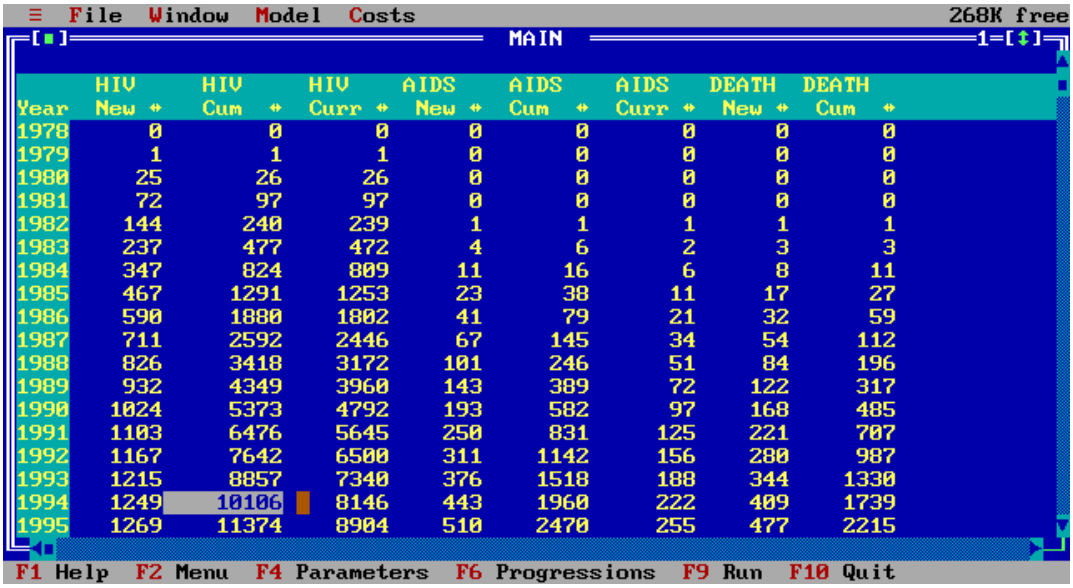
Alternatively we can select the option to round off the output numbers. We do this by opening the Models menu - pressing the <Alt plus M> keys or by clicking the mouse on Model at the top line of the screen. In the Model menu we select Options, and once we are in the options window we select the option in the lower right corner of the option window (L2-9) - Round values to tens, hundreds or thousands, etc.

L2-9



Try both methods to visualize the output numbers more clearly. These methods will be especially useful when we begin to use the costing module later in this manual because the calculation of medical costs for treatment of AIDS patients will involve very large numbers. For now, continue with the option to round off the numbers by thousands as shown in L2-10.

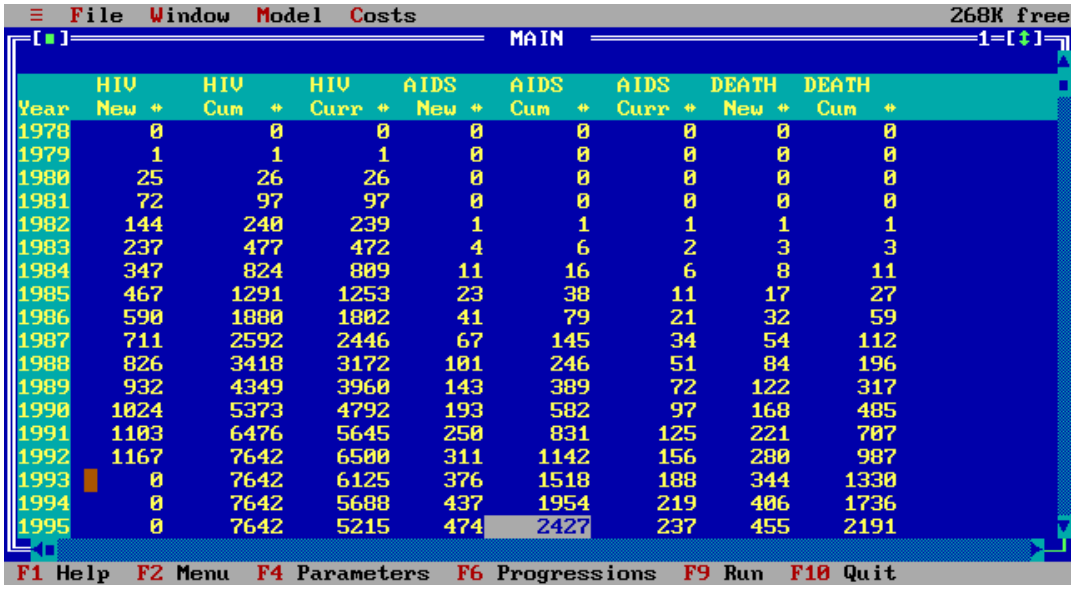
L2-10



Year	HIV New	HIV Cum	HIV Curr	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
1978	0	0	0	0	0	0	0	0
1979	1	1	1	0	0	0	0	0
1980	25	26	26	0	0	0	0	0
1981	72	97	97	0	0	0	0	0
1982	144	240	239	1	1	1	1	1
1983	237	477	472	4	6	2	3	3
1984	347	824	809	11	16	6	8	11
1985	467	1291	1253	23	38	11	17	27
1986	590	1880	1802	41	79	21	32	59
1987	711	2592	2446	67	145	34	54	112
1988	826	3418	3172	101	246	51	84	196
1989	932	4349	3960	143	389	72	122	317
1990	1024	5373	4792	193	582	97	168	485
1991	1103	6476	5645	250	831	125	221	707
1992	1167	7642	6500	311	1142	156	280	987
1993	1215	8857	7340	376	1518	188	344	1330
1994	1249	10106	8146	443	1960	222	409	1739
1995	1269	11374	8904	510	2470	255	477	2215

10 To do another EPIMODEL run press <F4> or click the mouse on F4 at the bottom line of the screen. For this new run, we will keep all input values and options the same except we will stop HIV transmission after the reference year by pressing (toggling) the <Space> bar to re-insert the X in box 4 of the input parameter screen. We then exit the input screen and the graphic screen as described above to reach the output screen again (L2-11).

L2-11

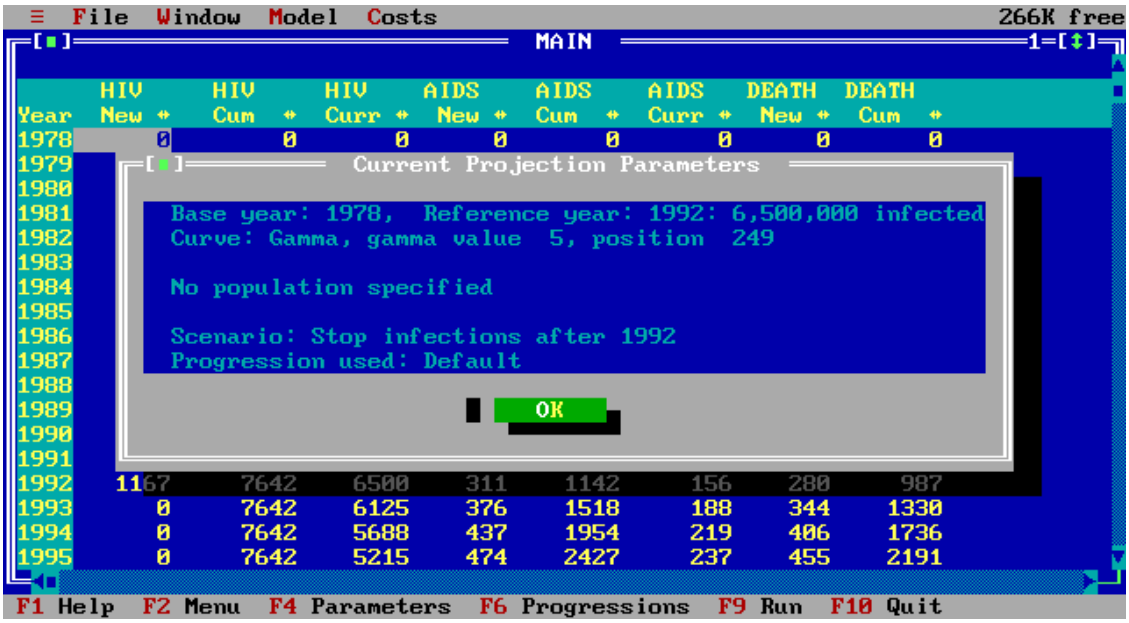


Year	HIV New	HIV Cum	HIV Curr	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
1978	0	0	0	0	0	0	0	0
1979	1	1	1	0	0	0	0	0
1980	25	26	26	0	0	0	0	0
1981	72	97	97	0	0	0	0	0
1982	144	240	239	1	1	1	1	1
1983	237	477	472	4	6	2	3	3
1984	347	824	809	11	16	6	8	11
1985	467	1291	1253	23	38	11	17	27
1986	590	1880	1802	41	79	21	32	59
1987	711	2592	2446	67	145	34	54	112
1988	826	3418	3172	101	246	51	84	196
1989	932	4349	3960	143	389	72	122	317
1990	1024	5373	4792	193	582	97	168	485
1991	1103	6476	5645	250	831	125	221	707
1992	1167	7642	6500	311	1142	156	280	987
1993	0	7642	6125	376	1518	188	344	1330
1994	0	7642	5688	437	1954	219	406	1736
1995	0	7642	5215	474	2427	237	455	2191

Compared with, the first run where HIV infections were continued after the reference year, the number of cumulative AIDS cases in this run, where annual HIV infections are stopped after the reference year (1992), is not significantly lower until after 1995. In the first run there were 2470 thousand cumulative AIDS cases in 1995 and in the second run there are 2427 thousand cumulative AIDS cases. This feature of stopping all transmission of HIV infection after the reference year is helpful to emphasize the long interval from HIV infection to the development of AIDS. In addition, this feature of EPIMODEL can be used to convince the public and policy makers that AIDS cases will continue to increase for many years after HIV transmission is significantly reduced by public health programs.

11 To view the parameter values for this projection run, we: I) access the Model menu or dialog box by pressing <Alt plus M> or by clicking the mouse on Model at the top of the screen; ii) move the cursor bar down to the View parameters option and select this option by pressing <Enter> or by clicking the mouse on this option. This opens the Current Projections Parameter window (L2-12) which shows all of the parameter values used for the current projection. Exit this window by pressing <Enter> or by clicking the mouse on the OK box.

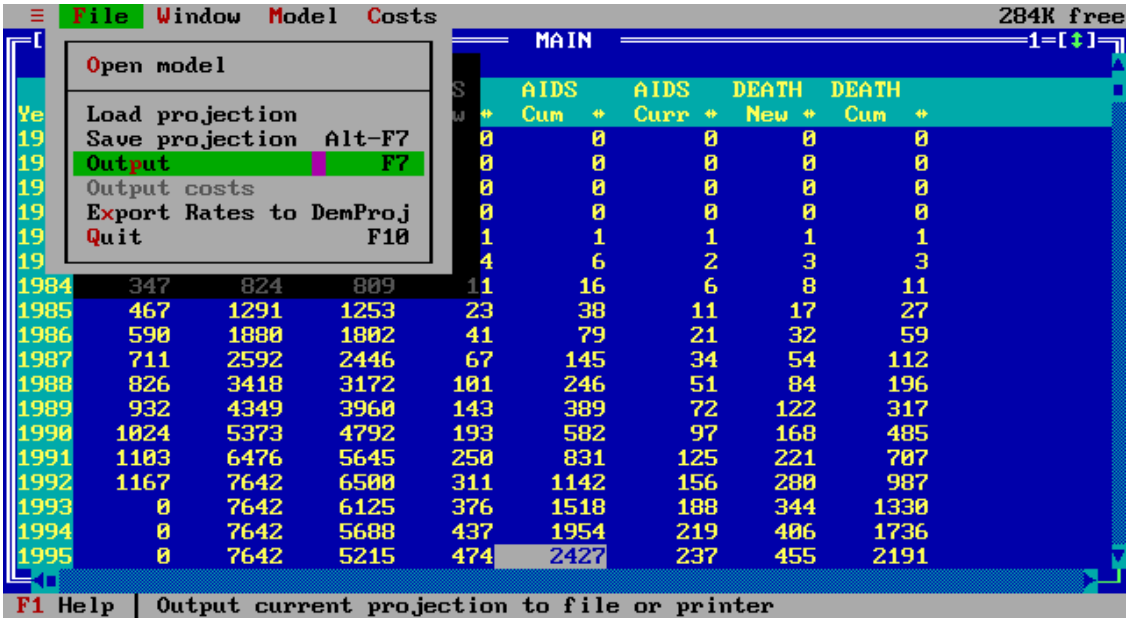
L2-12



12 We will next print the output of the second run by first accessing the File menu - pressing <Alt plus F>, or by clicking the mouse on Files at the upper left corner of the screen. The

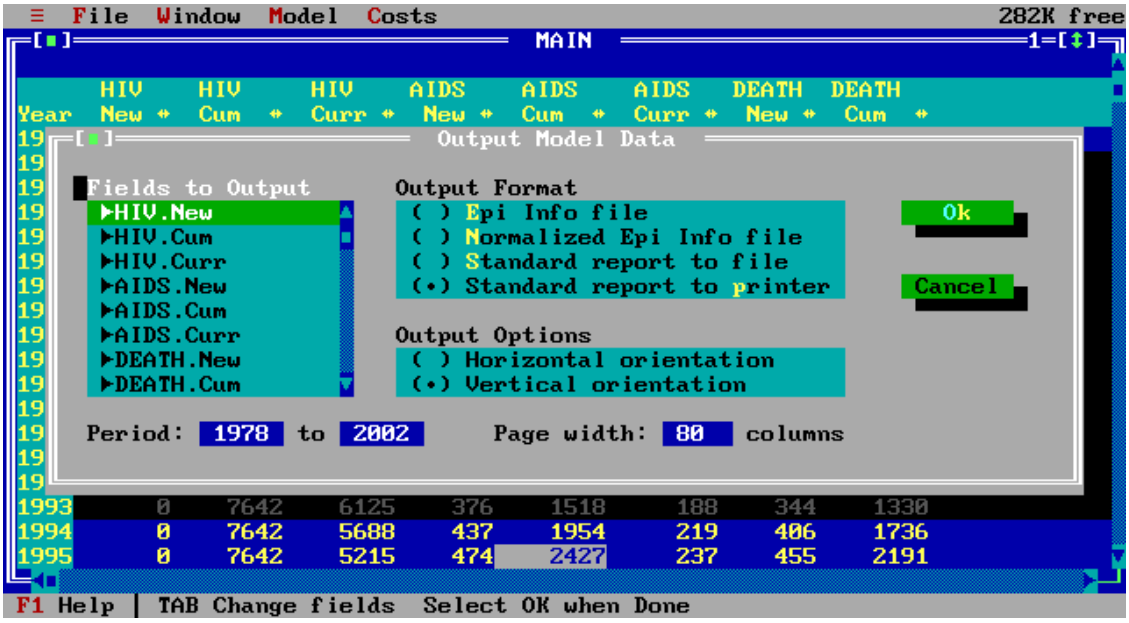
File menu dialog box (L2-13) contains seven items.

L2-13



Move the cursor bar with the down arrow key to the Output option and then press <Enter> or click the mouse on Output. This will open the Output Model Data dialog box (L2-14) which will enable you to print selected output columns from an EPIMODEL projection, or save data to a file, in one of several formats.

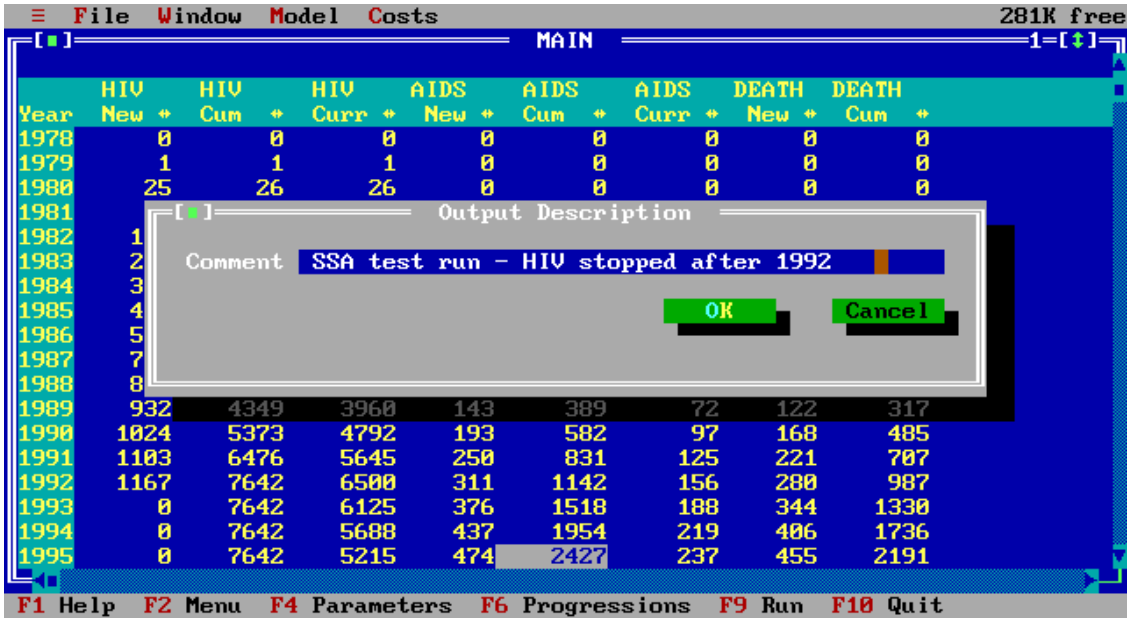
L2-14



Alternatively, you can get to this Output Model Data dialog box directly from the Output screen by pressing <F7>. At the left side of this dialog box is a Fields to Output box that

allows you to select which fields (columns) you want to output. Only fields with a triangle next to them will be output. You can toggle the output status of a field with the <Space> bar. Details of this output dialog box are found in the Appendix. For now accept the default setting to output all fields (columns) for the entire period of the projection run as a standard report to the printer by pressing <Enter> when the cursor is on the OK box or by clicking the mouse on the OK box. You will next see an Output Description dialog box (L2-15).

L2-15

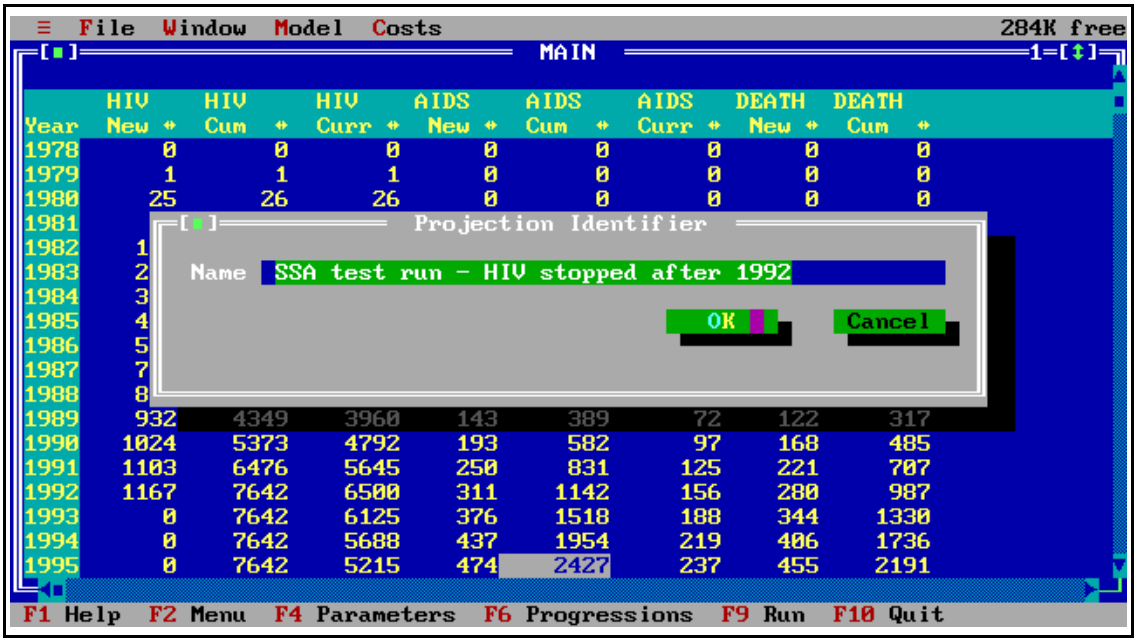


Year	HIV New	HIV Cum	HIV Curr	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
1978	0	0	0	0	0	0	0	0
1979	1	1	1	0	0	0	0	0
1980	25	26	26	0	0	0	0	0
1981								
1982	1							
1983	2							
1984	3							
1985	4							
1986	5							
1987	7							
1988	8							
1989	932	4349	3960	143	389	72	122	317
1990	1024	5373	4792	193	582	97	168	485
1991	1103	6476	5645	250	831	125	221	707
1992	1167	7642	6500	311	1142	156	280	987
1993	0	7642	6125	376	1518	188	344	1330
1994	0	7642	5688	437	1954	219	406	1736
1995	0	7642	5215	474	2427	237	455	2191

Type in the following Description title: SSA test run - HIV stopped after 1992, then press <Enter> or click the mouse on the OK box to start printing.

13 To save this specific projection run for future retrieval, we open the File menu again, and press <Enter> when the cursor bar is on the Save Projection option, or click the mouse on this option. Alternatively, we can press <Alt plus F7> to get to the Projection Identifier dialog box (L2-16) directly.

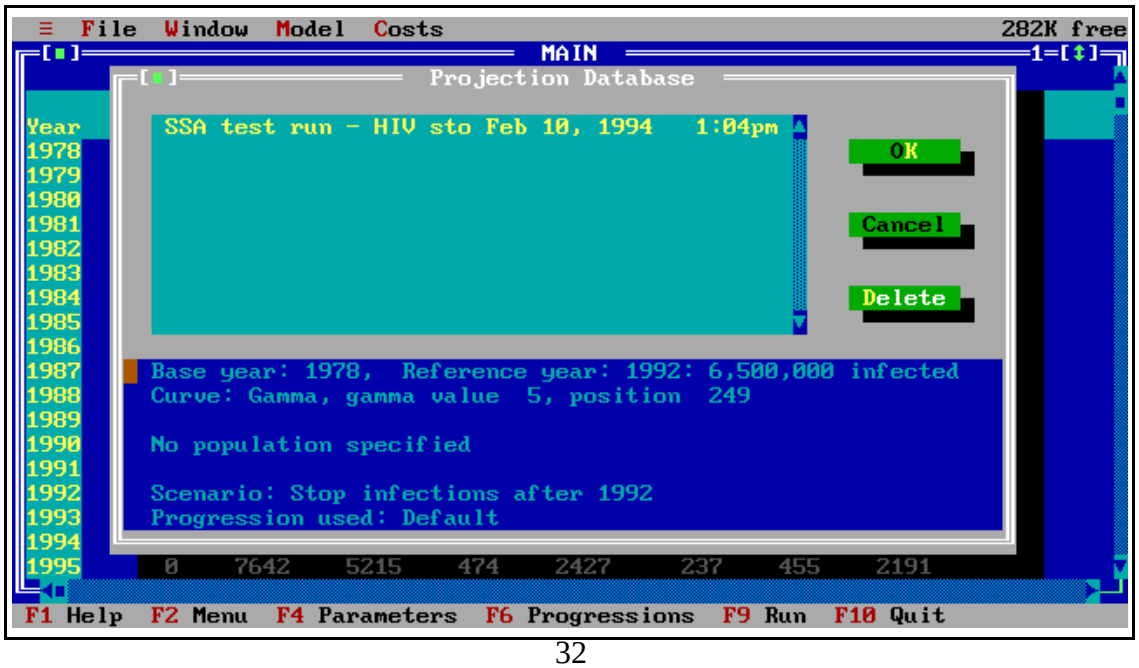
L2-16



The name for the Projection Identifier can be changed if needed, but for now, accept the current name by pressing <Enter> or clicking the mouse on the OK box.

14 To check whether this projection run was saved, we need to again access the File menu, move the cursor bar to the Load Projection option, then press <Enter> or click the mouse on this option. This opens the Projection Database dialog box that shows that our projection run was saved along with the date and time that it was saved (L2-17).

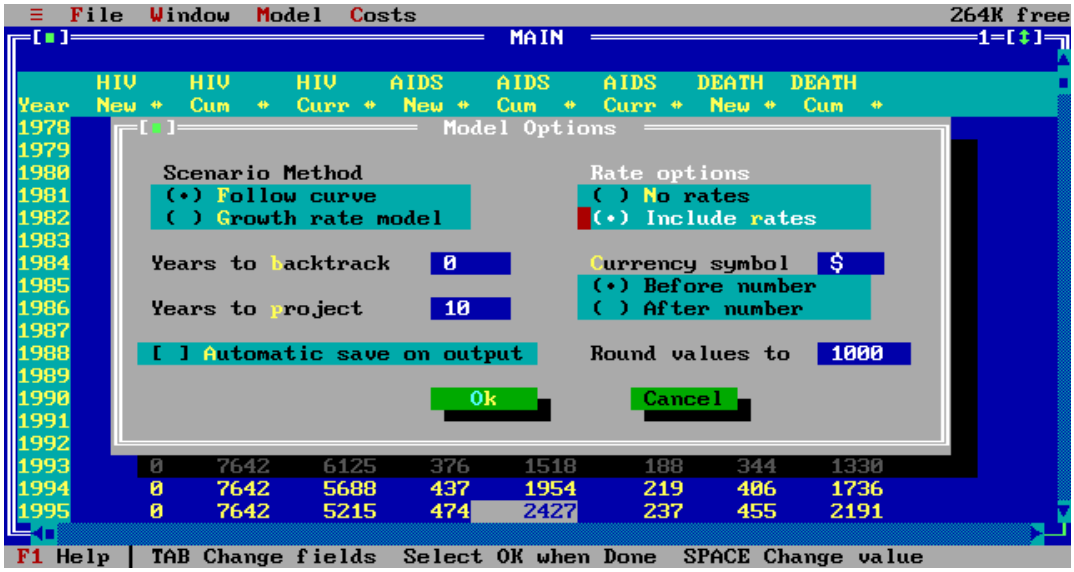
L2-17



LESSON 3. Advanced Features of EPIMODEL - Rates and Scenarios

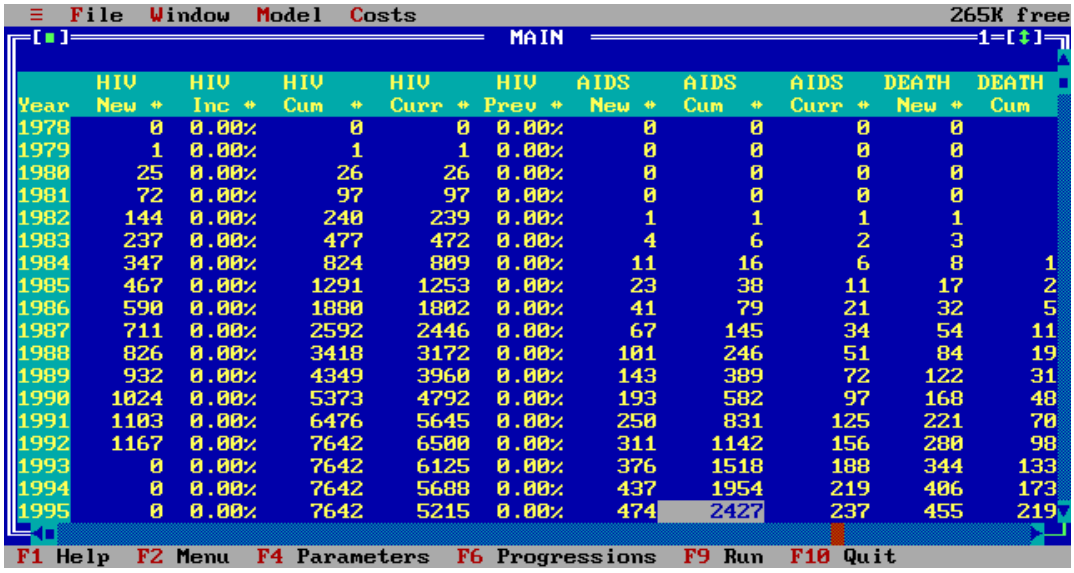
1. EPIMODEL can calculate annual HIV incidence and prevalence rates if population denominator values are entered. To do this: I) open EPIMODEL and get to the output screen; ii) open the File menu and select the Load Projection option to load the sub-Saharan Africa projection saved in Lesson 2; iii) open the Model menu and select Options; iv) within the Options dialog box move to the Rate Options box at the top right corner with the <Tab> key or with the mouse; v) select the Include rates option (**L3-1**) by moving to this option with the down arrow key and then press <Enter>or click the mouse on the OK box.

L3-1



2. The resultant screen **(L3-2)** now has two additional column - HIV Inc and HIV Prev. Both columns contain 0.00% because we have not yet added the population denominator. To do this we need to recycle through the EPIMODEL screens by first pressing <F4> to get to the data entry screen. Exit this screen without changing any of the values by cycling to the OK box with the <Enter> or <Tab> keys, then press <Enter> or click the mouse on the OK box.

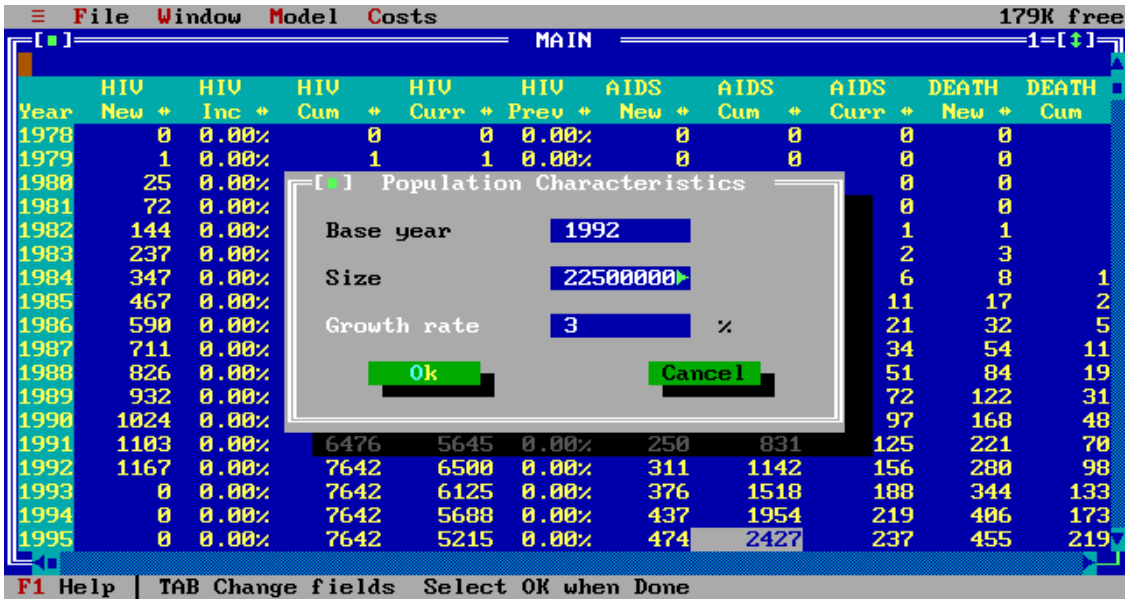
L3-2



Year	HIV New	HIV Inc	HIV Cum	HIV Curr	HIV Prev	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
1978	0	0.00%	0	0	0.00%	0	0	0	0	
1979	1	0.00%	1	1	0.00%	0	0	0	0	
1980	25	0.00%	26	26	0.00%	0	0	0	0	
1981	72	0.00%	97	97	0.00%	0	0	0	0	
1982	144	0.00%	240	239	0.00%	1	1	1	1	
1983	237	0.00%	477	472	0.00%	4	6	2	3	
1984	347	0.00%	824	809	0.00%	11	16	6	8	1
1985	467	0.00%	1291	1253	0.00%	23	38	11	17	2
1986	590	0.00%	1880	1802	0.00%	41	79	21	32	5
1987	711	0.00%	2592	2446	0.00%	67	145	34	54	11
1988	826	0.00%	3418	3172	0.00%	101	246	51	84	19
1989	932	0.00%	4349	3960	0.00%	143	389	72	122	31
1990	1024	0.00%	5373	4792	0.00%	193	582	97	168	48
1991	1103	0.00%	6476	5645	0.00%	250	831	125	221	70
1992	1167	0.00%	7642	6500	0.00%	311	1142	156	280	98
1993	0	0.00%	7642	6125	0.00%	376	1518	188	344	133
1994	0	0.00%	7642	5688	0.00%	437	1954	219	406	173
1995	0	0.00%	7642	5215	0.00%	474	2427	237	455	219

3. The next screen (**L3-3**) contains a Population Characteristics dialog box.

L3-3



The Base year is the reference year, which in this projection run is 1992. We will not change this value and we accept it by pressing <Enter> to move to the next box labeled Size (of the population). We need to enter the estimated size of the adult population of sub-Saharan Africa (SSA) because the WHO estimate of 6.5 million prevalent HIV infections in SSA in 1992 only included adults. The estimated size of the adult population in SSA in 1992 was about 225 million, and we will enter this number - 225000000.

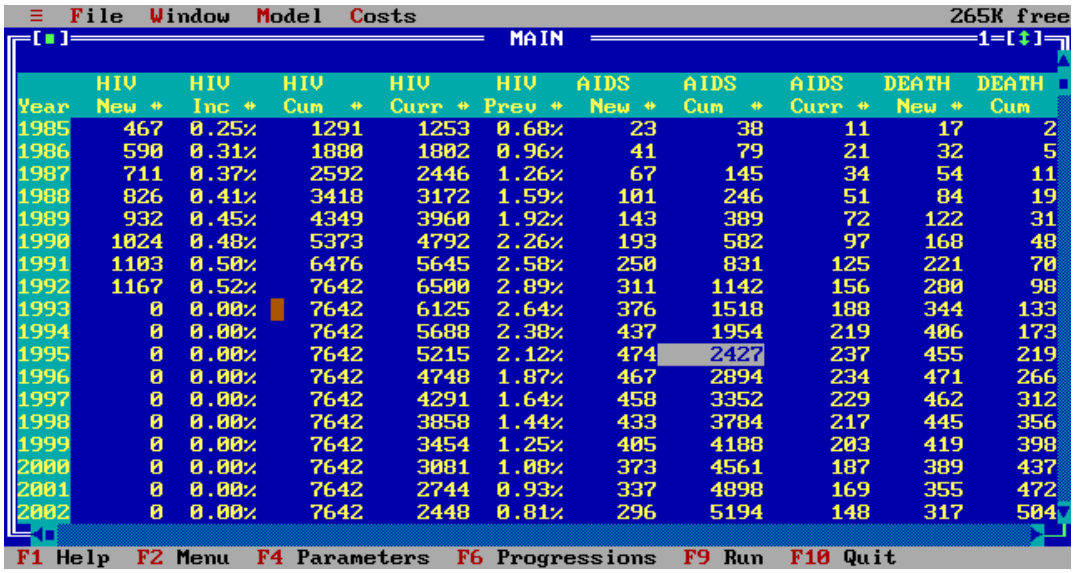
Note that after entering this number and pressing <Enter> to move to the last box, that there is a triangular symbol at the far right of the Size box. This indicates that a larger number is in the box than can be visualized. In this instance, we do not need to be concerned since the Size box can accept numbers up to one billion.

The last box is the Growth rate box - this is the annual population growth rate, and is needed to accurately calculate the HIV incidence and prevalence rates by factoring in the annual population growth. For this run, we will enter a conservative 3% population growth rate for SSA; then exit this dialog box by pressing <Enter> when in the OK box or by clicking the mouse on the OK box.

4. We next reach the graphics screen. Make no changes and exit this screen by pressing

<Enter>. The next screen (**L3-4**) shows the calculated HIV incidence and prevalence rates.

L3-4



File Window Model Costs 265K free

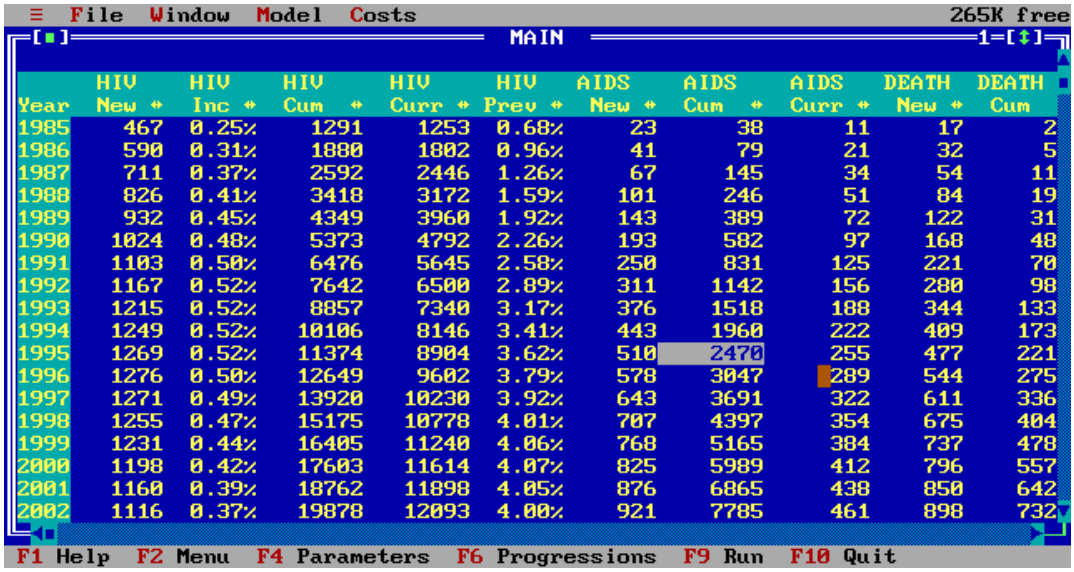
MAIN

Year	HIV New	HIV Inc	HIV Cum	HIV Curr	HIV Prev	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
1985	467	0.25%	1291	1253	0.68%	23	38	11	17	2
1986	590	0.31%	1880	1802	0.96%	41	79	21	32	5
1987	711	0.37%	2592	2446	1.26%	67	145	34	54	11
1988	826	0.41%	3418	3172	1.59%	101	246	51	84	19
1989	932	0.45%	4349	3960	1.92%	143	389	72	122	31
1990	1024	0.48%	5373	4792	2.26%	193	582	97	168	48
1991	1103	0.50%	6476	5645	2.58%	250	831	125	221	70
1992	1167	0.52%	7642	6500	2.89%	311	1142	156	280	98
1993	0	0.00%	7642	6125	2.64%	376	1518	188	344	133
1994	0	0.00%	7642	5688	2.38%	437	1954	219	406	173
1995	0	0.00%	7642	5215	2.12%	474	2427	237	455	219
1996	0	0.00%	7642	4748	1.87%	467	2894	234	471	266
1997	0	0.00%	7642	4291	1.64%	458	3352	229	462	312
1998	0	0.00%	7642	3858	1.44%	433	3784	217	445	356
1999	0	0.00%	7642	3454	1.25%	405	4188	203	419	398
2000	0	0.00%	7642	3081	1.08%	373	4561	187	389	437
2001	0	0.00%	7642	2744	0.93%	337	4898	169	355	472
2002	0	0.00%	7642	2448	0.81%	296	5194	148	317	504

F1 Help F2 Menu F4 Parameters F6 Progressions F9 Run F10 Quit

Note that HIV incidence (a number) and incidence rates (a percentage) increase every year up through 1992 when new infections are stopped in this projection run. Also note that HIV seroprevalence rates begin to decrease after 1992, but not markedly. To see how these rates will change if HIV infections were to be continued after 1992, we again cycle back to the data entry screen and toggle the X out of the box that stopped HIV transmission after the reference year. We will make no other changes to any other parameter and when we recycle back to the output screen, we will see that HIV incidence and incidence rates peak by the mid-1990s and then begin to decrease gradually whereas HIV prevalence and prevalence rates increase gradually during the remainder of this decade (**L3-5**). By the year 2000, over 17 million cumulative adult HIV infections are projected in SSA and the prevalence rate will be over 4%.

L3-5



File Window Model Costs 265K free

MAIN

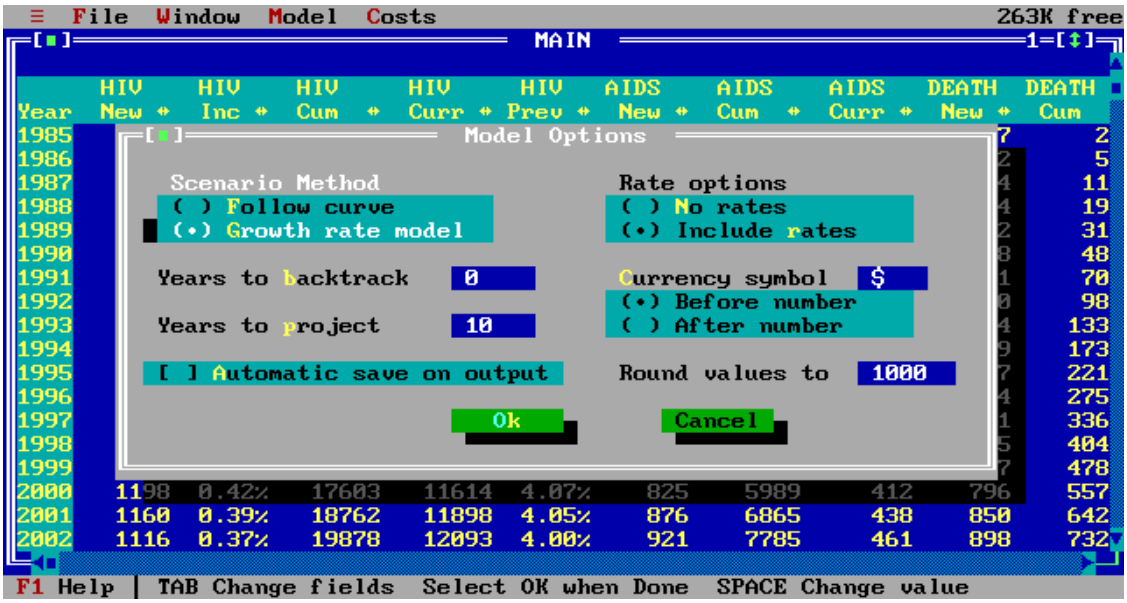
Year	HIV New	HIV Inc	HIV Cum	HIV Curr	HIV Prev	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
1985	467	0.25%	1291	1253	0.68%	23	38	11	17	2
1986	590	0.31%	1880	1802	0.96%	41	79	21	32	5
1987	711	0.37%	2592	2446	1.26%	67	145	34	54	11
1988	826	0.41%	3418	3172	1.59%	101	246	51	84	19
1989	932	0.45%	4349	3960	1.92%	143	389	72	122	31
1990	1024	0.48%	5373	4792	2.26%	193	582	97	168	48
1991	1103	0.50%	6476	5645	2.58%	250	831	125	221	70
1992	1167	0.52%	7642	6500	2.89%	311	1142	156	280	98
1993	1215	0.52%	8857	7340	3.17%	376	1518	188	344	133
1994	1249	0.52%	10106	8146	3.41%	443	1960	222	409	173
1995	1269	0.52%	11374	8904	3.62%	510	2470	255	477	221
1996	1276	0.50%	12649	9602	3.79%	578	3047	289	544	275
1997	1271	0.49%	13920	10230	3.92%	643	3691	322	611	336
1998	1255	0.47%	15175	10778	4.01%	707	4397	354	675	404
1999	1231	0.44%	16405	11240	4.06%	768	5165	384	737	478
2000	1198	0.42%	17603	11614	4.07%	825	5989	412	796	557
2001	1160	0.39%	18762	11898	4.05%	876	6865	438	850	642
2002	1116	0.37%	19878	12093	4.00%	921	7785	461	898	732

F1 Help F2 Menu F4 Parameters F6 Progressions F9 Run F10 Quit

5. As mentioned earlier in this manual, the gamma curve selected for use in EPIMODEL provided a good "fit" to the early phases of observed HIV epidemics in countries in sub-Saharan Africa and in many countries in Europe and North America. However, this gamma curve is relatively prolonged and elevated after peak annual HIV incidence is reached and may or may not provide a good approximation of HIV epidemics in their later epidemic and endemic phases. To enable construct different HIV scenarios after the early ascending phase or peak of an HIV epidemic, EPIMODEL has an option to abandon the gamma curve at any given year. From any given year or point on the gamma curve, EPIMODEL can project (calculate) the HIV incidence that will be needed to reach a stable (level) HIV prevalence rate. Thus, in the SSA projection, if we assumed that after 1993 the prevalence of HIV will become stable (i.e., endemic) at a level of about 3%, we can abandon the gamma curve after 1993 and switch to the prevalence growth rate option. This option also allows us to specify the numbers of years (0 to 6) that it will take to reach our specified prevalence growth rate.

6. To switch to this scenario method from the output screen, we need to open the Model menu again and select Options. Within the Model Options dialog box at the upper left corner is a Scenario Method box. Use the down arrow key or click the mouse on the Growth rate model to select this option (**L3-6**). Accept this setting by cycling to the OK box and press <Enter> or by clicking the mouse on the OK box.

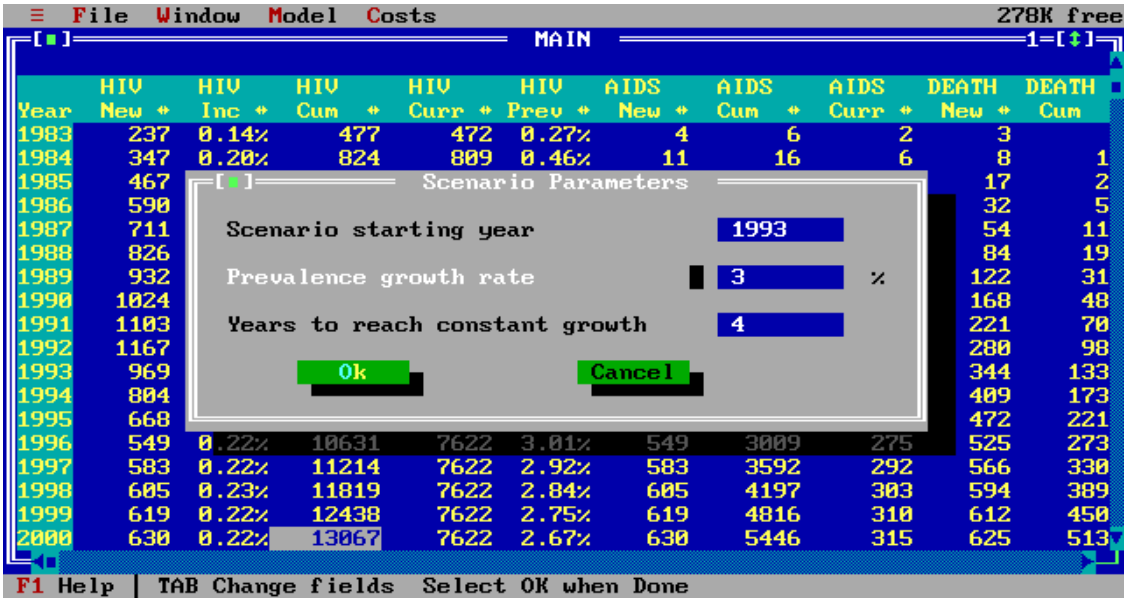
L3-6



Nothing will be changed on the output screen until we cycle through the EPIMODEL screens to reach the Scenario Parameters dialog box and specify what (HIV) prevalence growth rate we want and how many years will be needed to reach this growth rate.

7. In the Scenario Parameters dialog box (**L3-7**), the default setting for the start of the scenario is the year after the reference year, and for this projection run, this year is 1993 because our reference year was 1992.

L3-7

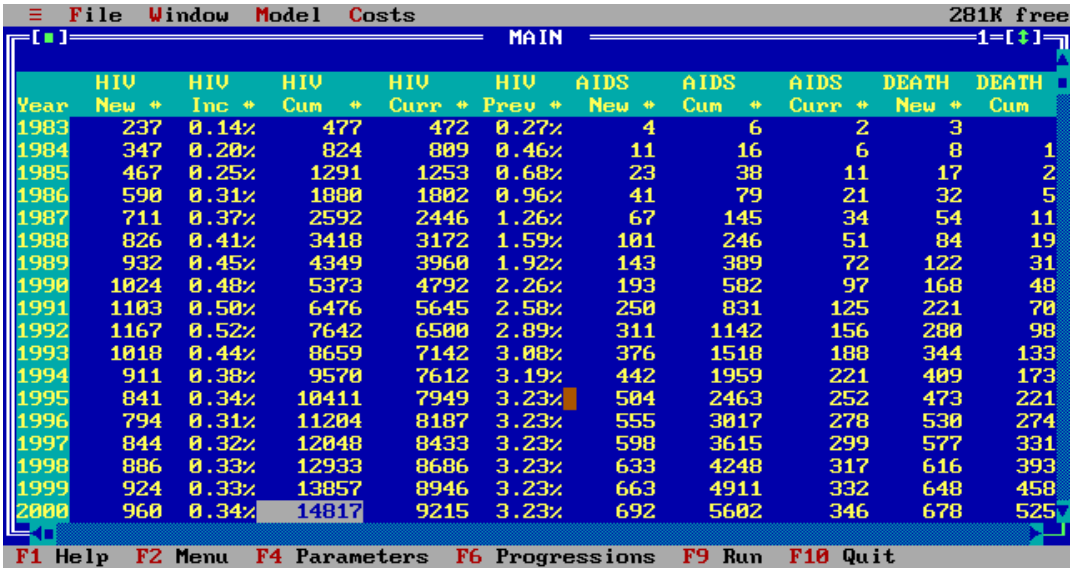


Year	HIV New	HIV Inc	HIV Cum	HIV Curr	HIV Prev	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
1983	237	0.14%	477	472	0.27%	4	6	2	3	
1984	347	0.20%	824	809	0.46%	11	16	6	8	1
1985	467								17	2
1986	590								32	5
1987	711								54	11
1988	826								84	19
1989	932								122	31
1990	1024								168	48
1991	1103								221	70
1992	1167								280	98
1993	969								344	133
1994	804								409	173
1995	668								472	221
1996	549	0.22%	10631	7622	3.01%	549	3009	275	525	273
1997	583	0.22%	11214	7622	2.92%	583	3592	292	566	330
1998	605	0.23%	11819	7622	2.84%	605	4197	303	594	389
1999	619	0.22%	12438	7622	2.75%	619	4816	310	612	450
2000	630	0.22%	13067	7622	2.67%	630	5446	315	625	513

We will accept the default setting for this run by pressing <Enter>, which gets us to the (HIV) prevalence growth rate box. For this run, we will enter 3% for the (HIV) prevalence growth rate - a percentage that matches the 3% annual population growth rate that we specified for SSA. After typing 3 in this Prevalence growth rate box press <Enter> to get to the last box (Years to reach constant growth) and type in 4 for the number of years to reach this prevalence growth rate, and then press <Enter> to get to the OK box, and exit by pressing <Enter> again or by clicking the mouse on the OK box.

8. The output screen (**L3-8**) now shows HIV prevalence peaking at 3.23% in 1995 and then remaining stable. In this HIV scenario, the HIV prevalence rate is unchanged after 1995. EPIMODEL has calculated the HIV incidence needed to keep HIV prevalence unchanged by taking into account the number of HIV-infected persons who develop AIDS and die each year, and the annual increase in the population. The cumulative number of HIV infections by the year 2000 is now about 14.8 million, which is about 3 million less than the cumulative total of 17.7 million that was projected using the gamma curve.

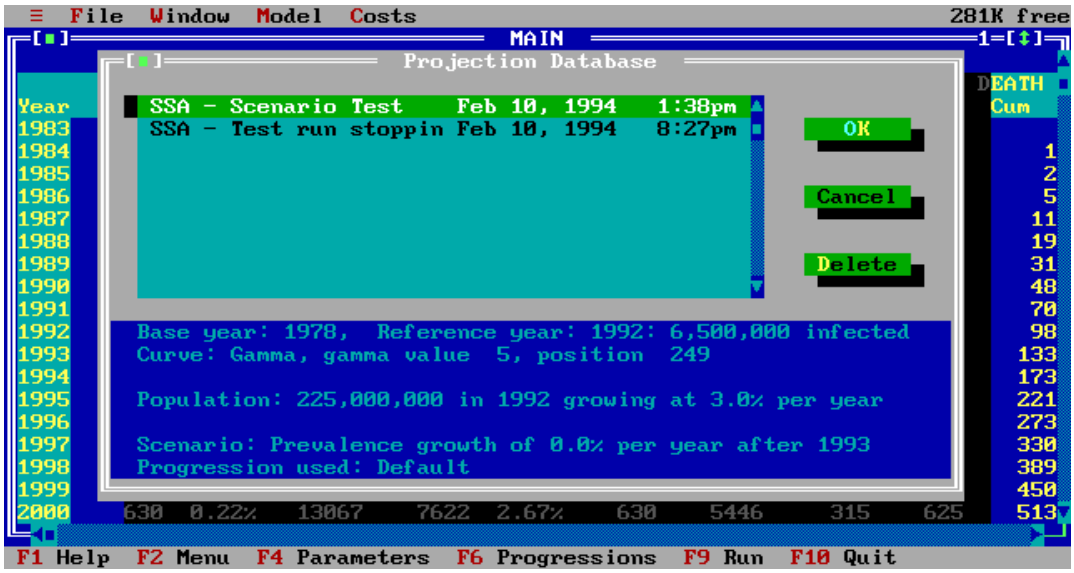
L3-8



Year	HIV New	HIV Inc	HIV Cum	HIV Curr	HIV Prev	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
1983	237	0.14%	477	472	0.27%	4	6	2	3	
1984	347	0.20%	824	809	0.46%	11	16	6	8	1
1985	467	0.25%	1291	1253	0.68%	23	38	11	17	2
1986	590	0.31%	1880	1802	0.96%	41	79	21	32	5
1987	711	0.37%	2592	2446	1.26%	67	145	34	54	11
1988	826	0.41%	3418	3172	1.59%	101	246	51	84	19
1989	932	0.45%	4349	3960	1.92%	143	389	72	122	31
1990	1024	0.48%	5373	4792	2.26%	193	582	97	168	48
1991	1103	0.50%	6476	5645	2.58%	250	831	125	221	70
1992	1167	0.52%	7642	6500	2.89%	311	1142	156	280	98
1993	1018	0.44%	8659	7142	3.08%	376	1518	188	344	133
1994	911	0.38%	9570	7612	3.19%	442	1959	221	409	173
1995	841	0.34%	10411	7949	3.23%	504	2463	252	473	221
1996	794	0.31%	11204	8187	3.23%	555	3017	278	530	274
1997	844	0.32%	12048	8433	3.23%	598	3615	299	577	331
1998	886	0.33%	12933	8686	3.23%	633	4248	317	616	393
1999	924	0.33%	13857	8946	3.23%	663	4911	332	648	458
2000	960	0.34%	14817	9215	3.23%	692	5602	346	678	525

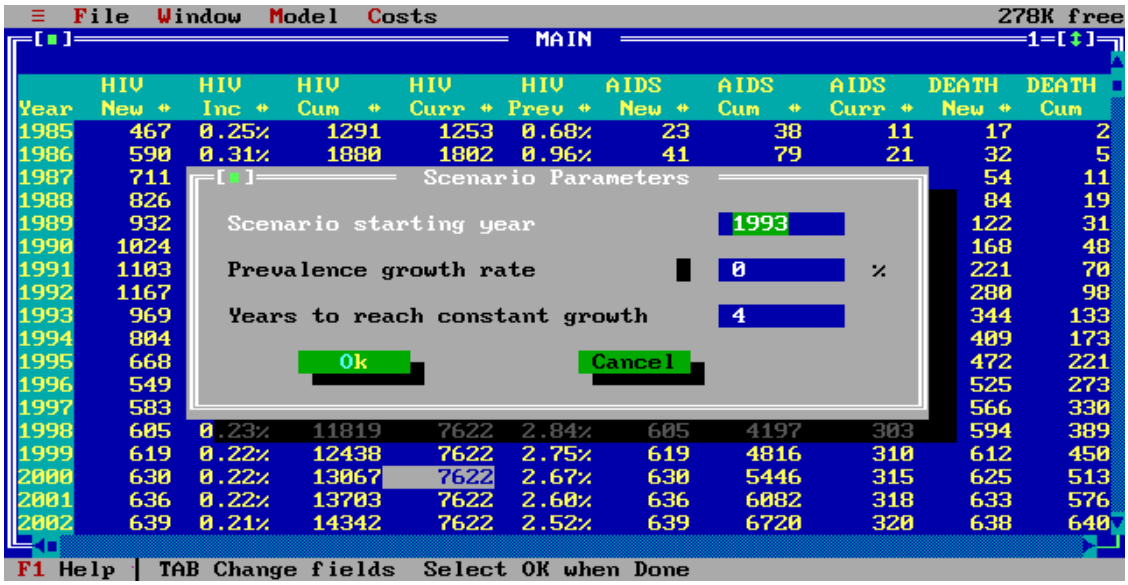
Save this scenario projection as <u>SSA - Scenario Test</u> (**L3-9**) for future retrieval.

L3-9



9. We will now run a couple of other scenario projections. Recycle back to the Scenario Parameters dialog box and change the Prevalence growth rate to 0 (**L3-10**).

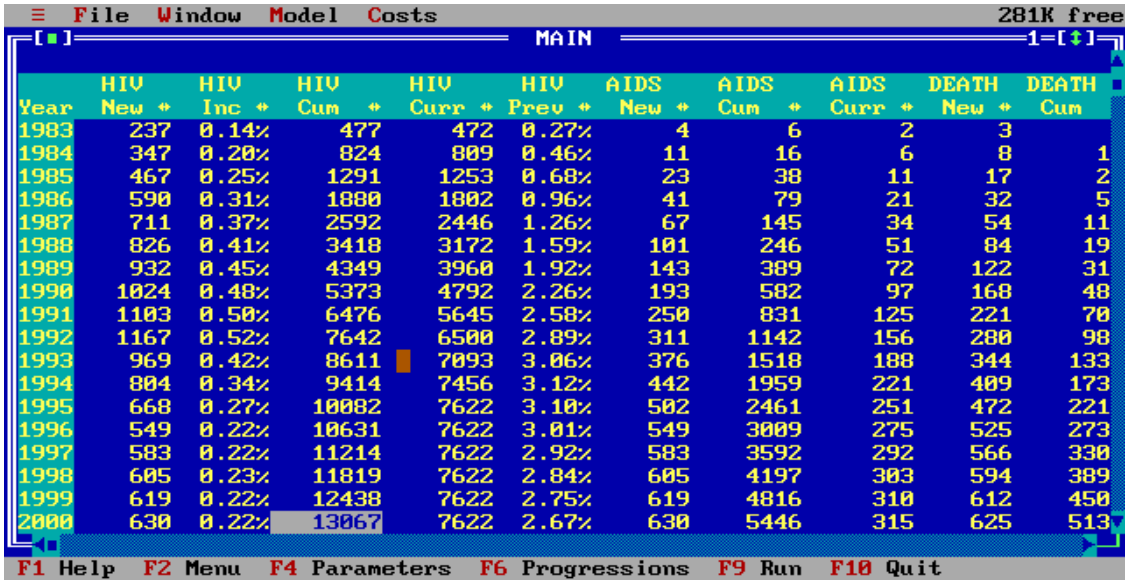
L3-10



Year	HIV New	HIV Inc	HIV Cum	HIV Curr	HIV Prev	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
1985	467	0.25%	1291	1253	0.68%	23	38	11	17	2
1986	590	0.31%	1880	1802	0.96%	41	79	21	32	5
1987	711								54	11
1988	826								84	19
1989	932								122	31
1990	1024								168	48
1991	1103								221	70
1992	1167								280	98
1993	969								344	133
1994	804								409	173
1995	668								472	221
1996	549								525	273
1997	583								566	330
1998	605	0.23%	11819	7622	2.84%	605	4197	303	594	389
1999	619	0.22%	12438	7622	2.75%	619	4816	310	612	450
2000	630	0.22%	13067	7622	2.67%	630	5446	315	625	513
2001	636	0.22%	13703	7622	2.60%	636	6082	318	633	576
2002	639	0.21%	14342	7622	2.52%	639	6720	320	638	640

The resulting output screen (**L3-11**) shows a gradually decreasing HIV prevalence rate primarily because EPIMODEL is not increasing HIV incidence enough to compensate for the annual population growth rate.

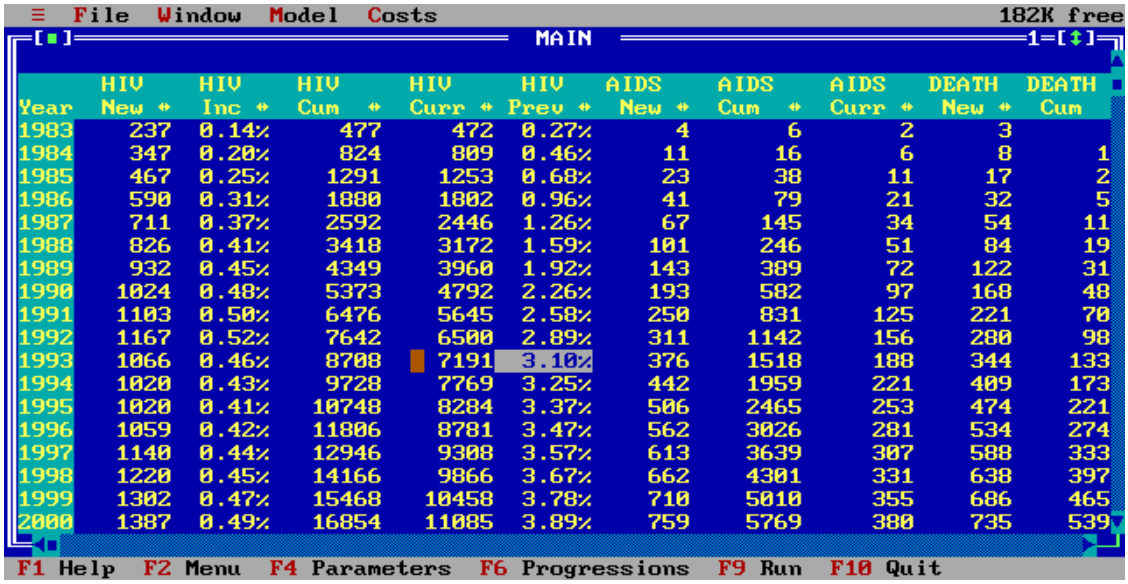
L3-11



Year	HIV New	HIV Inc	HIV Cum	HIV Curr	HIV Prev	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
1983	237	0.14%	477	472	0.27%	4	6	2	3	
1984	347	0.20%	824	809	0.46%	11	16	6	8	1
1985	467	0.25%	1291	1253	0.68%	23	38	11	17	2
1986	590	0.31%	1880	1802	0.96%	41	79	21	32	5
1987	711	0.37%	2592	2446	1.26%	67	145	34	54	11
1988	826	0.41%	3418	3172	1.59%	101	246	51	84	19
1989	932	0.45%	4349	3960	1.92%	143	389	72	122	31
1990	1024	0.48%	5373	4792	2.26%	193	582	97	168	48
1991	1103	0.50%	6476	5645	2.58%	250	831	125	221	70
1992	1167	0.52%	7642	6500	2.89%	311	1142	156	280	98
1993	969	0.42%	8611	7093	3.06%	376	1518	188	344	133
1994	804	0.34%	9414	7456	3.12%	442	1959	221	409	173
1995	668	0.27%	10082	7622	3.10%	502	2461	251	472	221
1996	549	0.22%	10631	7622	3.01%	549	3009	275	525	273
1997	583	0.22%	11214	7622	2.92%	583	3592	292	566	330
1998	605	0.23%	11819	7622	2.84%	605	4197	303	594	389
1999	619	0.22%	12438	7622	2.75%	619	4816	310	612	450
2000	630	0.22%	13067	7622	2.67%	630	5446	315	625	513

10 As a final projection run, we again recycle back to the Scenario Parameters dialog box and change the Prevalence growth rate to 6 (double the annual population growth rate). This last output screen (**L3-12**) shows HIV prevalence rates increasing slowly but steadily. This last scenario projects a cumulative total of 16.8 million HIV infections in the year 2000; very close to the 17.8 million reached using the gamma curve. This scenario option of EPIMODEL enables the construction of different HIV scenarios, from very optimistic or low HIV scenarios to very pessimistic or high HIV scenarios. For each HIV scenario, EPIMODEL will be able to provide annual estimates and projections of AIDS cases and deaths needed for the planning of health care and social welfare programs.

L3-12



Year	HIV New	HIV Inc	HIV Cum	HIV Curr	HIV Prev	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEATH Cum
1983	237	0.14%	477	472	0.27%	4	6	2	3	
1984	347	0.20%	824	809	0.46%	11	16	6	8	1
1985	467	0.25%	1291	1253	0.68%	23	38	11	17	2
1986	590	0.31%	1880	1802	0.96%	41	79	21	32	5
1987	711	0.37%	2592	2446	1.26%	67	145	34	54	11
1988	826	0.41%	3418	3172	1.59%	101	246	51	84	19
1989	932	0.45%	4349	3960	1.92%	143	389	72	122	31
1990	1024	0.48%	5373	4792	2.26%	193	582	97	168	48
1991	1103	0.50%	6476	5645	2.58%	250	831	125	221	70
1992	1167	0.52%	7642	6500	2.89%	311	1142	156	280	98
1993	1066	0.46%	8708	7191	3.10%	376	1518	188	344	133
1994	1020	0.43%	9728	7769	3.25%	442	1959	221	409	173
1995	1020	0.41%	10748	8284	3.37%	506	2465	253	474	221
1996	1059	0.42%	11806	8781	3.47%	562	3026	281	534	274
1997	1140	0.44%	12946	9308	3.57%	613	3639	307	588	333
1998	1220	0.45%	14166	9866	3.67%	662	4301	331	638	397
1999	1302	0.47%	15468	10458	3.78%	710	5010	355	686	465
2000	1387	0.49%	16854	11085	3.89%	759	5769	380	735	539

11 In general, high HIV scenarios can be constructed by: (1) increasing the estimates of current HIV prevalence; (2) increasing the steepness of the ascending slope of the gamma curve used for projection of HIV incidence, which results in more infections over a shorter period of time; (3) decreasing the "age" of the HIV epidemic, i.e., by placing the current or HIV prevalence estimate year at an earlier point on the ascending (left) portion of the HIV incidence curve, which also results in more HIV infections in a shorter time period; and (4) combinations and/or permutations of all of these manipulations. Low or more optimistic HIV scenarios can be developed by reversing any or all of the above factors. However, all HIV scenarios, whether high or low, should be plausible, i.e., all of the above factors should "fit" within a reasonable range of those values extrapolated from available data.

LESSON 4 - Using the Costing Module

Introduction

The costing module of EPIMODEL calculates annual or cumulative costs that may be related to any of its output columns. Each cost item has three components: % who use, which defines what percentage of the selected variable (i.e., an EPIMODEL output column such as AIDS.New, DEATH.New etc.) will receive the cost item; Unit cost, which defines how much a unit of this item costs; and Unit/user, which defines how many units each user of this item will receive (per year). Using this information, the cost projection is computed through simple multiplication of these values with the variable to which the cost item is attached.

This system is set up to allow a hierarchy of cost items. For example, the cost of drugs might be composed of two individual cost items: AZT, and other drugs. In this case, drugs will be a summary cost at level 1, and will be composed of two cost items at level 2: AZT and other drugs. The cost values computed for these two components will be summed to give the total drug cost. The summary cost is the sum of all of its component costs. The maximum number of subdivisions or levels is nine.

A mouse is very convenient and greatly facilitates use of the costing module of EPIMODEL, but is not required. Also, the window features of EPIMODEL are useful for detailed editing and viewing of cost estimates. The window menu can be opened by pressing the <Alt plus W> keys or by clicking the mouse on Window at the top left corner of the output screen. A detailed description of the window features is included in the Appendix and can be referred to if needed during this lesson.

1. To illustrate the costing module, we will estimate and project the direct health care costs of annual AIDS cases in sub-Saharan Africa, using the SSA - Scenario Test projection that we saved at the end of Lesson 3:

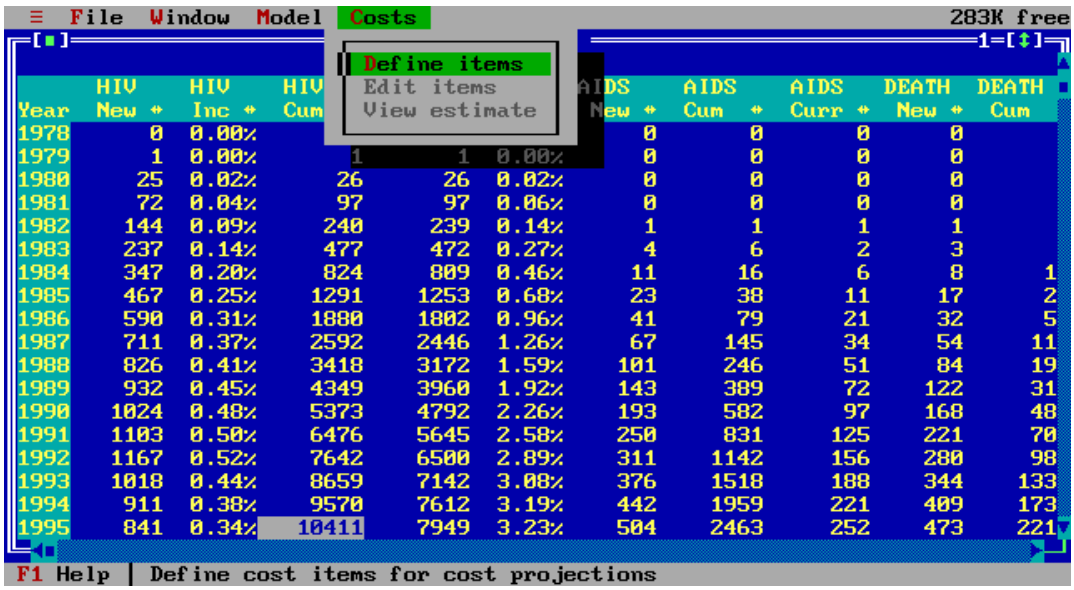
   i) open the File menu by pressing <Alt plus F> or click the mouse on File at the top left corner of the output screen;

   ii) select Load projection and press <Enter> or click the mouse on that option to access the Projection Database; and

   iii) retrieve the projection by pressing <Enter> when the cursor bar is over this projection or by clicking the mouse on this projection.

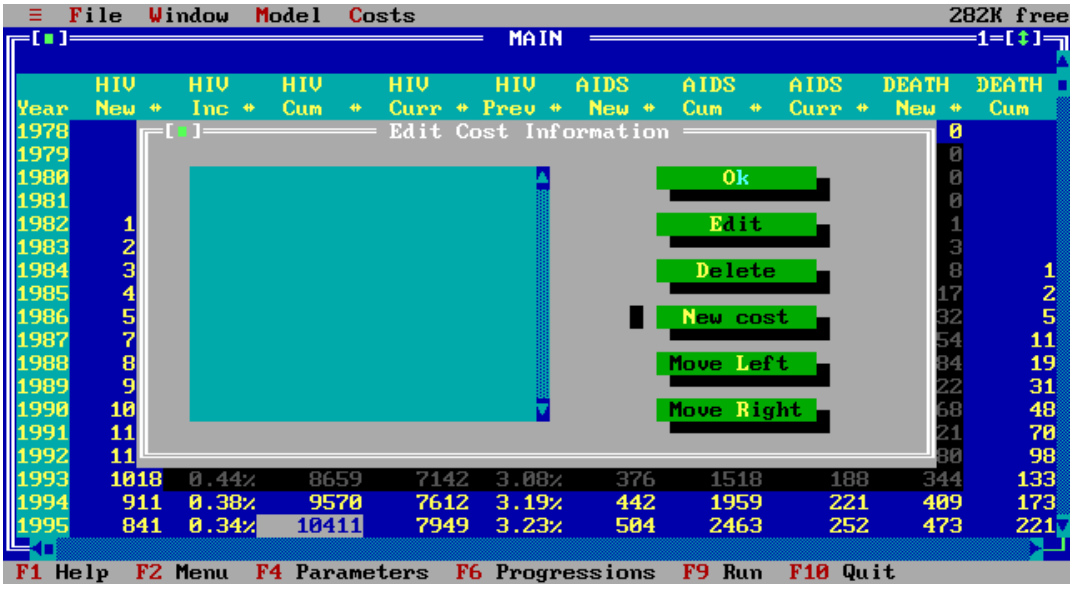
2. In the output screen, open the Costs menu by pressing <Alt plus C> or click the mouse on Costs, the last item at the top left corner of the output screen (L4-1).

L4-1



With the cursor bar on Define items, press <Enter> or click the mouse on this first option. This opens the Edit Cost Information dialog box (L4-2).

L4-2

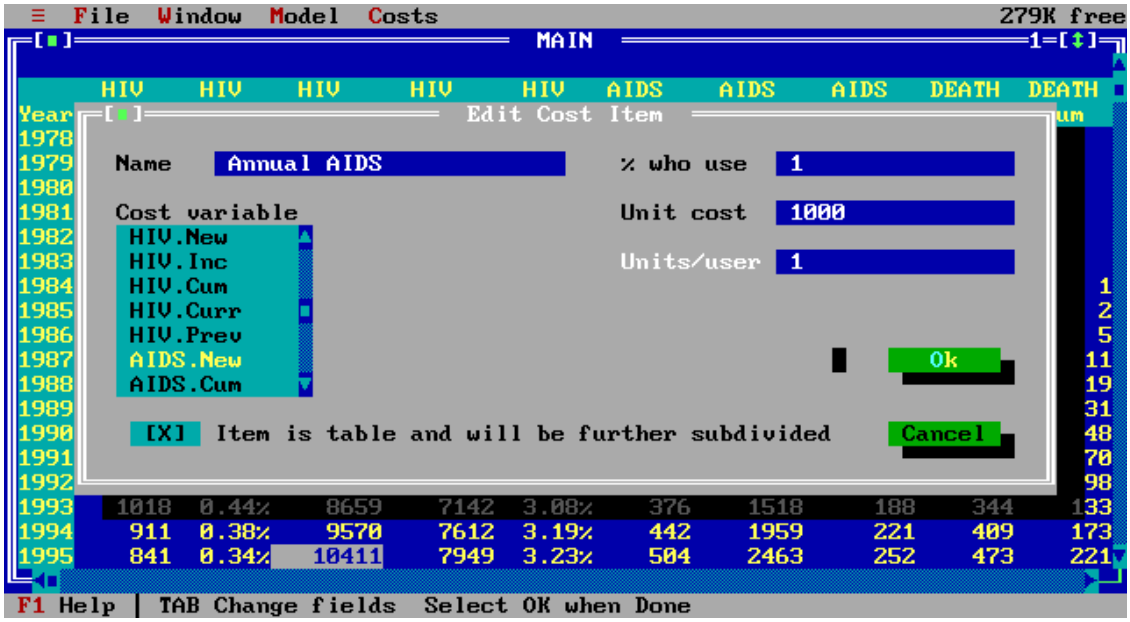


Within this dialog box, we will select New cost by pressing the <Tab> key until the cursor bar is on New cost and then press <Enter> or alternatively, we can select this option by pressing the <N> key or by clicking the mouse on New cost.

3. This opens the Edit Cost Item dialog box. We will type Annual AIDS in the Name box and then press <Enter>. This forwards us to the Cost variable box which lists all of the columns in EPIMODEL's output screen. Since we want to calculate the health care costs of annual AIDS cases, we need to move the cursor bar using the down arrow key to AIDS.New and select this output column by pressing <Enter> or by clicking the mouse on AIDS.New. This forwards us to an empty box which will indicate whether the cost Item is table and will be further subdivided. In this example, annual AIDS will be a summary cost which will be further subdivided. However, because this is now the first and only cost item, it will not matter what is in this box at this time. For this example, we will specify that this will be an item which will be further subdivided by pressing (toggling) the <Space> bar or by clicking the mouse in this box until an X appears and then pressing <Enter> to select this option.

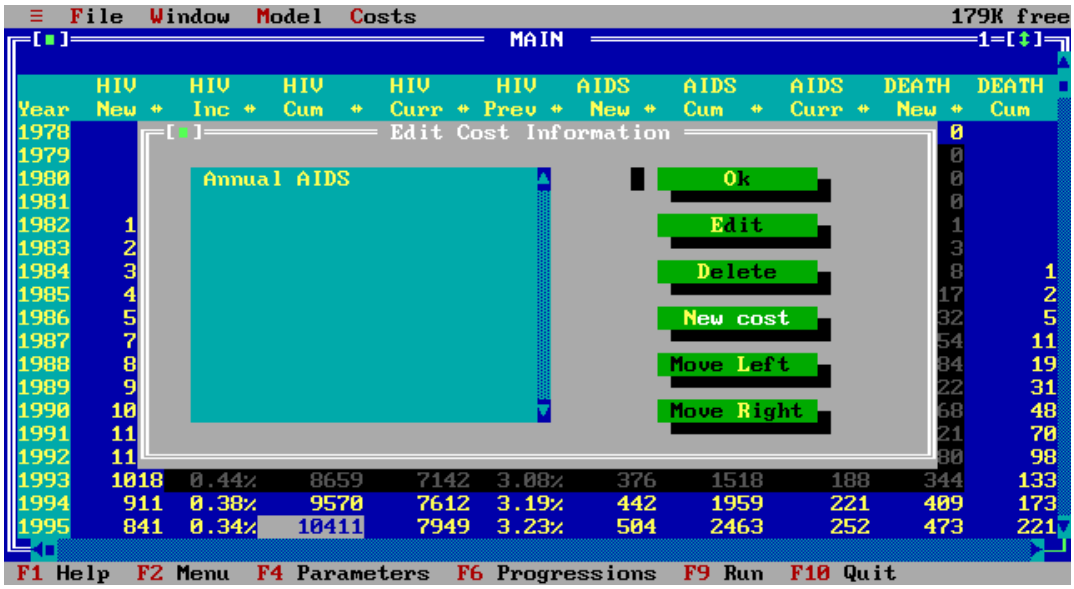
This forwards us to the % who use box where we will type in 1 in order to include all (100%) of the annual AIDS cases in our calculation. After pressing <Enter> we are forwarded to the Unit cost box where we will type in 1000 as the average health care cost of an AIDS case (NOTE: EPIMODEL's default currency symbol is $, but the unit cost can be in any currency the user designates). We then enter the Units/users box where we will enter 1 because in this example, the unit cost is the average health care cost for each AIDS case and thus there can only be 1 AIDS case (i.e., unit or user) for each unit cost. This completes the entries in this dialog box (L4-3) and to accept all of these entries we press <Enter> when the cursor is in the OK box or we click the mouse on the OK box. If we need to change any of our entries, we can cycle back to any box using the <Tab> key or by clicking on a specific box with the mouse.

L4-3



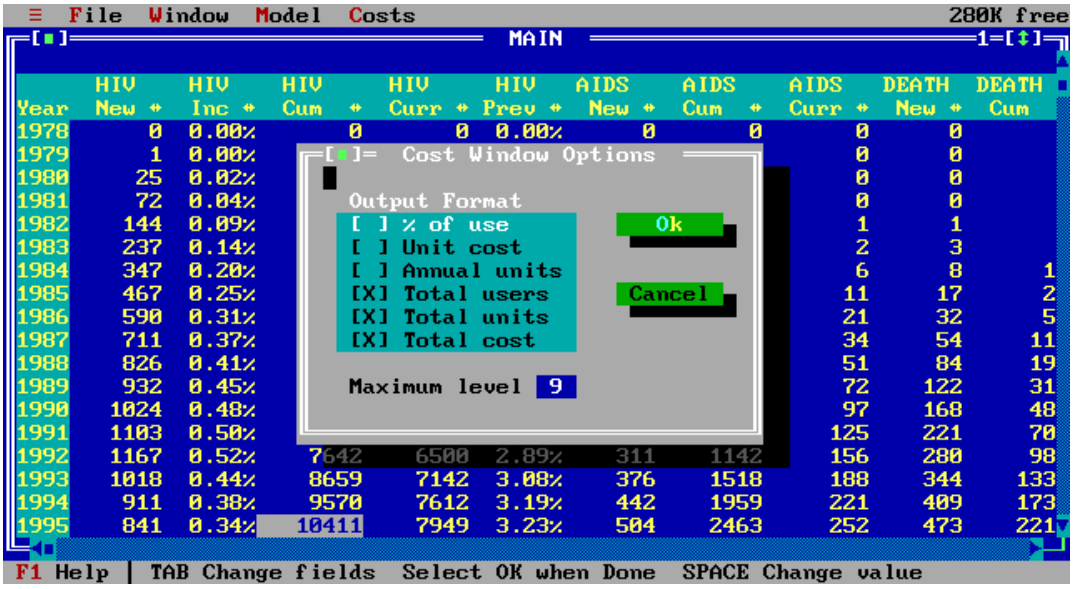
4. We are returned to the Edit Cost Information dialog box which now has Annual AIDS listed (L4-4).

L4-4



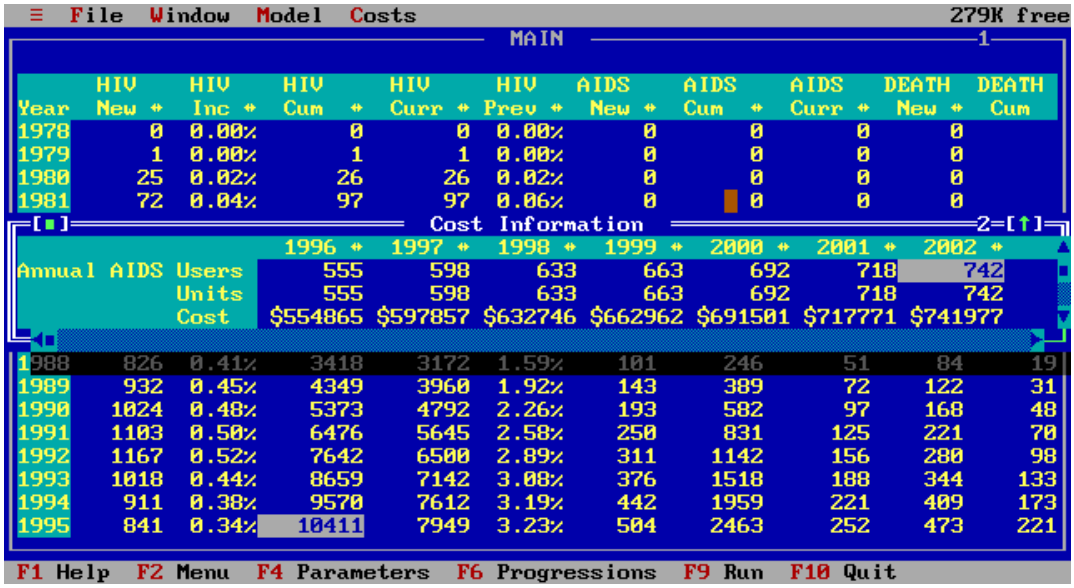
We exit this dialog box by pressing <Enter> when the cursor is in the OK box or by clicking the mouse on the OK box. This returns us to the output screen. Reopen the Costs menu by pressing the <Alt plus C> keys or by clicking the mouse on Costs at the top line of the screen. Move the cursor bar down to the last of the 3 options - View estimate, and select this option by pressing <Enter> or by clicking the mouse on this option. This opens up the Cost Window Options dialog box (L4-5). For now, we will accept the default settings and move the cursor bar to the OK box and press <Enter> or click the mouse on the OK box.

L4-5



5. A Cost Information window now appears in the middle of the screen on top of the output screen. All of the numbers in the Cost Information window are zeros because the costs have not yet been calculated. Press <F9> to calculate costs (L4-6), and then use the right arrow key to scroll the active window to the right to see the increasing costs up to the year 2002.

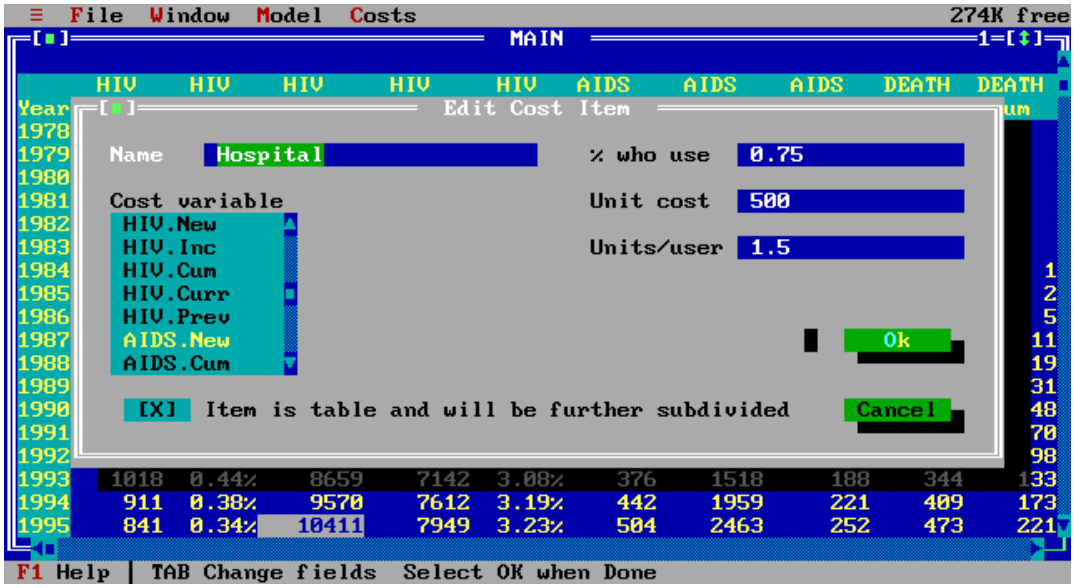
L4-6



In the year 2000 about 692,000 new annual AIDS cases are projected for SSA (all of the output is expressed in thousands because we selected the option to round off the output values by 1000). The total projected health care cost of new annual AIDS cases in the year 2000 (at an average cost of $1000) will be about $692 million. To close or exit the Cost Information window, we press the <Alt plus F6> keys or we can open the Window menu by pressing the <Alt plus W> keys or by clicking the mouse on Windows at the top line of the screen, and then selecting the Next (Window) option.

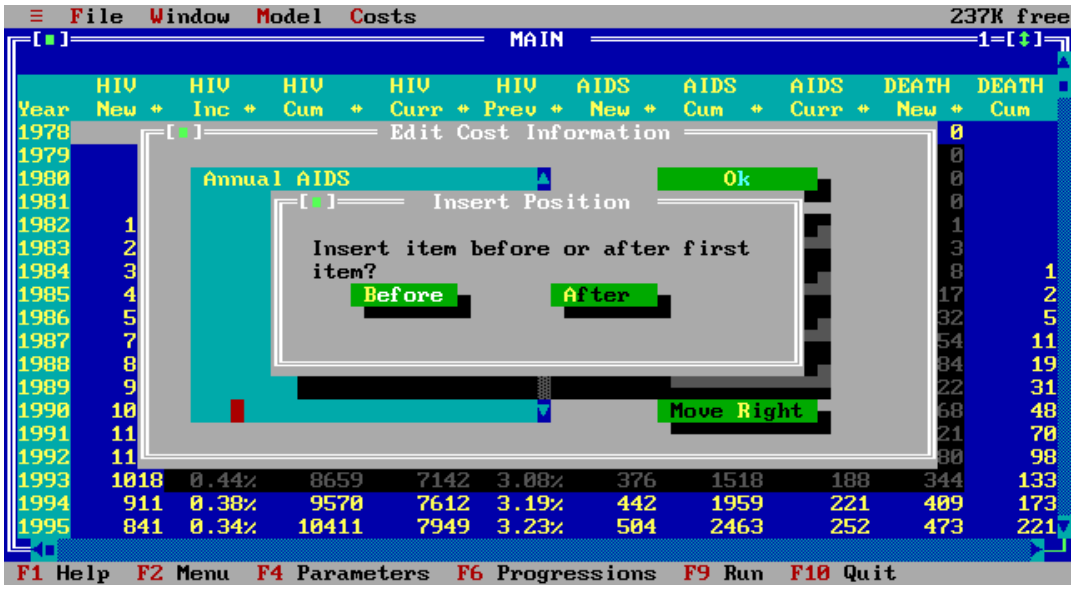
6. We will now add other cost items to learn more details about the costing module: I) From the output screen, open the Costs menu by clicking the mouse on Costs at the top of the screen or by pressing the <Alt plus C> keys; ii) Select the Define items options; iii) In the Define items dialog box select the New cost option again; iv) In the Edit Cost Item dialog box type Hospital in the Name box; v) select AIDS.New again as the Cost variable; vi) insert an X in the next box to enable further subdivision of this item; vii) in the % who use box type in 0.75 to indicate that only 75% of new annual AIDS cases will be hospitalized; viii) in the Unit cost box type in 500 to indicate that the cost of each hospitalization will be $500; ix) in the Units/users box type in 1.5 to indicate that of those AIDS patients who are hospitalized, that they will on average be hospitalized 1.5 times during the year; x) exit this completed dialog box (L4-7, shown on the next page) by pressing <Enter> when the cursor is on the OK box or click the mouse on the OK box.

L4-7



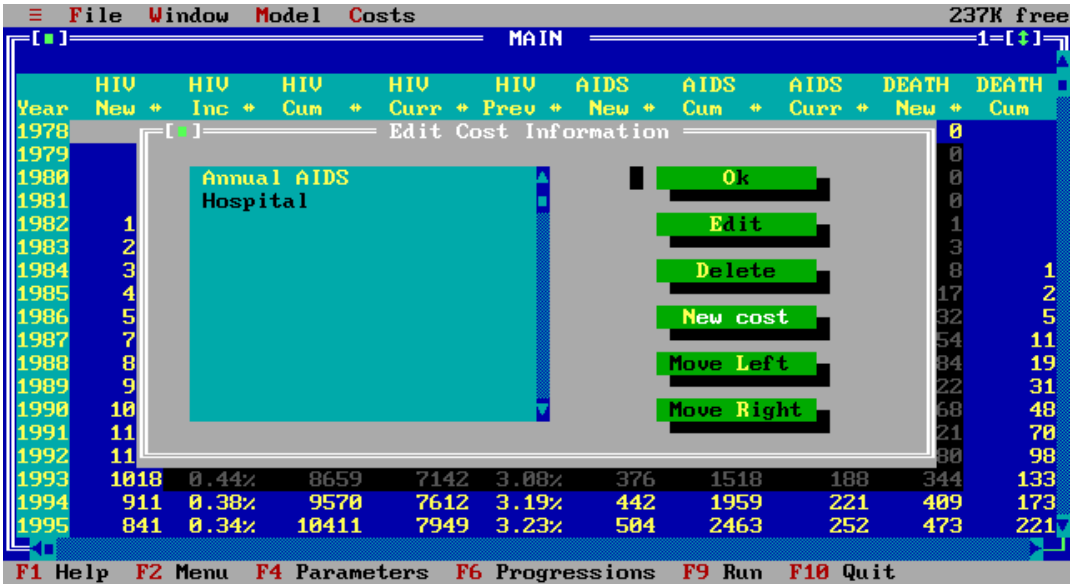
7. Upon exiting the Edit Cost Item dialog box an Insert Position dialog box appears which gives an option to place the new cost item before or after the first item (L4-8). Since Hospital costs will be a component of Annual AIDS costs, we will select the After option by clicking the mouse on this option or move the cursor with the <Tab> key to this option and then press <Enter>.

L4-8



8. We return to the Edit Cost Information dialog box which now shows Hospital as a new cost under Annual AIDS (L4-9). Exit this dialog box to the output screen by moving the cursor with the <Tab> key to the OK box or click on the OK box with the mouse.

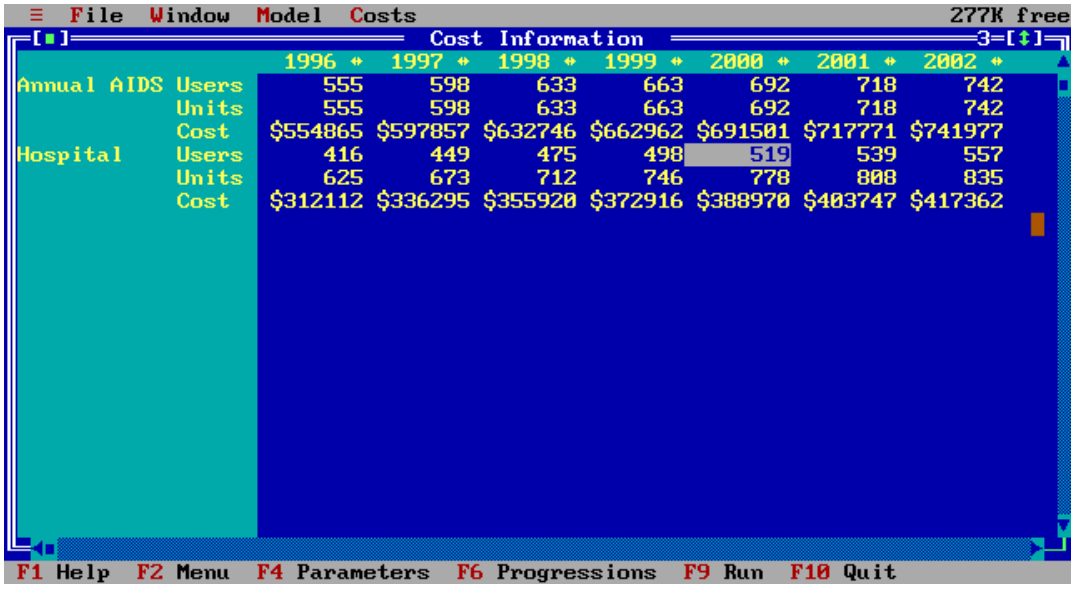
L4-9



9. Open the Costs menu again by pressing the <Alt plus C> keys or by clicking the mouse on Costs at the top of the screen and select the View estimate option again. Accept the default setting in the Output format dialog box by moving the cursor to the OK box and press <Enter> or click the mouse on the OK box. This opens up the Cost Information window.

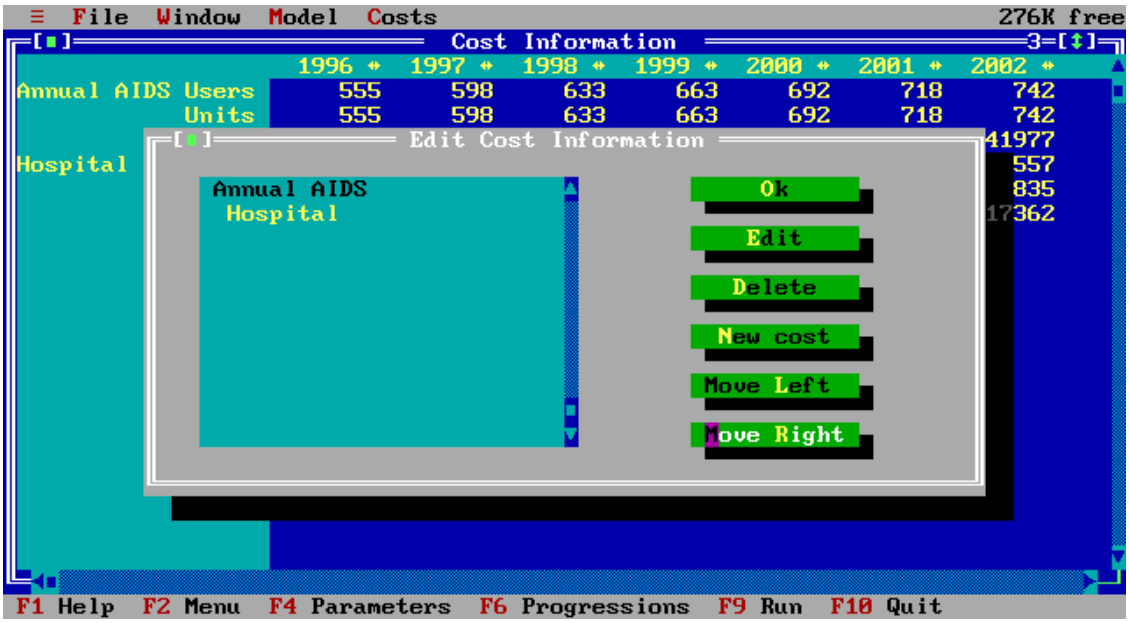
   Use the down arrow key to scroll this narrow window down to visualize the Hospital cost output and then scroll all the way to the right with the right arrow key to see the output up to the year 2002. Alternatively, you can click the mouse on the window arrows to scroll the window. Note that all of the hospital cost numbers are still zeros. Press <F9> or click the mouse on F9 at the bottom of the screen to calculate hospital costs. To enlarge or zoom this window to see all of the cost output rows press the <F5> key. Note the output in the year 2000. Since only 75% of the annual AIDS cases are hospitalized, we see that instead of 692,000 users there are 519,000 users and since each user is hospitalized 1.5 times, we have 778,000 units of hospitalization at a cost of $500 per unit for a grand total of close to $389 million (L4-10, shown on the next page). Also note that the annual AIDS costs and hospital costs are separate and independent of each other. To return to the main output screen press the <Alt plus F6> keys.

L4-10



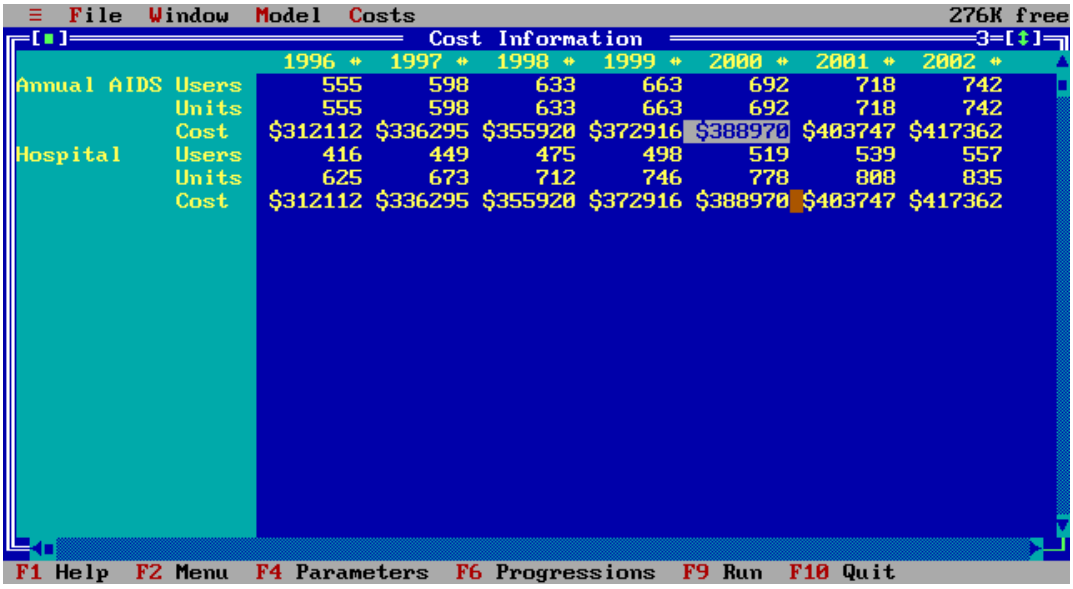
10 We will now use the table and subdivide feature of the costing module. As detailed in step 6 of this Lesson: I) we first need to open the Costs menu to select the Define Items option; ii) in the Edit Cost Information dialog box we select Hospital by moving the cursor to this item with the down arrow key or by clicking the mouse on this item; iii) we then move this cost item to the right by pressing the <R> key or by clicking the mouse on the Move Right option box on the right side of the dialog box (L4-11);

L4-11



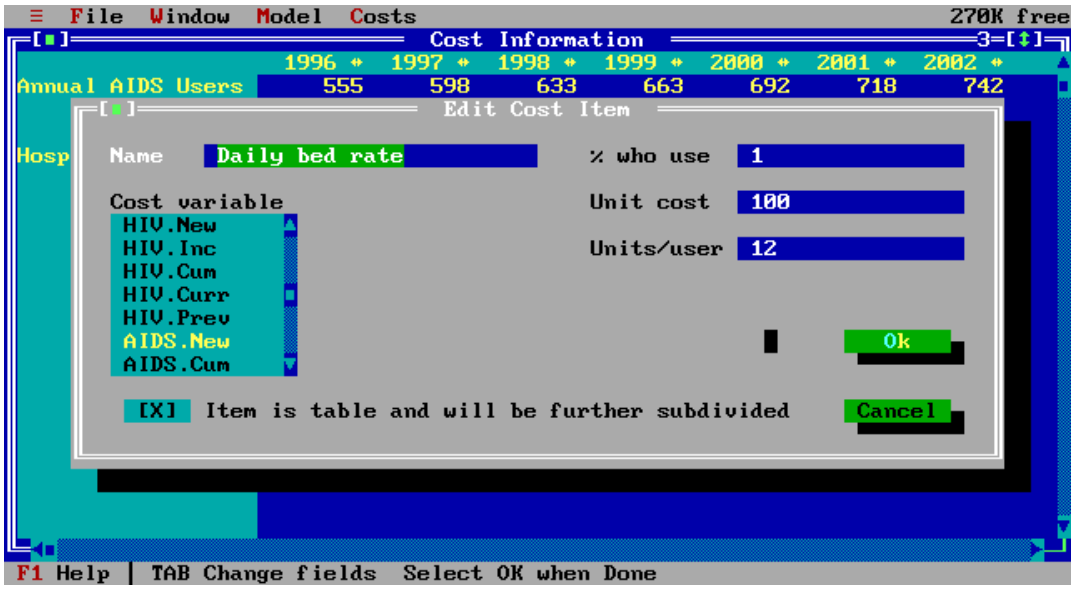
iv) we exit this dialog box by clicking the mouse on the OK box or by pressing <Enter> when the cursor is on the OK box; v) no change in the cost output will be seen until we press the <F9> key (L4-12). Note that the cost output for Annual AIDS is the same as the Hospital item. This is because Annual AIDS is a summary cost made up of the cost item(s) which are nested below it and to its right.

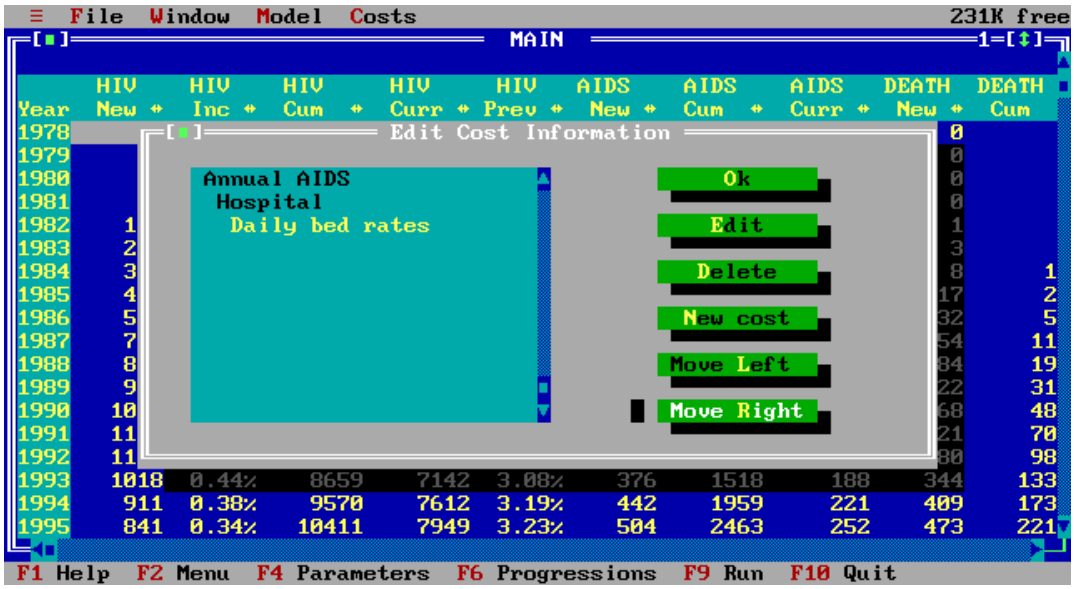
L4-12

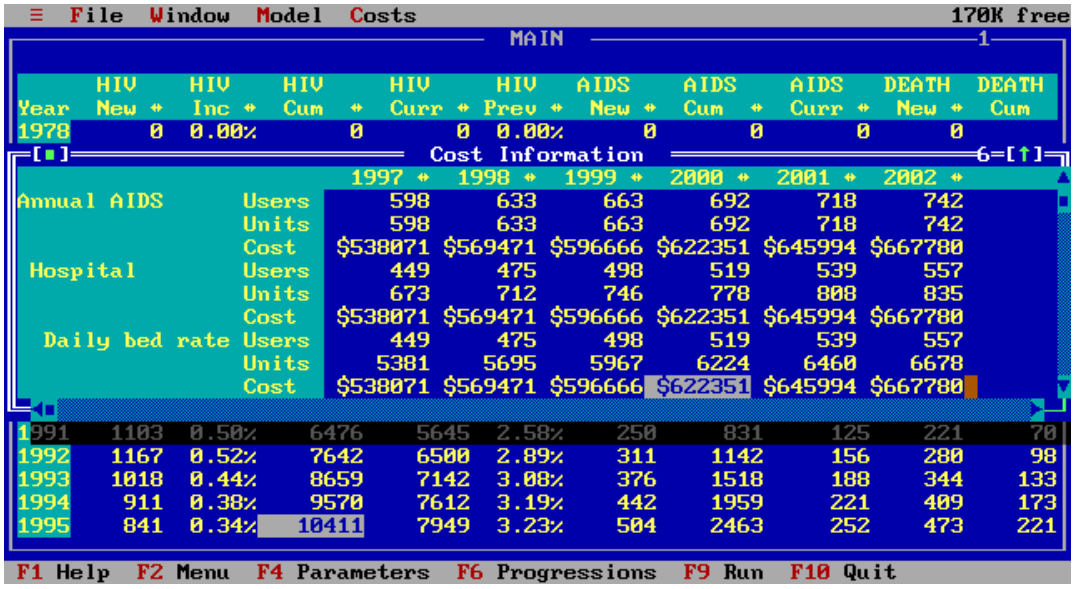


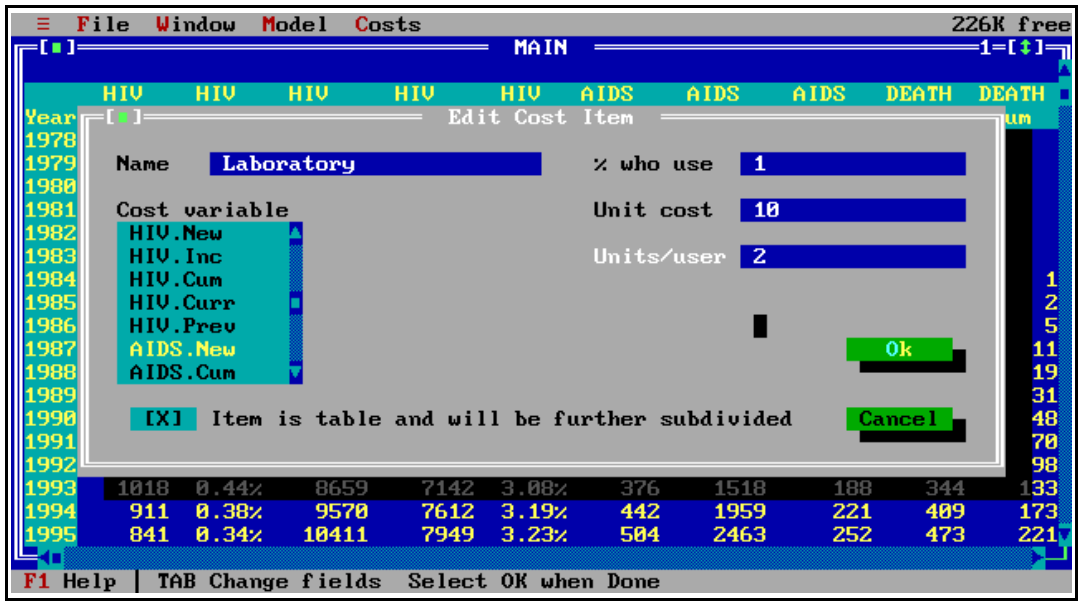
11. We will now add several additional cost items for Annual AIDS by repeating steps 6-9 for the following cost items and using the values and settings shown in the following screens: Daily bed rates (L4-13 to L4-15); Laboratory (L4-16); Drugs (L4-17); Basic [drugs] (L4-18); Special [drugs] (L4-19 and L4-20). Screens L4-14 to L4-20 are shown on the next three pages.

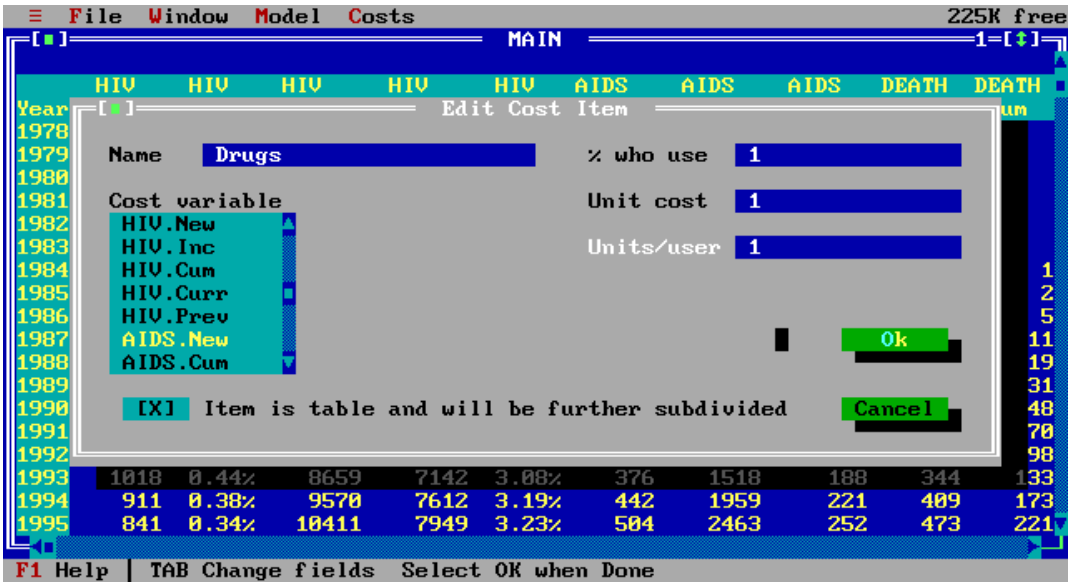
L4-13

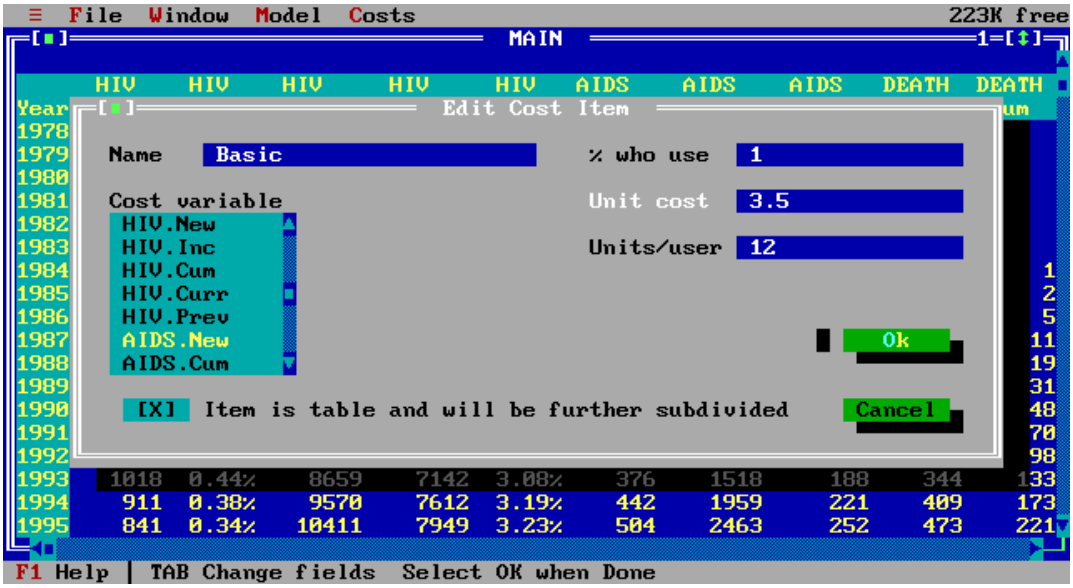


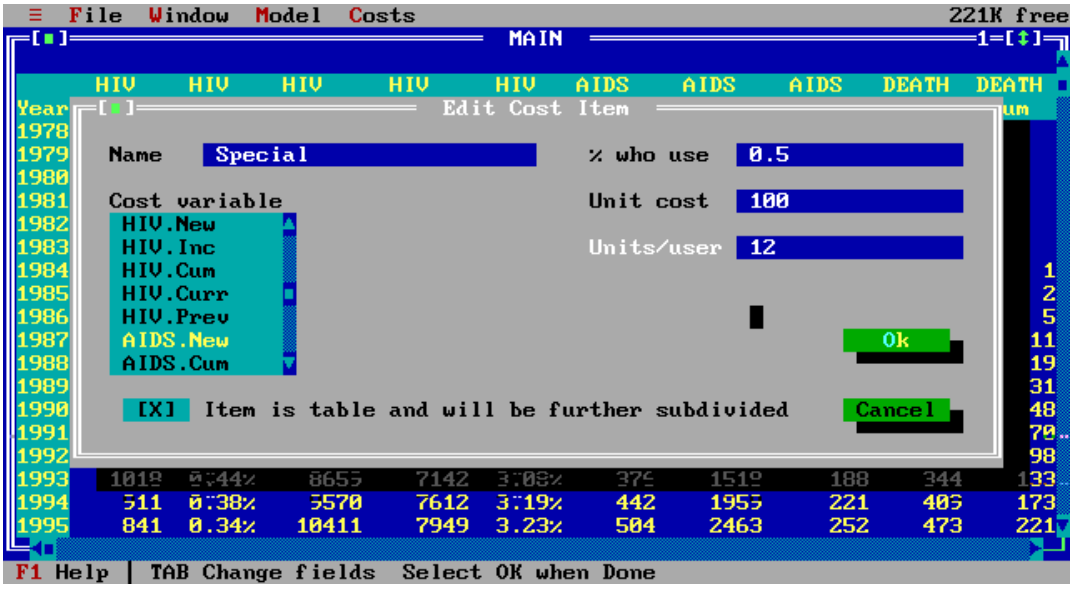

File Window Model Costs
231K free
MAIN
Edit Cost Information
Annual AIDS
Hospital
Daily bed rates
Ok
Edit
Delete
New cost
Move Left
Move Right
F1 Help F2 Menu F4 Parameters F6 Progressions F9 Run F10 Quit


File Window Model Costs
170K free
MAIN
Cost Information
1997 1998 1999 2000 2001 2002
Annual AIDS Users 598 633 663 692 718 742
Units 598 633 663 692 718 742
Cost $538071 $569471 $596666 $622351 $645994 $667780
Hospital Users 449 475 498 519 539 557
Units 673 712 746 778 808 835
Cost $538071 $569471 $596666 $622351 $645994 $667780
Daily bed rate Users 449 475 498 519 539 557
Units 5381 5695 5967 6224 6460 6678
Cost $538071 $569471 $596666 $622351 $645994 $667780
F1 Help F2 Menu F4 Parameters F6 Progressions F9 Run F10 Quit

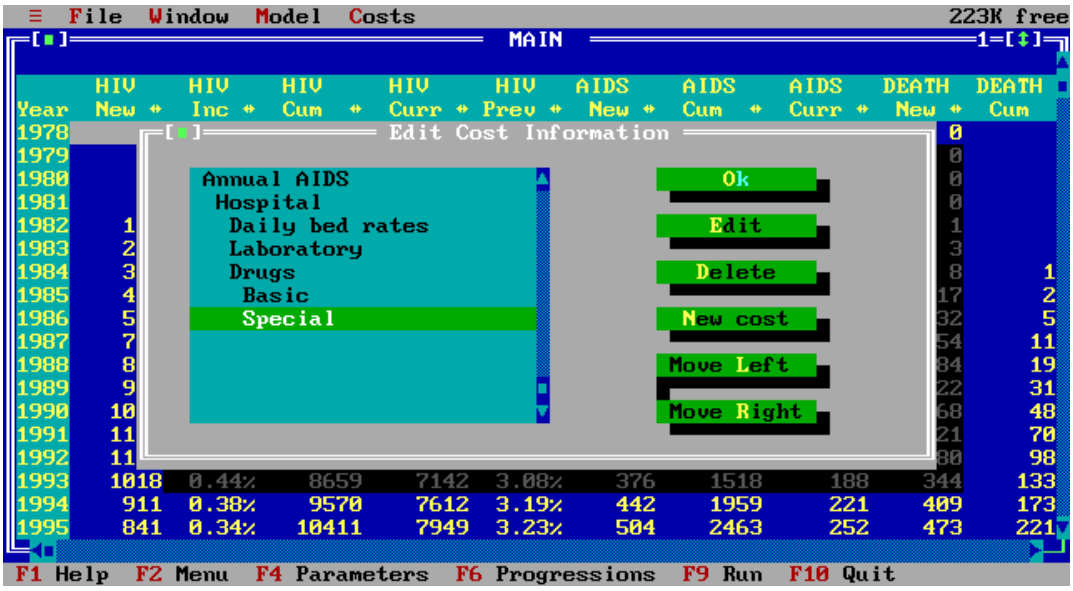

File Window Model Costs
226K free
MAIN
Edit Cost Item
Name Laboratory
% who use 1
Cost variable
Unit cost 10
HIV.New
HIV.Inc
HIV.Cum
HIV.Curr
HIV.Prev
AIDS.New
AIDS.Cum
Units/user 2
Ok
[X] Item is table and will be further subdivided
Cancel
F1 Help | TAB Change fields Select OK when Done


File Window Model Costs
225K free
MAIN
Edit Cost Item
Name Drugs
% who use 1
Cost variable
Unit cost 1
HIV.New
HIV.Inc
HIV.Cum
HIV.Curr
HIV.Prev
AIDS.New
AIDS.Cum
Units/user 1
Ok
[X] Item is table and will be further subdivided
Cancel
F1 Help | TAB Change fields Select OK when Done


File Window Model Costs
223K free
MAIN
Edit Cost Item
Name Basic
% who use 1
Cost variable
Unit cost 3.5
HIV.New
HIV.Inc
HIV.Cum
HIV.Curr
HIV.Prev
AIDS.New
AIDS.Cum
Units/user 12
Ok
[X] Item is table and will be further subdivided
Cancel
F1 Help | TAB Change fields Select OK when Done

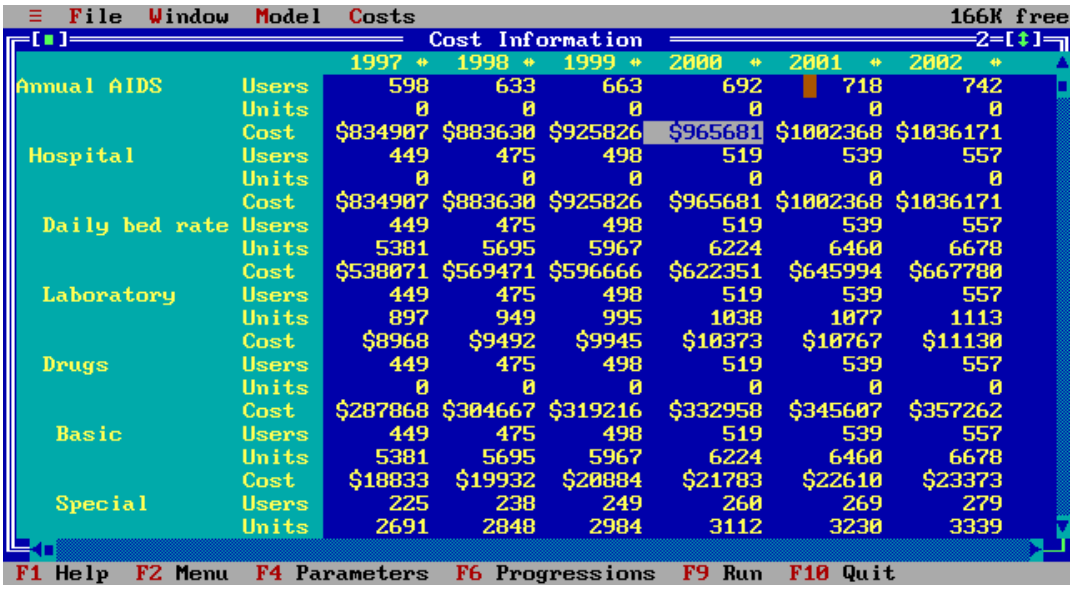

File Window Model Costs
221K free
MAIN
Edit Cost Item
Name Special
% who use 0.5
Cost variable
Unit cost 100
HIV.New
HIV.Inc
HIV.Cum
HIV.Curr
HIV.Prev
AIDS.New
AIDS.Cum
Units/user 12
Ok
[X] Item is table and will be further subdivided
Cancel
F1 Help | TAB Change fields Select OK when Done

L4-20



12. If all of the new cost settings and values were accurately copied from screens L4-13 to L4-20, then the cost of Annual AIDS in the year 2000 will be the summary costs of all Hospital cost items which, as shown in screen L4-21, is close to $966 million. Note that the summary cost of Drugs for the year 2000 is over $332 million and that Special drugs accounted for over $311 million, or over 90% of the total Drug cost.

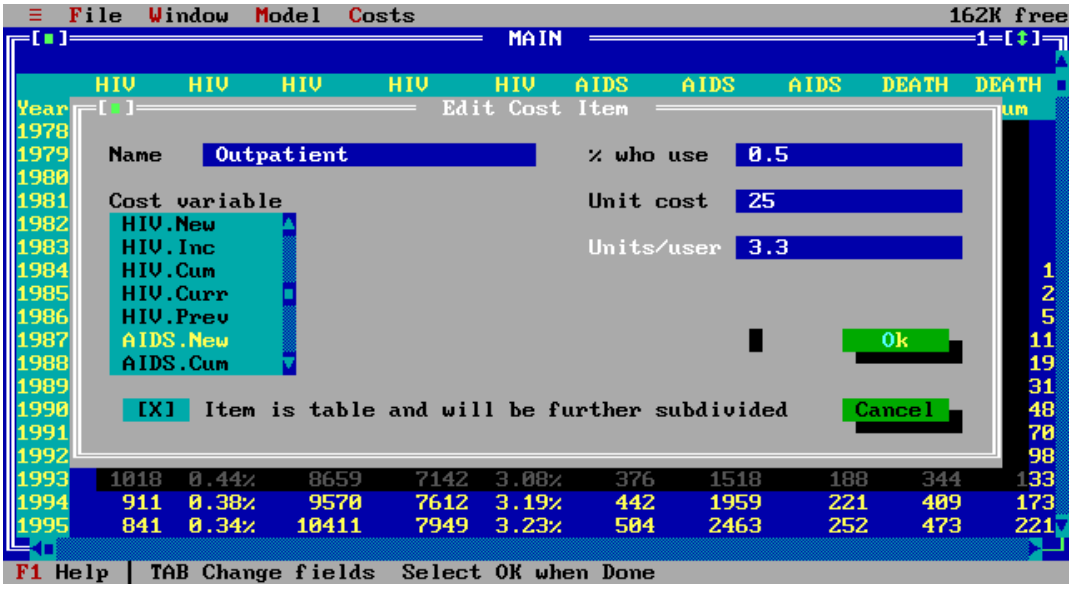
L4-21



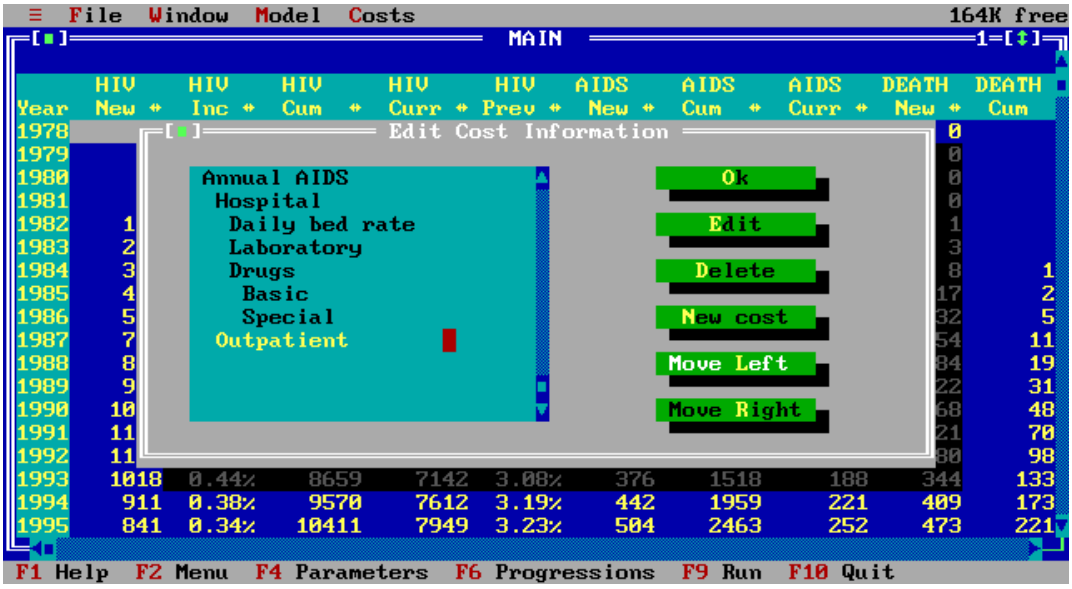
		1997	1998	1999	2000	2001	2002
Annual AIDS	Users	598	633	663	692	718	742
	Units	0	0	0	0	0	0
	Cost	$834907	$883630	$925826	$965681	$1002368	$1036171
Hospital	Users	449	475	498	519	539	557
	Units	0	0	0	0	0	0
	Cost	$834907	$883630	$925826	$965681	$1002368	$1036171
Daily bed rate	Users	449	475	498	519	539	557
	Units	5381	5695	5967	6224	6460	6678
	Cost	$538071	$569471	$596666	$622351	$645994	$667780
Laboratory	Users	449	475	498	519	539	557
	Units	897	949	995	1038	1077	1113
	Cost	$8968	$9492	$9945	$10373	$10767	$11130
Drugs	Users	449	475	498	519	539	557
	Units	0	0	0	0	0	0
	Cost	$287868	$304667	$319216	$332958	$345607	$357262
Basic	Users	449	475	498	519	539	557
	Units	5381	5695	5967	6224	6460	6678
	Cost	$18833	$19932	$20884	$21783	$22610	$23373
Special	Users	225	238	249	260	269	279
	Units	2691	2848	2984	3112	3230	3339

13. We will now add a final cost item for Annual AIDS with settings and values as shown in screens L4-22 and L4-23. Since this new item is the cost of Outpatient care and is not a component or subdivision of Hospital costs, we will need to move this item a couple of shifts to the left so that it is nested to the right of Annual AIDS, but vertically lined up with Hospital (L4-23).

L4-22

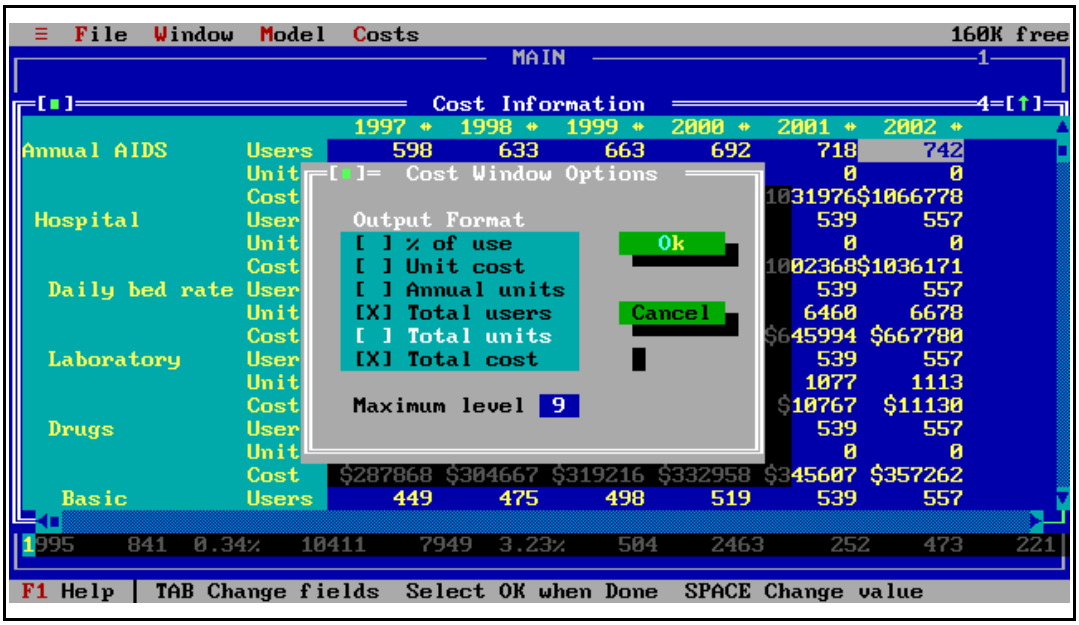


L4-23



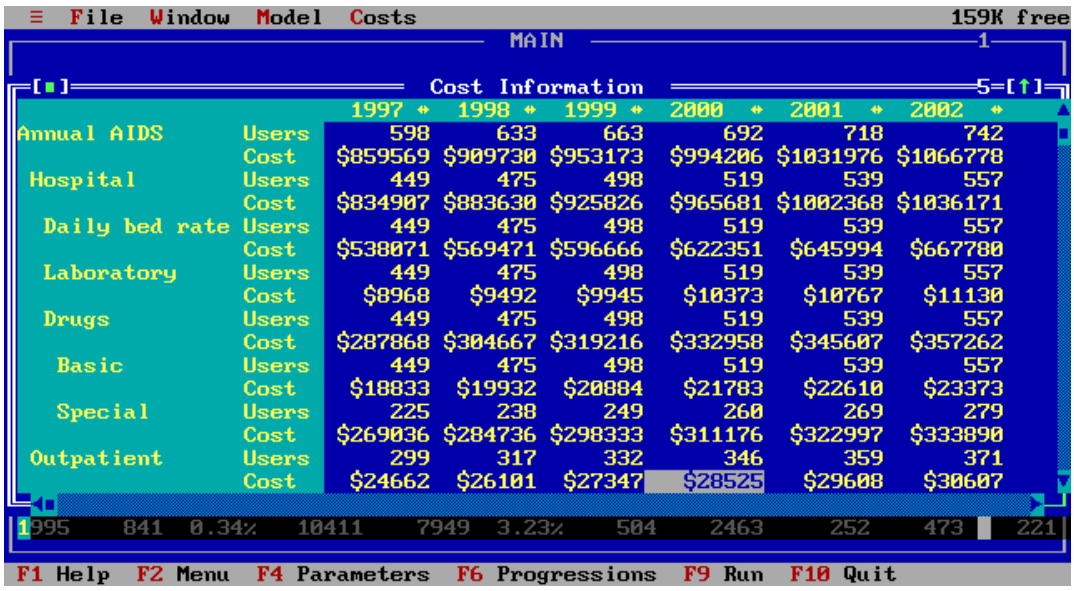
14. To view all of these cost estimates in a single screen without scrolling: I) open the Costs menu; ii) select the View estimate option; iii) use the down arrow key to get the cursor to the Total units box and press (toggle) the <Spacebar> to remove the X from this box, or click the mouse on this box to remove the X; and iv) accept this setting by cycling to the OK box with the <Tab> key and then press <Enter>, or click the mouse on the OK box (L4-24).

L4-24



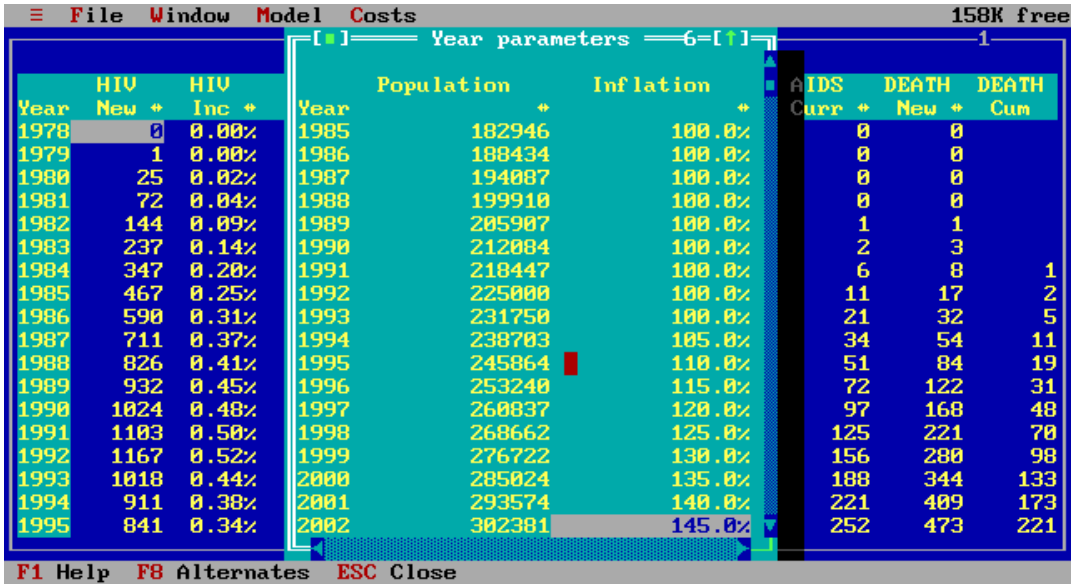
Note in the resultant Cost Information screen (L4-25) that Units are no longer displayed, and that the total cost of Annual AIDS in the year 2000 is now $994 million - $966 million for all Hospital costs, plus $28.5 million for Outpatient costs.

L4-25



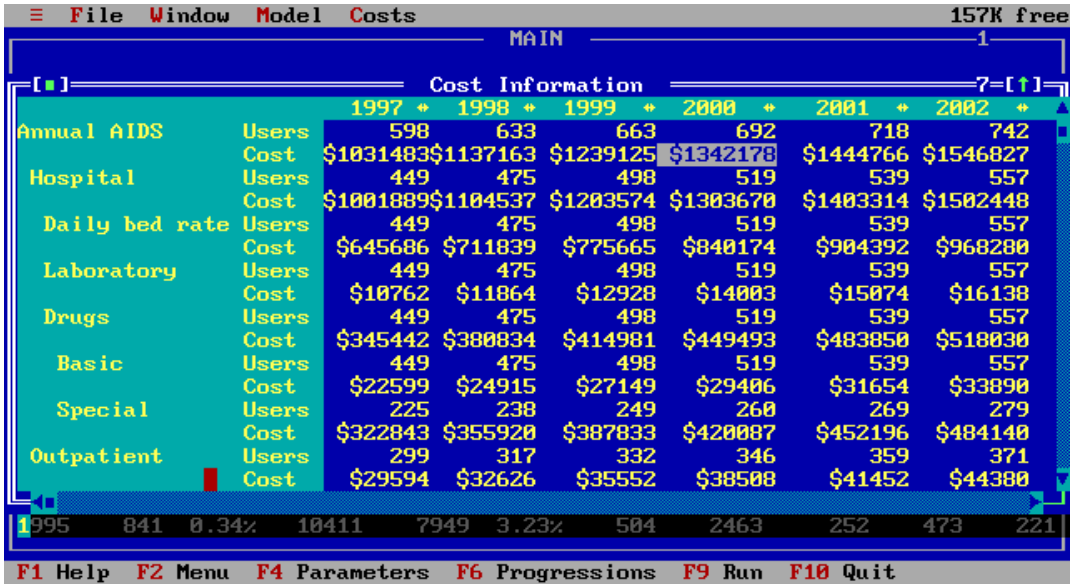
15. Costs can be made to vary over the years of the projection in two ways. The first is through the global inflation parameter, accessible through the Year parameters option of the Model menu. This parameter affects all costs in the system. All costs are multiplied by the inflation factor which is entered for any of the years. The default value for inflation is 100% for each year, which effectively disables the inflation feature (since each cost is multiplied by 1.00). Changing the inflation value for a year will affect all costs for that year by the same factor. To illustrate this feature: I) select the Year parameters option from the Model menu; ii) in the Year parameter dialog box, use the right arrow key to move the cursor bar to the Inflation column, and then use the down arrow key to move the cursor bar to 1994; iii) type 1.05 and then press <Enter> to accept an Inflation value of 105% for 1994; iv) continue to increase the Inflation factor by 5% for each year up through the year 2002. This is illustrated in screen L4-26 where starting in 1994, the Inflation factor is increased by 5% per year so that by the year 2002, item costs are 45% higher than they were in 1993. After completion of all Inflation entries, press the <Esc> key and all cost items will be multiplied by the Inflation factor entered for each year.

L4-26



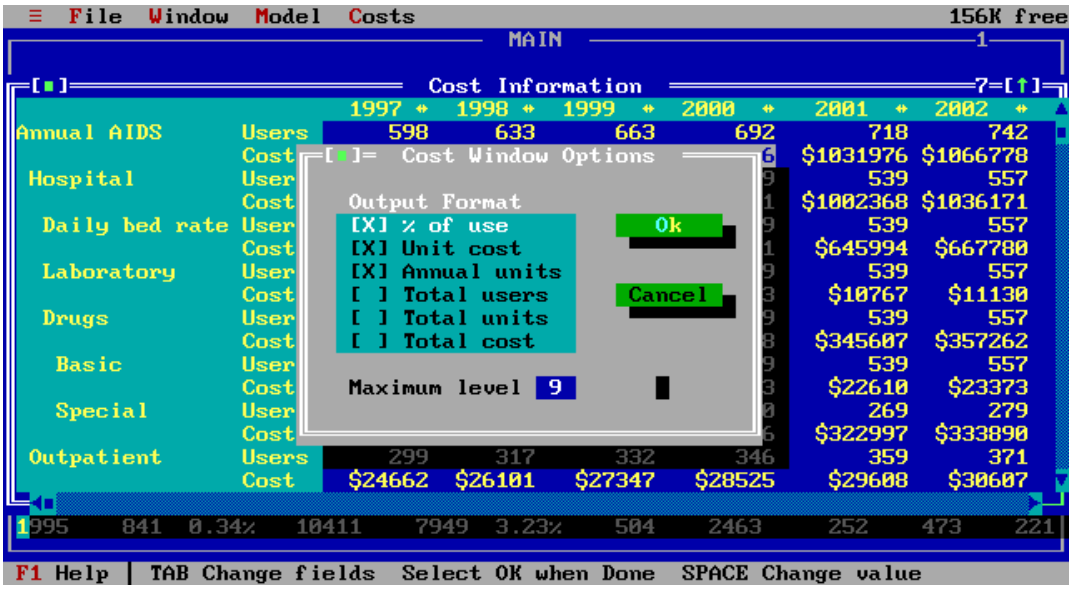
16. In the year 2000, the total cost of Annual AIDS is now $1.3 billion which is a 35% increase of the 1993 costs (L4-27, shown on the next page). Before proceeding to the next step, change the Inflation factor back to the default value by selecting the Year parameter option from the Model options menu and in the Year parameters dialog box move the cursor to the top of the Inflation column, type 1 and then press the <Ctrl plus D> keys. This will change all values in this column back to 100%.

L4-27



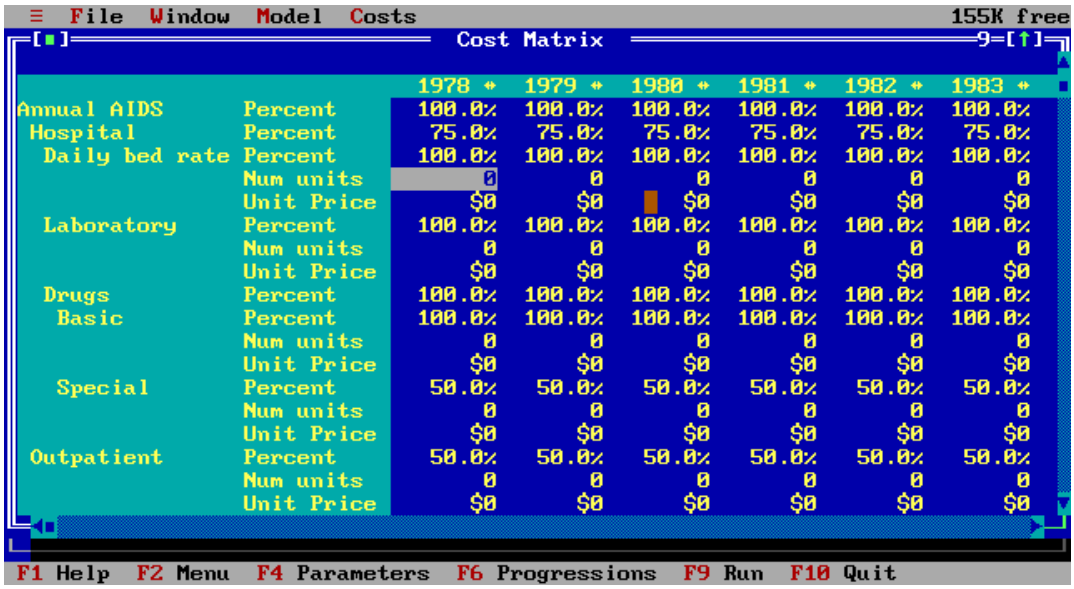
17. The other way to change costs from year to year is by actually changing the individual components (% who use, Unit cost, and Units/user) of the cost item. These numbers are stored in a vector, one value per year. For example, suppose we wish to only change special drug costs for some years. By selecting the Edit items option from the Cost menu, we open a Cost Window Options dialog box (L4-28).

L4-28



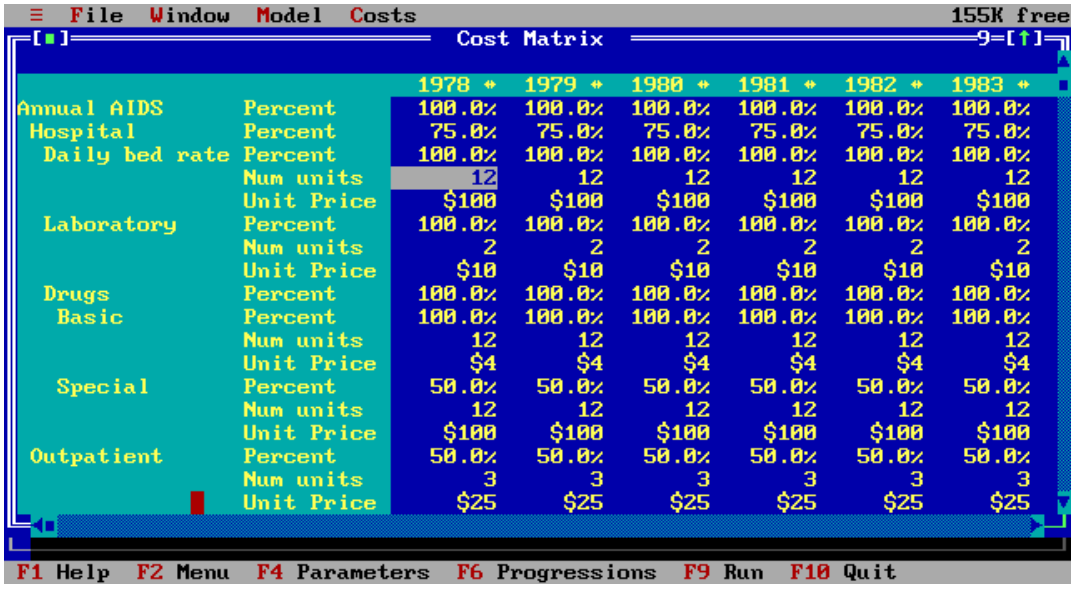
18. For now, we will accept the default settings and exit this dialog box by clicking the mouse on the OK box or by cycling to the OK box with the <Tab> key and then pressing <Enter>. This will bring up a Cost Matrix window displaying for each non-summary cost item, the Percent used, Number of units used and Unit Price per year. Any of these individual cells can be changed for any year. If you are still using the SSA - Scenario Test projection, you will see that other than the Percent rows, all of the rows have only zeros (L4-29). This is because the SSA - Scenario Test projection rounded off all output values by 1000.

L4-29



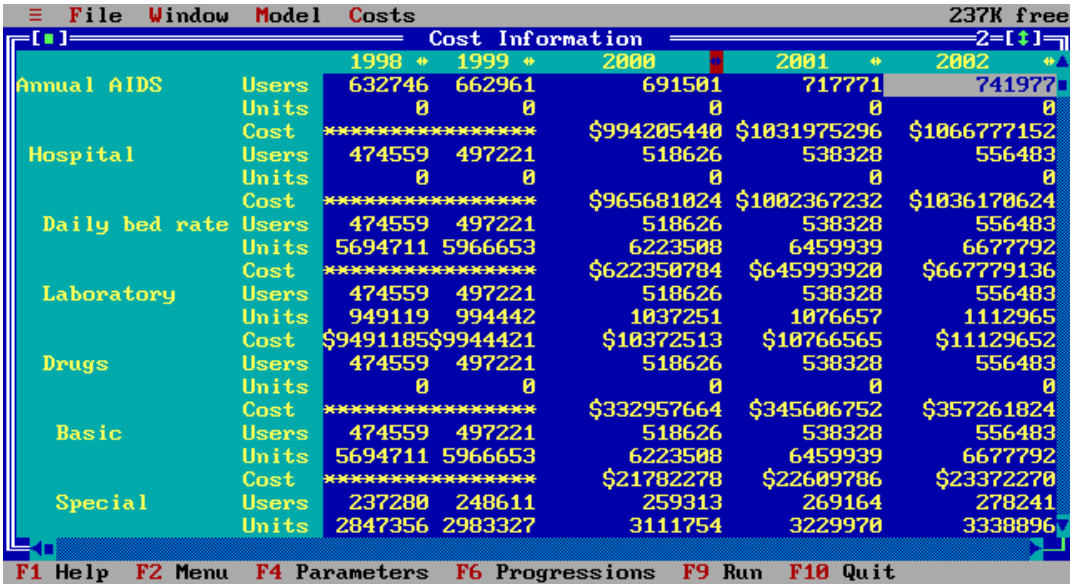
19. In order to use this Cost Matrix window, we need to select Options from the Model menu and change the number in the Round values to box back to 1. Then the number of units and unit prices can be visualized (L4-30).

4-30



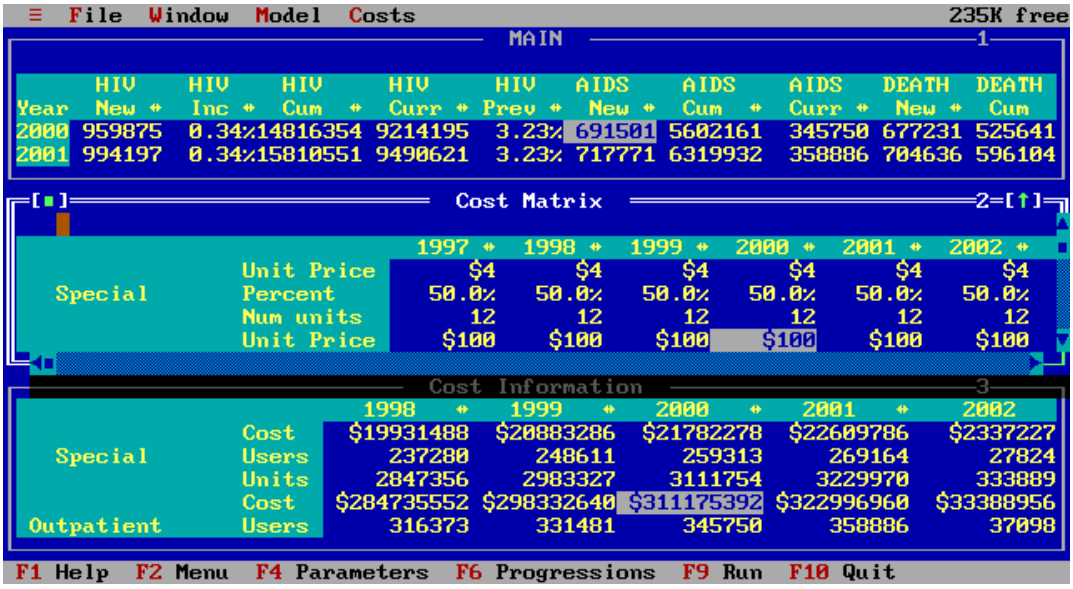
20. We can now make changes in any cell by moving the cursor bar to that cell, typing in a new value and then pressing <Enter>. However, for this lesson, we will not do this until we reorganize all three of the output screens (Main, Cost Matrix, and Cost Information) with the Tile option of the Window menu so that they can all be visualized on one screen at the same time. To do this we first open the Cost Information screen or window by selecting the View estimate option from the Cost menu. Since the output values are now not rounded off by 1000, the costs of Annual AIDS, especially around the year 2000 are very large numbers that cannot be visualized on the screen because the columns merge into each other. When this occurs, cells with such large numbers appear on the screen as ********. These numbers can be pulled open by clicking and holding the mouse on the arrow symbol in between the columns at the top of the screen to drag the columns apart (L4-31). This action can only be done with a mouse. Users without a mouse will need to resort to the Round value to option to visualize large numbers in the Cost Information screen and then switch back to visualize smaller numbers in the Cost Matrix screen.

L4-31



21. We next access the Window menu by pressing the <Alt plus W> keys or by clicking the mouse on Windows at the top left of the screen. In the Windows menu, move the cursor bar down with the down arrow key to the Tile option and then press <Enter> or click the mouse on the Tile option. This will result in a screen with all three output screens or windows showing - the MAIN output screen at the top, the Cost Matrix screen in the middle, and the Cost Information screen at the bottom (L4-32, shown on the next page). Each of these "tiled" windows is about the same size and each window is unobscured by the other windows.

L4-32



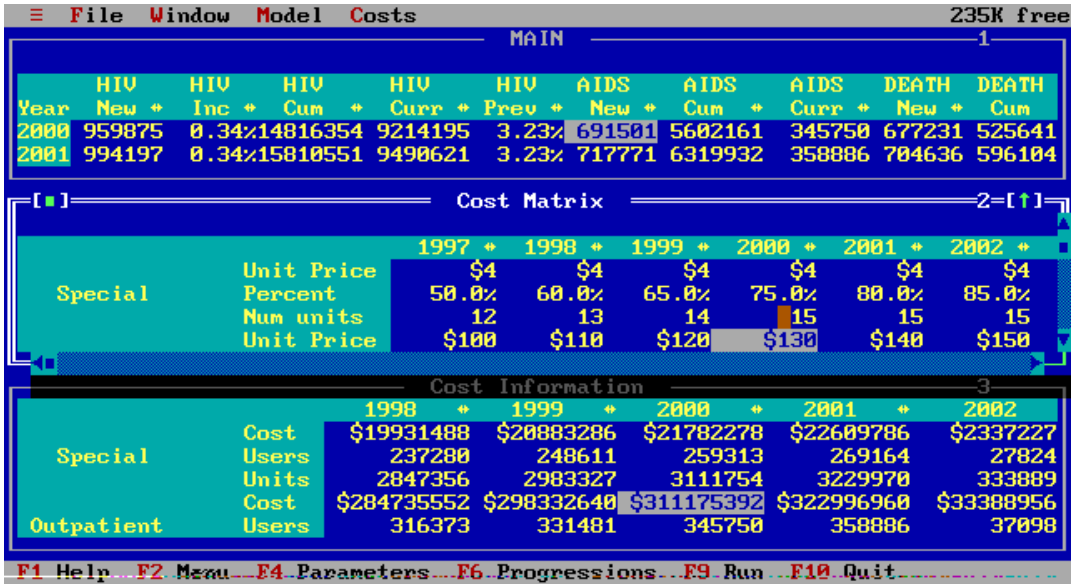
To utilize these "tiled" windows, we have to recognize and understand the "active" window feature. The active window is the window that is on "top" of the stack of windows on the screen. When a window is active, its border is drawn in double lines. The cursor can only be moved within the active window. Near the upper right hand corner of each of these "tiled" screens or windows is a number and when a window is the active window, there is an up arrow sign pointing upwards to the right of the window number. Clicking the mouse on this arrow will zoom this active window to fill the screen. There is also a square sign at the upper left corner of the active window. Clicking the mouse on this square will close this window. You can make the next window in the window stack the active window by pressing the <Alt plus F6> keys; by repeating this action you can cycle through all the stacked windows until you reach the window you want.

You can also activate any window on the screen by clicking the mouse on any cell within that window. For this lesson, first make the MAIN screen the active window, and then move the cursor to the AIDS New column and then down this column so that the outputs for the years 2000 and 2001 are showing. Next, activate the Cost Information window and using the arrow keys, first move the cursor to the year 2000 column and then down to the cost information rows for Special (drugs). Finally, activate the Cost Matrix window, and move the cursor to the year 2000 column, and then down to the component rows of the cost vector for Special (drugs). The resultant screen should be almost identical to that seen in L4-33 (shown on the next page), with 691581 annual AIDS (AIDS New) cases in the year 2000, and $311175329 as the cost for Special drugs.

22. With the Cost Matrix screen as the active window, increase the Percent (users), Num[ber of]

units per user and Unit Price of special drugs starting in the year 1998 with the values shown in L4-33. After correctly entering all entries through the year 2002, press <F9> to recalculate the costs of special drugs.

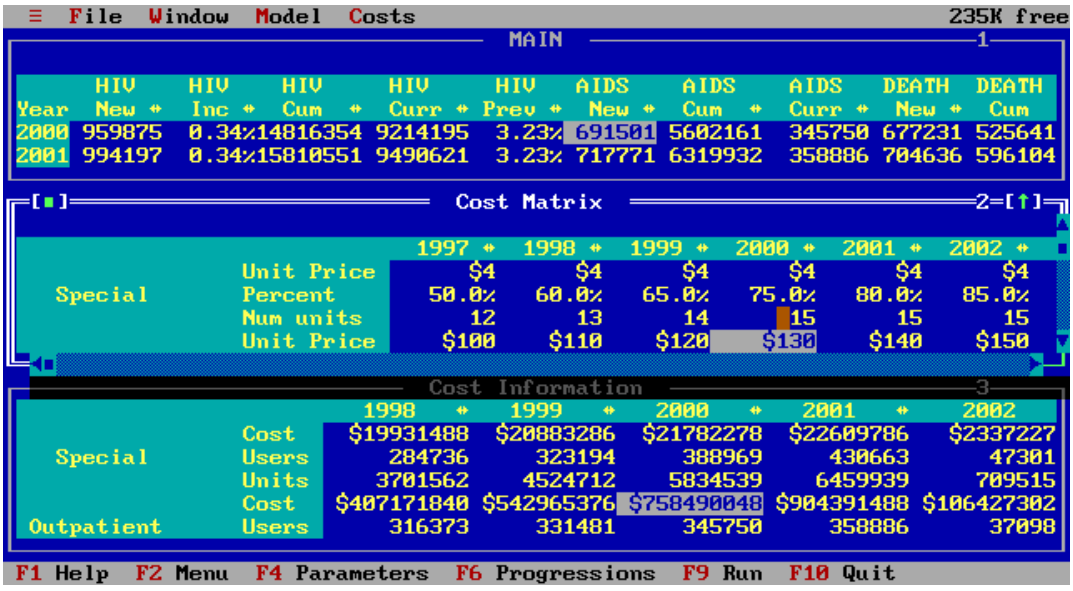
L4-33



23. Note that the costs of Special drugs are now markedly increased after 1998 and in the year 2000 is now $758490048 (L4-34). To visualize the total Cost Information screen, we have to make this window the active one by cycling to it by pressing the <Alt plus F6> keys, or by clicking the mouse in any cell in this window. With the Cost Information screen as the active window, we can enlarge it (zoom) by pressing the <F5> key or by clicking the mouse on the up arrow sign at the upper right corner of this screen.

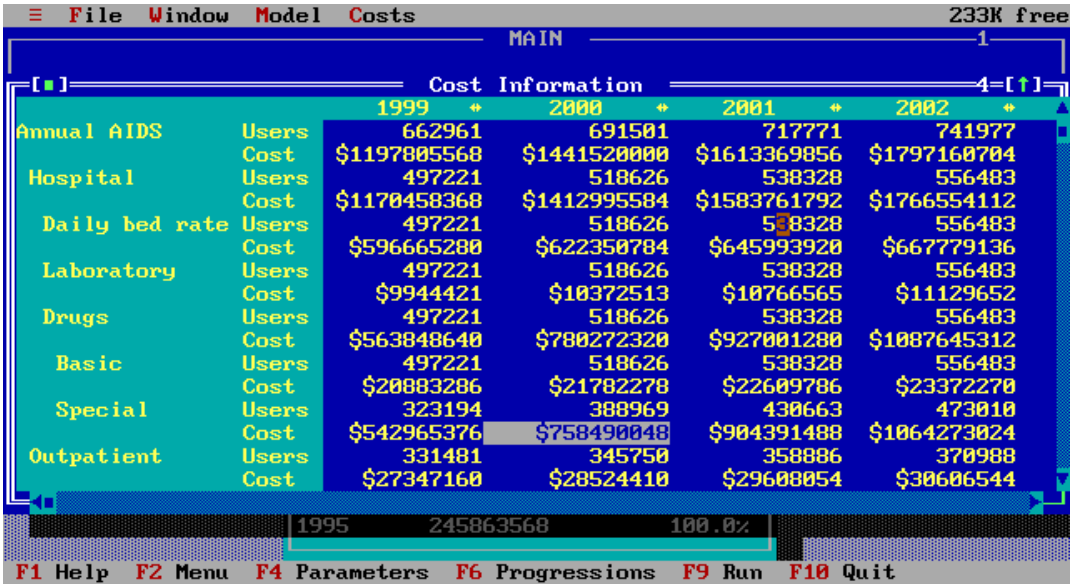
L4-34

24. The resultant Cost Information screen is shown in L4-35, and we can see that the increase of



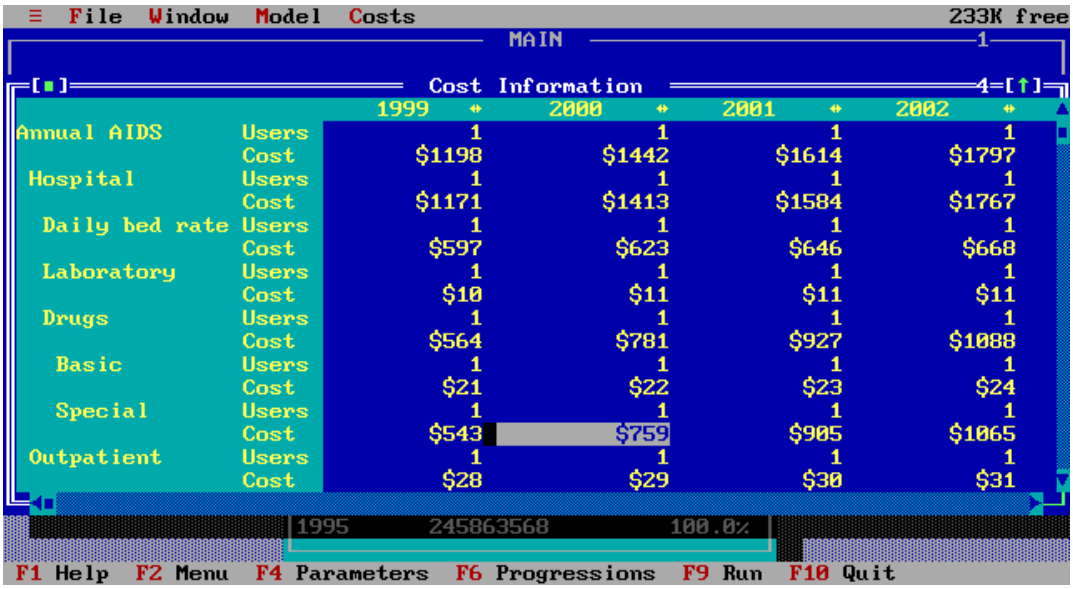
Annual AIDS costs and Hospital costs is due to the increase costs of Special drugs.

L4-35



25. Using the Round value to option and rounding values to a million is shown in L4-36.

L4-36



LESSON 5. Using the CHILD Module

Introduction

In developing countries, reliable data on reported cases of pediatric AIDS and maternal AIDS orphans are not available for estimating and projecting the current and future numbers of these children. Two methods which do not rely on reported case data are available for estimating the number of HIV-infected and uninfected children born to HIV-infected women. The simplest method estimates the percent of females of child-bearing age infected with HIV, and then applies this percent to total annual births to arrive at the number of births among HIV-infected women each year. Annual HIV-infected infants can then be calculated by applying an average perinatal transmission rate to total births among HIV-infected women. The number of uninfected infants born to HIV-infected women constitutes the number of potential maternal AIDS orphans.

The CHILD module of EPIMODEL provides a more detailed method for estimating and projecting pediatric AIDS and maternal AIDS orphans. This module calculates total children born to HIV-infected women - including those children born before these women were infected by HIV - and calculates the age of these children at the time their mothers die of AIDS (i.e., when they become maternal AIDS orphans).

The CHILD module of EPIMODEL does the following:

1. Calculates for females aged 15-59 the annual number (cohort) of HIV-infected females;

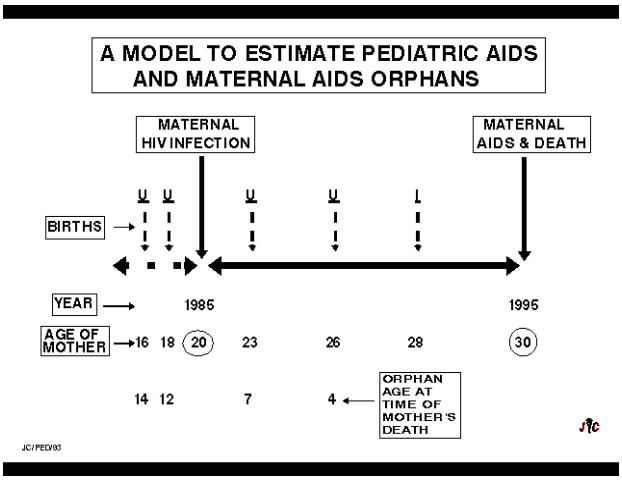
2. subdivides each annual cohort into nine 5-year age groups or age-specific subcohorts;

3. applies annual progression rates from HIV infection to AIDS to each of the annual age-specific subcohorts for a 20 year period;

4. from the year a particular age-specific subcohort develops AIDS, the model applies age-specific fertility rates annually to this subcohort back to age 15 to calculate how many children were born to women in this age-specific subcohort in each year;

5. for each age-specific subcohort, the time period from infection to AIDS is divided into 10 parts, and a variable perinatal transmission rate is assigned to each time interval to calculate the number of perinatally infected infants; and

6. calculates the number and ages of uninfected children in the year of their mothers' death.



The following example illustrated in the figure describes how one HIV-infected female is handled in the CHILD module. In this example, we have a female who was infected in 1985 when she was 20 years old, and then develops AIDS in 1995 when she is 30 years old. Using age-specific fertility rates, the model then calculates backwards to determine how many children she had from the time she was 15, i.e. from 1980 to 1995. This particular woman (in EPIMODEL she would be a 5 year subcohort of women) had a total of five children - when she was 16, 19, 23, 26 and 28 years old. The model then determines how many of her children were infected perinatally. She had two children before her HIV infection; these children were not at risk of a perinatal HIV infection. Three children were born after her HIV infection. The model divides her incubation period - from infection to development of AIDS - into ten equal parts. Since in this example it took ten years for her to develop AIDS, each tenth of her incubation period is 1 year (if her incubation period to AIDS was 15 years, then each tenth would be 1.5 years).

For each birth, the model can use different perinatal transmission rates depending on when in the course of the mother's HIV infection the pregnancy occurred. A low transmission rate (i.e., 10%) can be selected in the early part of her incubation period, and a very high rate (i.e., 80%) can be selected when the mother is in the late clinical phase of her HIV infection. Applying such variable perinatal transmission rates to her pregnancies after her infection, the model determined that the first two children were not infected, but that the last child, born when she was 29 years old, was infected. With this information, the model can calculate the ages of her uninfected children at the time of her death. In this example, there will be four new maternal orphans in 1995 - aged 4, 7, 12, and 14.

The following sections describe the major variables that are used in EPIMODEL's CHILD module, and how they may be derived or estimated.

HIV seroprevalence in women - HIV infections in women can be determined from the ratio of male to female HIV infections observed in different geographical areas. For areas with limited or inadequate HIV seroprevalence data, HIV infection in women can be estimated indirectly from the observed sex ratio of reported AIDS cases. The observed epidemiologic trends and estimates can then be used to project HIV infections in women.

Age-specific infection rates and age-specific fertility rates - The number of children born to HIV-infected women depends on the age at which they first acquire HIV infection and on prevalent age-specific fertility rates. Age-specific HIV infection rates for females of child bearing age can be derived from HIV serological survey data; age-specific fertility rates and patterns have been collected for use by demographers and family planning programs. Whether HIV infection has any significant effect on fertility rates is not known.

Perinatal transmission rates - The probability that an infected woman will transmit HIV to her fetus or infant ranged from less than 20% in several European studies to about 40% in some African studies. Some data indicate that perinatal transmission may be very high during the brief acute phase of maternal HIV infection, relatively low during the variable but usually prolonged asymptomatic phase, and then increase to high levels again during the late clinical phase of infection. As of 1995, researchers believe that, on average, the perinatal transmission rate for HIV-1 infected women in North America and Western Europe is 20% or less, but may be 30% or more in sub-Saharan African women. EPIMODEL can vary the perinatal transmission rate depending on when during the incubation period from HIV infection to the development of AIDS each pregnancy may occur.

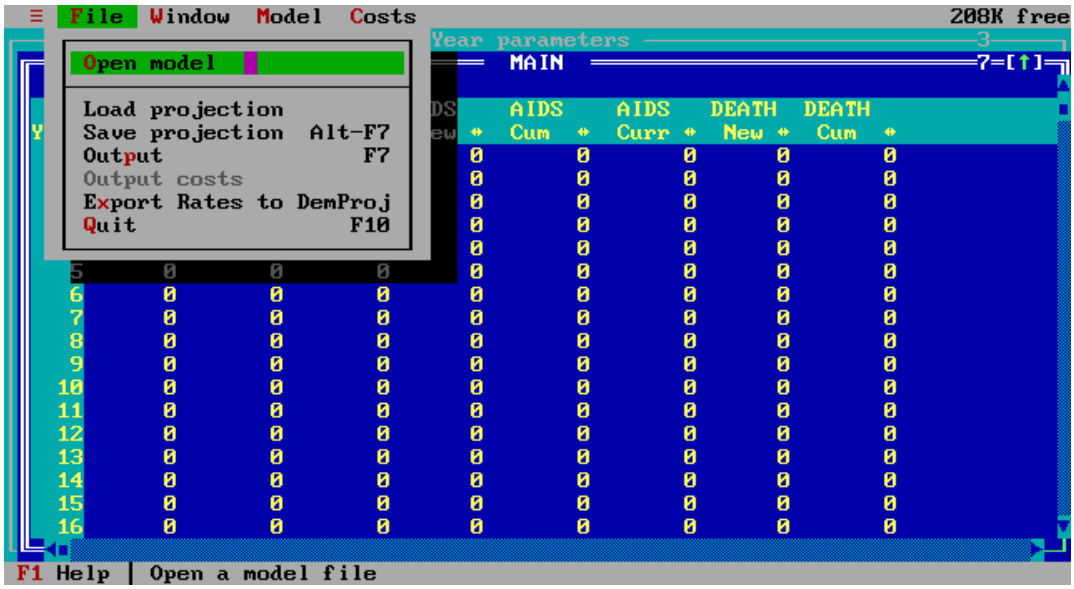
Progression rates from HIV infection to AIDS in children - Infants infected perinatally progress to AIDS much more rapidly than do adults. For the purposes of EPIMODEL, it has been assumed that 80 to 90% of perinatally infected infants will die as a result of HIV-related conditions before their 6th birthday.

All of the default values used in the CHILD module for these maternal and pediatric parameters are derived from sub-Saharan African populations. Age-specific HIV infection rates in females, age-specific fertility rates, and a high perinatal HIV transmission rate are derived from African data. The default value used for each of these parameters should be changed when the CHILD module is used for other populations.

We are now ready to use the CHILD module to make estimates and projections of pediatric AIDS cases and maternal AIDS orphans in sub-Saharan Africa.

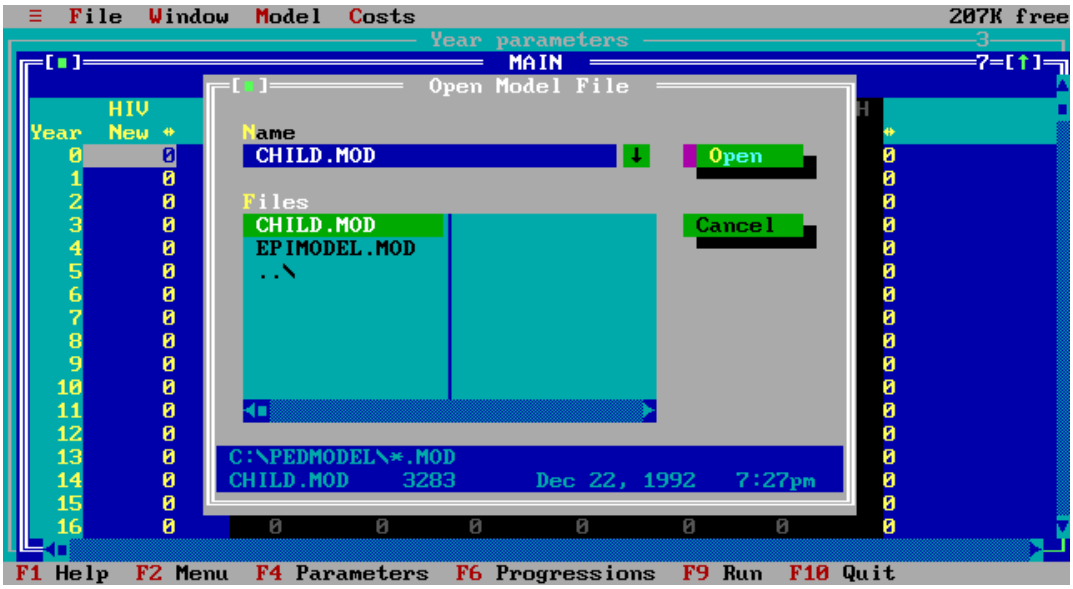
1. To open the CHILD module, we need to be in the MAIN output screen from which we open the File menu by pressing the <Alt plus F> keys or by clicking the mouse on File at the upper left corner of the screen. The cursor bar will be on the Open model option, and we select this option by pressing <Enter> or by clicking the mouse on this first option (**L5-1**).

L5-1



2. This opens the Open Model File dialog box. We need to press the <Tab> key to move to the Files box, and then with the cursor bar on CHILD.MOD we press <Enter> or click the mouse on CHILD.MOD to select this module. This will result in CHILD.MOD showing in the Name box at the top of this dialog box (**L5-2**). Open CHILD.MOD by moving the cursor with the <Tab> key to the Open box and then press <Enter> or click the mouse on the Open box.

L5-2

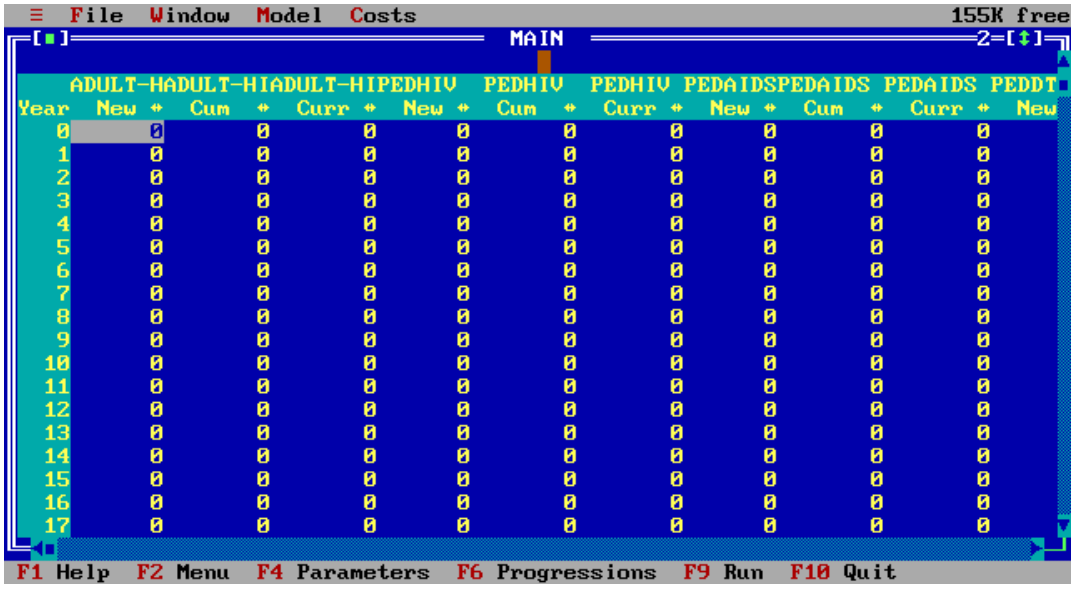


2. This gets us to the Main output screen of the CHILD module which in addition to all of the adult output columns has 14 columns of pediatric and orphan outputs. Scroll to the right with the arrow key to visualize all of the output columns.

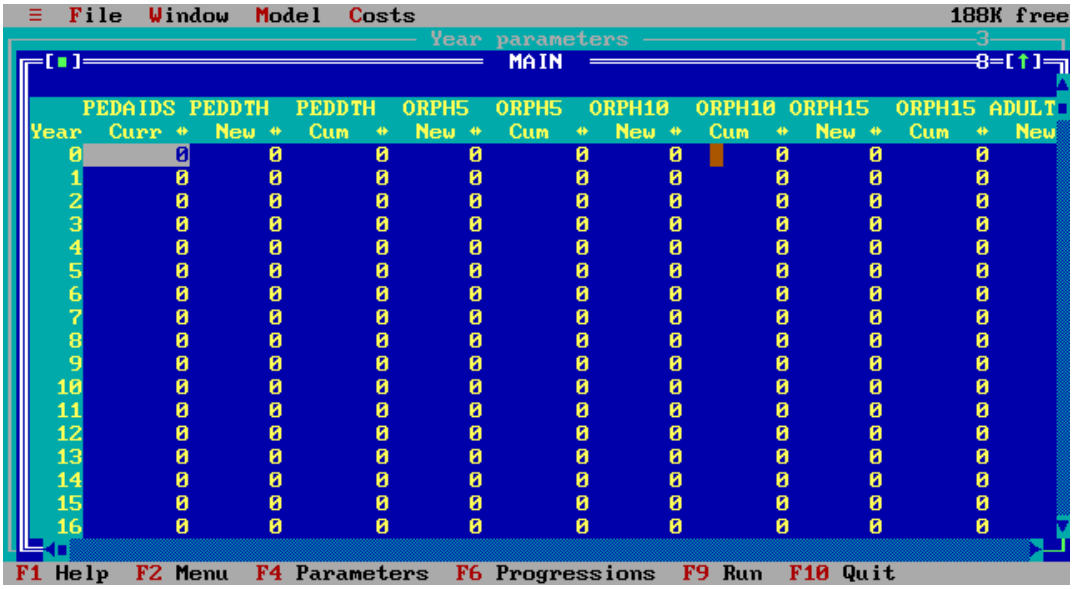
   The following columns are shown in **L5-3** and **L5-4**.

   PEDHIV New - Annual perinatal HIV infections
   PEDHIV Cum - Cumulative perinatal HIV infections
   PEDHIV Curr - Prevalent pediatric HIV infections at the beginning of the year
   (All HIV infections minus those who progressed to AIDS)
   PEDAIDS New - Annual pediatric AIDS
   PEDAIDS Cum - Cumulative pediatric AIDS
   PEDAIDS Curr - Prevalent pediatric AIDS cases at the beginning of the year
   (Cumulative AIDS cases minus those who died)
   PEDDTH New - Annual pediatric AIDS deaths
   PEDDTH Cum - Cumulative pediatric AIDS deaths
   ORPH5 New - Annual maternal AIDS orphans less than 5 years old
   ORPH5 Cum - Cumulative maternal AIDS orphans less than 5 years old
   ORPH10 New - Annual maternal AIDS orphans less than 10 years old
   ORPH10 Cum - Cumulative maternal AIDS orphans less than 10 years old
   ORPH15 New - Annual maternal AIDS orphans less than 15 years old
   ORPH15 Cum - Cumulative maternal AIDS orphans less than 15 years old

L5-3

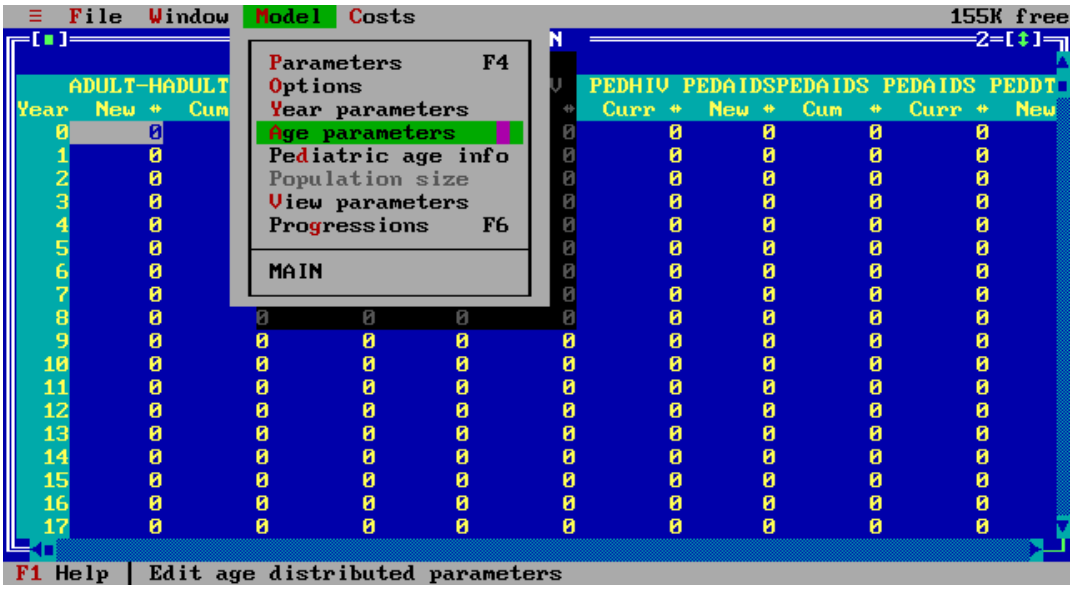


L5-4



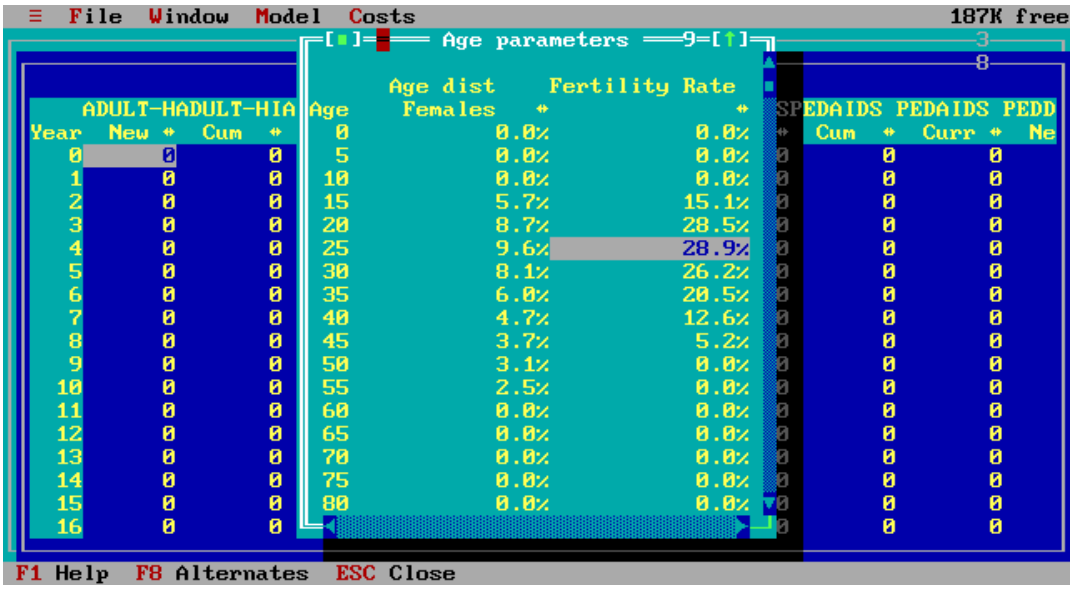
3. We next need to become familiar with the parameters in the CHILD module that differ from the adult model and learn how to access and change these parameters when needed. Age parameters are used in the CHILD module and can be accessed through the Model menu by pressing <Alt plus M> or by clicking the mouse on Model at the top line of the output screen. Use the down arrow key to move the cursor to the Age parameter option (**L5-5**), and then select this option by pressing <Enter>or by clicking the mouse on this option.

L5-5



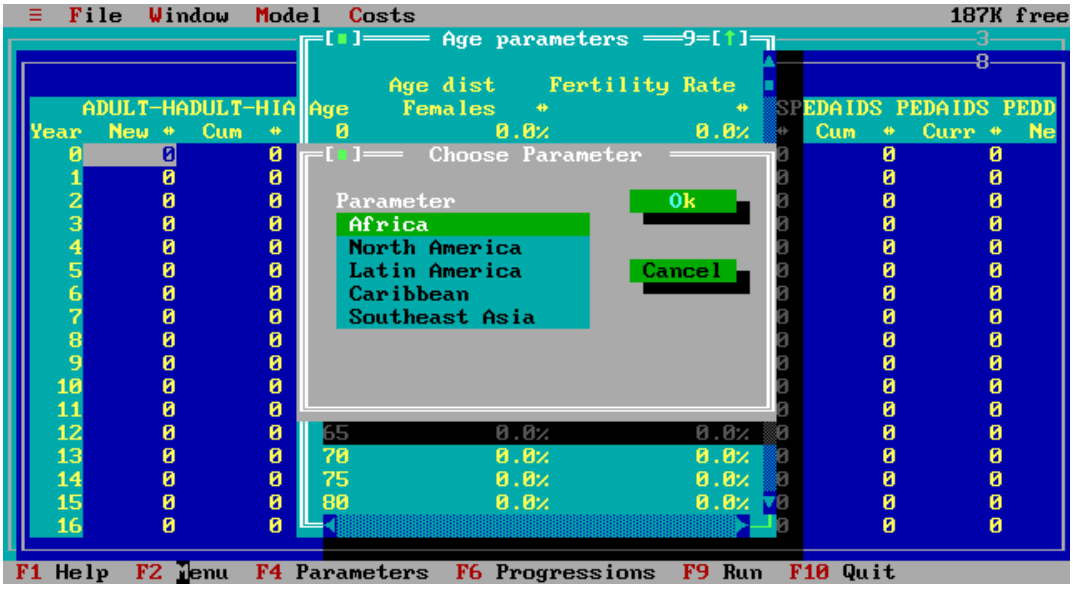
4. This opens the Age parameter dialog box (**L5-6**). Note the three columns in this dialog box - Age (in 5 year age-groups), Age dist[ribution of HIV-infected] Females, and [Age-specific] Fertility Rates. The age-distribution parameter for HIV-infected females is used by EPIMODEL to calculate the annual number of HIV-infected females in each 5 year age group. The values for these parameters are derived from sub-Saharan African data. The percent of infected females for all age groups is about 50% which approximates the male to female ratio of HIV infections in Africa: the very high age-specific fertility rates are also those found in sub-Saharan African populations. The values for these parameters must be changed when populations other than sub-Saharan African ones are modeled.

L5-6



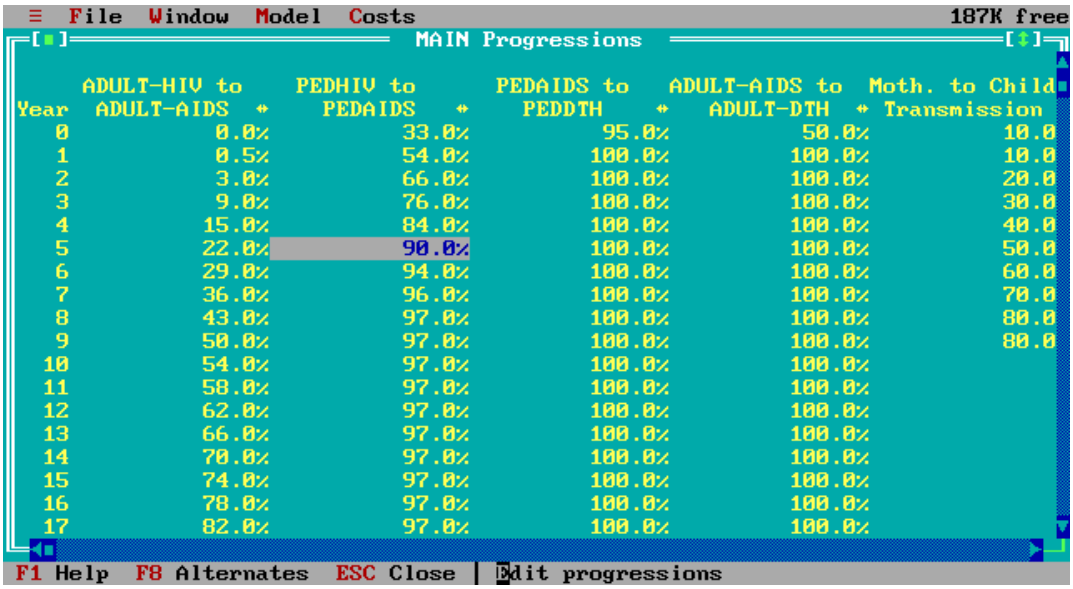
5. The age and fertility rate parameters can be changed manually, but in this version of EPIMODEL, alternate age-specific fertility rates for other regions are available. To access other fertility rates we need to move the cursor to the Fertility Rate column and then press <F8> or click the mouse on F8 at the bottom left corner of the screen (**L5-6**). This opens a Choose Parameter dialog box which lists five geographical regions (**L5-7,** shown on the next page**)**. For this lesson we will keep the default parameter for Africa, but now you know how to change this parameter. Exit the Choose Parameter dialog box by either pressing the <Esc> key or by clicking the mouse on the Cancel box. Also exit from the Year parameter dialog box by pressing the <Esc> key or by clicking the mouse on Esc Close at the bottom of the screen.

L5-7



6. We will next review the default progression rates used in the CHILD module by pressing the <F6> key or by clicking the mouse on F6 which is in the middle at the bottom of the screen. This opens up the MAIN Progressions dialog box (**L5-8**).

L5-8



Year	ADULT-HIV to ADULT-AIDS	PEDHIV to PEDAIDS	PEDAIDS to PEDDTH	ADULT-AIDS to ADULT-DTH	Moth. to Child Transmission
0	0.0%	33.0%	95.0%	50.0%	10.0
1	0.5%	54.0%	100.0%	100.0%	10.0
2	3.0%	66.0%	100.0%	100.0%	20.0
3	9.0%	76.0%	100.0%	100.0%	30.0
4	15.0%	84.0%	100.0%	100.0%	40.0
5	22.0%	90.0%	100.0%	100.0%	50.0
6	29.0%	94.0%	100.0%	100.0%	60.0
7	36.0%	96.0%	100.0%	100.0%	70.0
8	43.0%	97.0%	100.0%	100.0%	80.0
9	50.0%	97.0%	100.0%	100.0%	80.0
10	54.0%	97.0%	100.0%	100.0%	
11	58.0%	97.0%	100.0%	100.0%	
12	62.0%	97.0%	100.0%	100.0%	
13	66.0%	97.0%	100.0%	100.0%	
14	70.0%	97.0%	100.0%	100.0%	
15	74.0%	97.0%	100.0%	100.0%	
16	78.0%	97.0%	100.0%	100.0%	
17	82.0%	97.0%	100.0%	100.0%	

The default adult progression rates from HIV infection to AIDS (column 2), and from AIDS to death (column 5) are the same as the default rates in the adult model. No alternate adult progression rates are available in the CHILD module, but both progression rates can be changed manually in this dialog box. The default progression rate from perinatal infection to AIDS has 90% of infected children developing AIDS by their 6th birthday, and dying

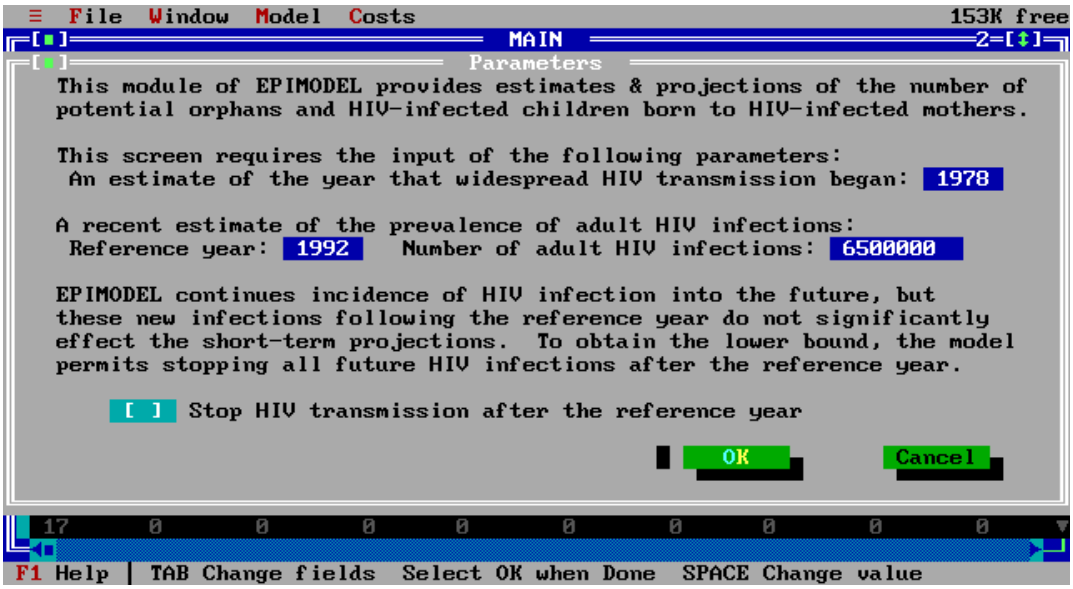
during the year they develop AIDS. These progression rates can also be changed manually, if needed, in this dialog box. The last column (column 6) in this dialog box is the default Moth[er] to Child Transmission rate or the perinatal transmission rate. The ten rates in this column are not yearly rates: they are perinatal transmission rates that are applied to the ten equal parts of the time period from HIV infection to the development of AIDS in women. This will be explained in the following sections which describes in detail how the CHILD module uses all of the input parameters.

7. The CHILD module first uses the HIV age-specific rates given in the Age parameter dialog box to calculate the number of infected women in 5 year groups within each annual cohort of infected women. These annual age-specific subcohorts (a total of nine 5 year subcohorts - 15-19, 20-24...55-59 - for each year) are progressed from the year of their infection to the year that they develop AIDS. Thus, each annual cohort of HIV-infected females when followed for the subsequent 20 years will generate 180 subcohorts of women, each of whom will develop AIDS in different years and at different ages. For each of these age-specific subcohorts the model uses age-specific fertility rates to back calculate the number of infants born each year to women in these subcohorts from the year in which AIDS developed. This back calculation is continued back to age 15 regardless of the age when the subcohort was infected in order to include the uninfected children who will constitute the older orphans.

8. Progression from HIV infection to AIDS is variable and ranges from 1 to 20 years. It is believed that the perinatal transmission rate increases as immune deficiency and AIDS develops fully in HIV-infected women. The CHILD module divides the time period from HIV infection to AIDS into ten parts and can vary the perinatal transmission rate for each of these ten parts of the "incubation" period. As shown in the last column of **L5-8**, the default perinatal transmission rate is 10% for the first two tenths of the incubation period and then increases by 10% for each subsequent tenth until it reaches 80% for the last two tenths. The default perinatal transmission rate is equivalent to an average rate of about 30%. This high default perinatal transmission rate should be lowered when modeling populations outside of sub-Saharan Africa. We exit from the MAIN Progressions dialog box by pressing the <Esc> key or by clicking the mouse on ESC Close at the bottom of the screen.

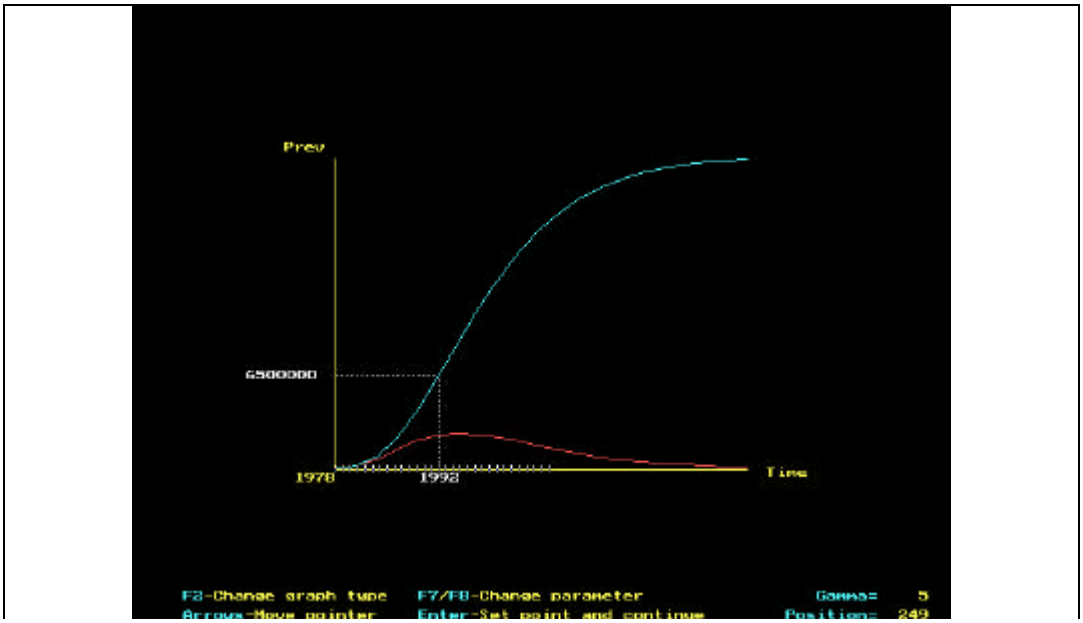
9. We will now estimate and project pediatric AIDS cases and maternal AIDS orphans using the default parameters described above. To get to the epidemiologic data entry screen, we press the <F4> key or click the mouse on F4 found at the bottom line of the output screen. In the resultant Parameters dialog box we will enter 1978 for the year that widespread transmission began, 1992 as the Reference year, and 6500000 as the Number of Adult HIV infections as shown in **L5-9 (**on the next page**)**.

L5-9



10. We select OK to exit this data entry screen, and this opens the graphic screen which is the same as the one in the adult module (**L5-10)**. We will accept the default setting since this approximates the HIV epidemic curve for sub-Saharan Africa. Upon pressing <Enter>, the model begins to calculate annual pediatric AIDS cases and maternal AIDS orphans based on the values selected for the input parameters. These calculations take less than a minute in PCS with a math co-processor, but are much longer in PCS without a co-processor.

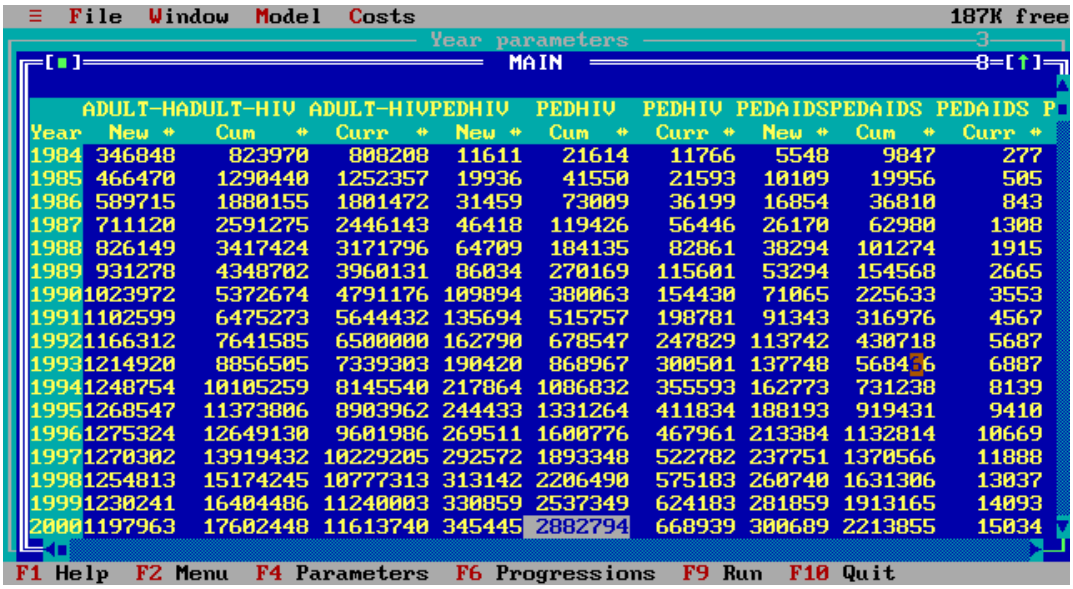
L5-10



11. The resultant output (**L5-11**) shows that by the year 2000, over 17 million cumulative HIV

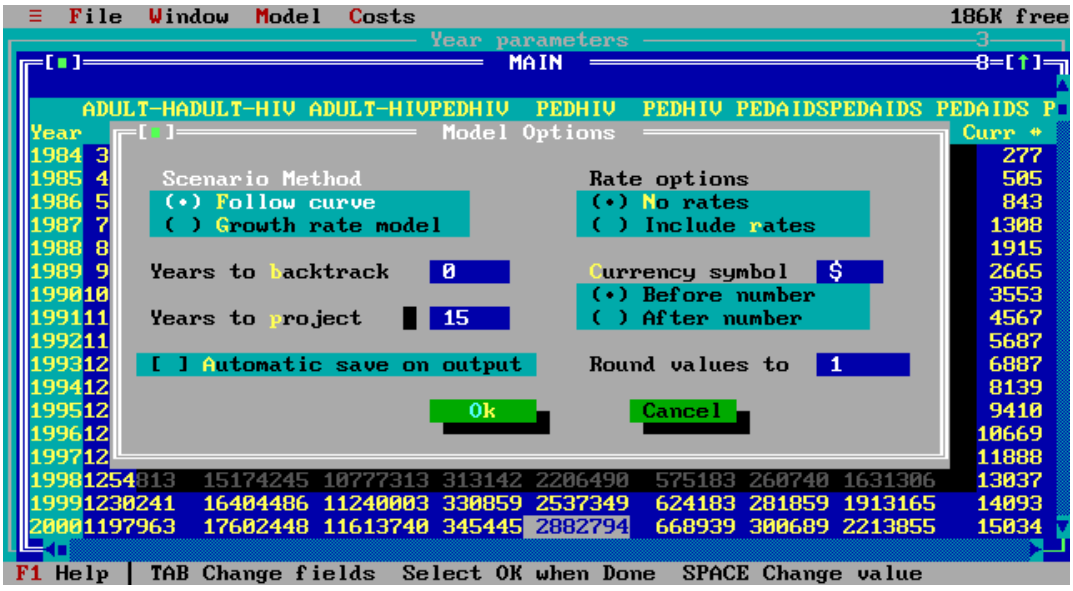
infections will have occurred in adults, and over 2.8 million perinatally acquired HIV infections will have occurred in children born to HIV-infected women in sub-Saharan Africa. (NOTE: These estimates and projections have not been adjusted for pediatric deaths from other causes.)

L5-11



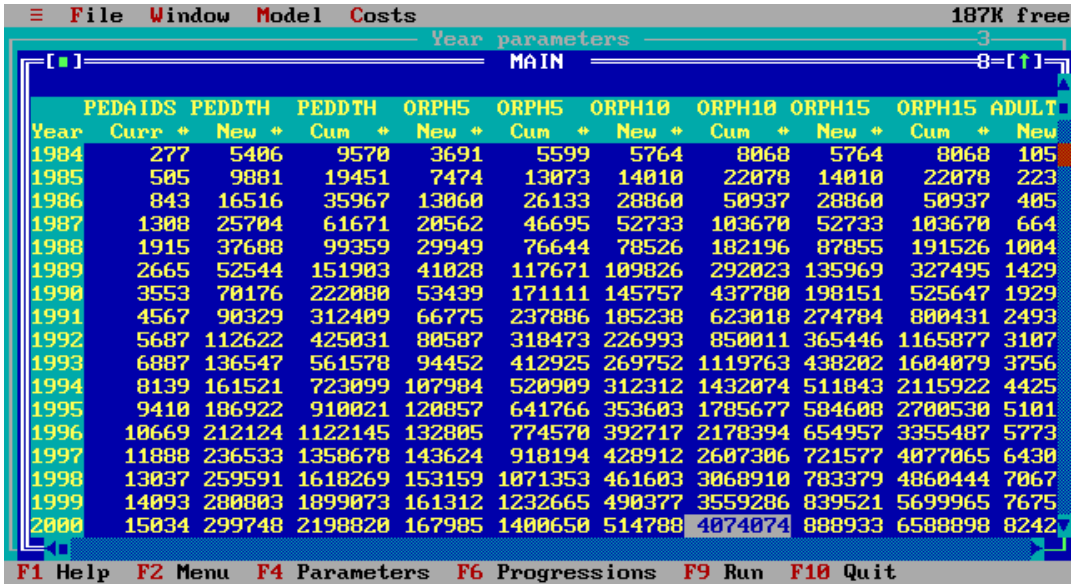
Before we review the output columns for maternal AIDS orphans, we should first see the default values for the number of years we want the model to project back from the starting year of extensive HIV spread and the number of years we want to project forward from the reference year. To do this, we need to access the Model menu to select Options to open the Model Options dialog box (**L5-12**). The default values are 0 Years to backtrack and 15 Years to project. Exit from this dialog box without making any changes at this time by selecting OK.

L5-12



12. Scroll the output screen to the right to visualize the additional columns for pediatric AIDS and maternal AIDS orphans (**L5-13**). In the year 2000, over 500,000 children, under the age of 10 years will, during the year, become maternal AIDS orphans. The cumulative total of children who will have been orphaned by their mothers' death when they were less than 10 years old by the year 2000 is over 4 million. (NOTE: These estimates and projections of maternal AIDS orphans have also not been adjusted for infant and child mortality which are prevalent in sub-Saharan Africa.)

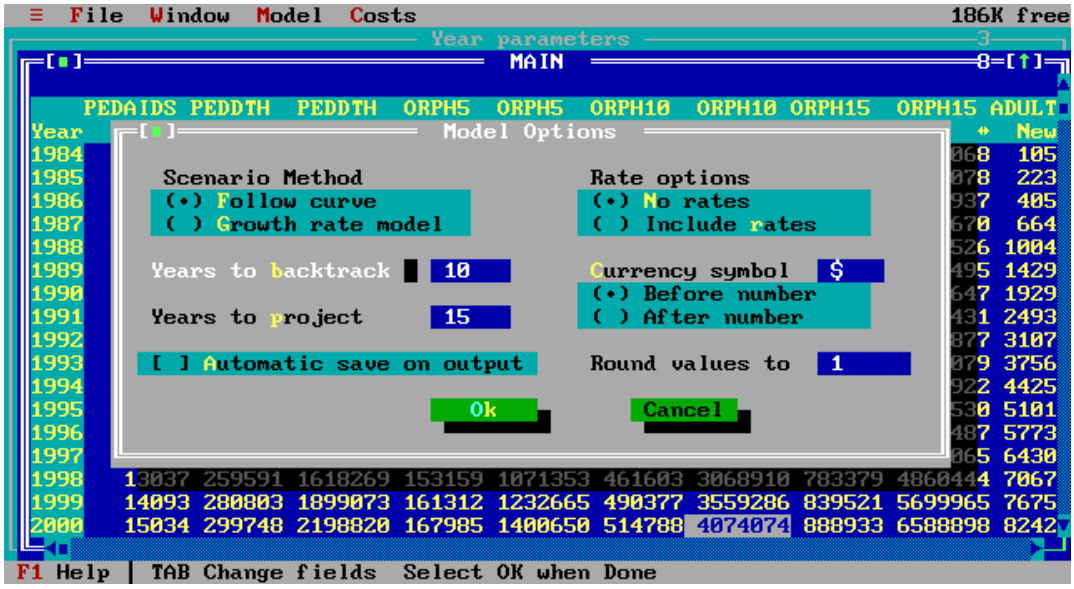
L5-13



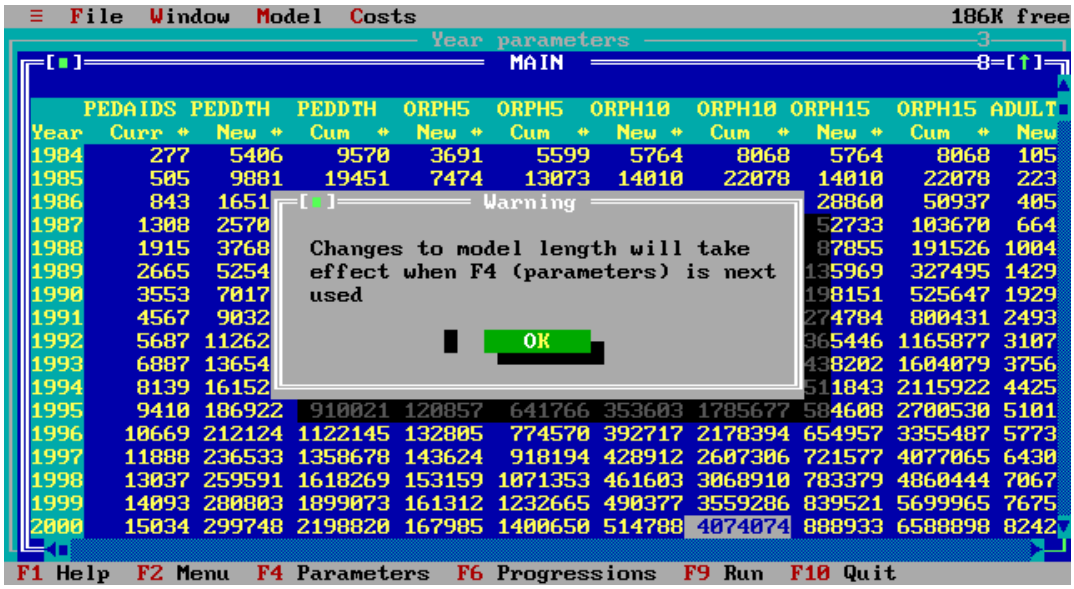
Year	PEDAIDS Curr	PEDDTH New	PEDDTH Cum	ORPH5 New	ORPH5 Cum	ORPH10 New	ORPH10 Cum	ORPH15 New	ORPH15 Cum	ADULT New
1984	277	5406	9570	3691	5599	5764	8068	5764	8068	105
1985	505	9881	19451	7474	13073	14010	22078	14010	22078	223
1986	843	16516	35967	13060	26133	28860	50937	28860	50937	405
1987	1308	25704	61671	20562	46695	52733	103670	52733	103670	664
1988	1915	37688	99359	29949	76644	78526	182196	87855	191526	1004
1989	2665	52544	151903	41028	117671	109826	292023	135969	327495	1429
1990	3553	70176	222080	53439	171111	145757	437780	198151	525647	1929
1991	4567	90329	312409	66775	237886	185238	623018	274784	800431	2493
1992	5687	112622	425031	80587	318473	226993	850011	365446	1165877	3107
1993	6887	136547	561578	94452	412925	269752	1119763	438202	1604079	3756
1994	8139	161521	723099	107984	520909	312312	1432074	511843	2115922	4425
1995	9410	186922	910021	120857	641766	353603	1785677	584608	2700530	5101
1996	10669	212124	1122145	132805	774570	392717	2178394	654957	3355487	5773
1997	11888	236533	1358678	143624	918194	428912	2607306	721577	4077065	6430
1998	13037	259591	1618269	153159	1071353	461603	3068910	783379	4860444	7067
1999	14093	280803	1899073	161312	1232665	490377	3559286	839521	5699965	7675
2000	15034	299748	2198820	167985	1400650	514788	4074074	888933	6588898	8242

13. Since many women who were infected in 1978 already had children in prior years, the model needs to calculate the number and ages of children who were born to HIV-infected women before 1978 in order to calculate the age of these children when their mothers will die as a result of AIDS. To do this, we need to access the Model menu to select Options to open the Model Options dialog box again. This time we will move the cursor to the Years to backtrack box and enter 10 for the number of years we want to backtrack (**L5-14**). Upon exiting this box by selecting OK, a warning box appears to inform us that the Changes to model length will take effect when F4 (parameters) is next used (**L5-15**). This means that we have to rerun the model starting from the Main Parameters data entry screen. This is done by pressing the <F4> key or by clicking the mouse on F4 Parameters at the bottom of the screen. We will make no changes in the data entry screen or the graphic screen and when we exit from the graphics screen, the model will recalculate back to 1968. Screens **L5-14** and **L5-15** are on the next page.

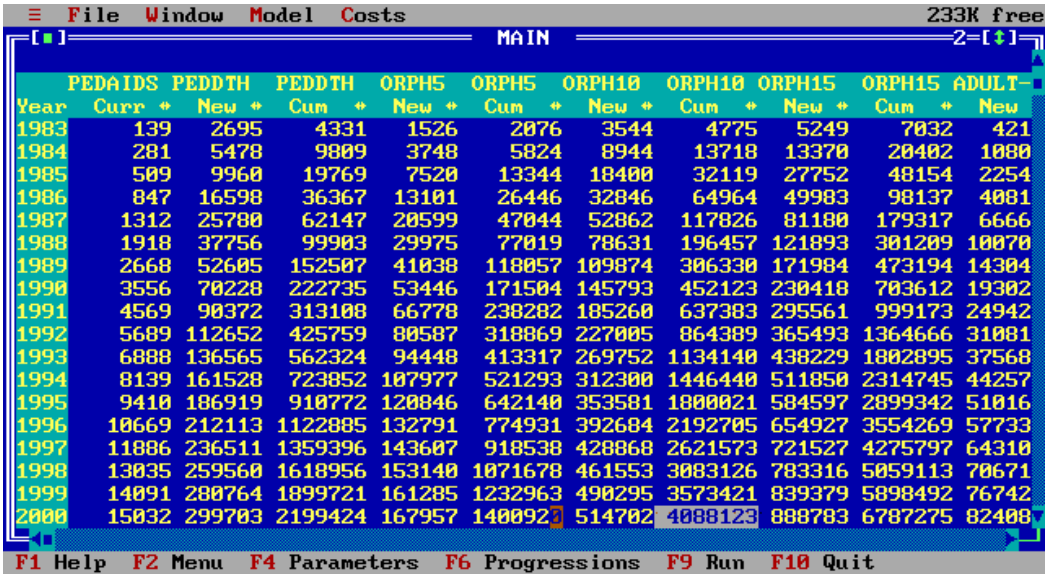
L5-14



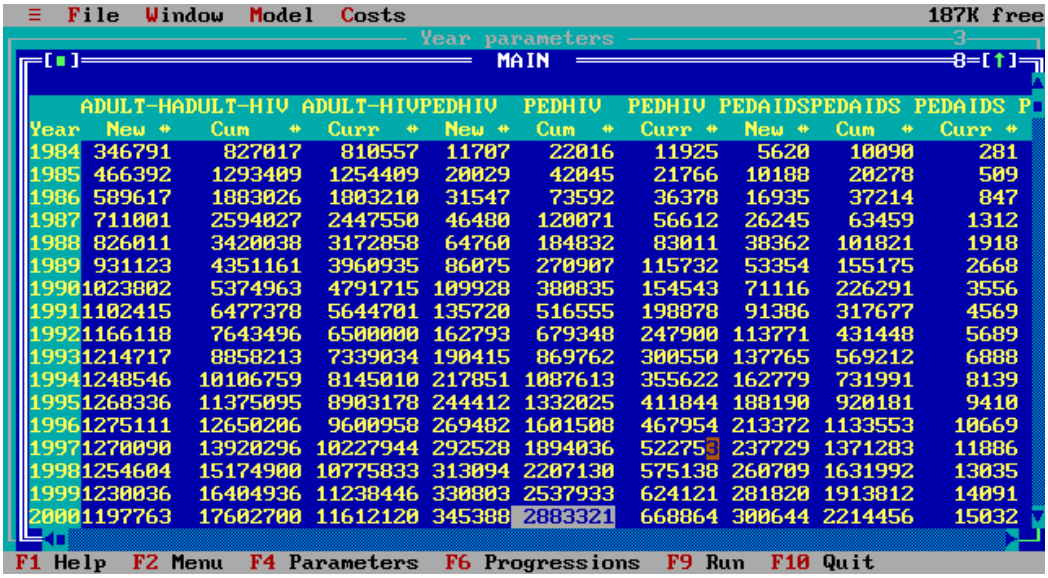
L5-15



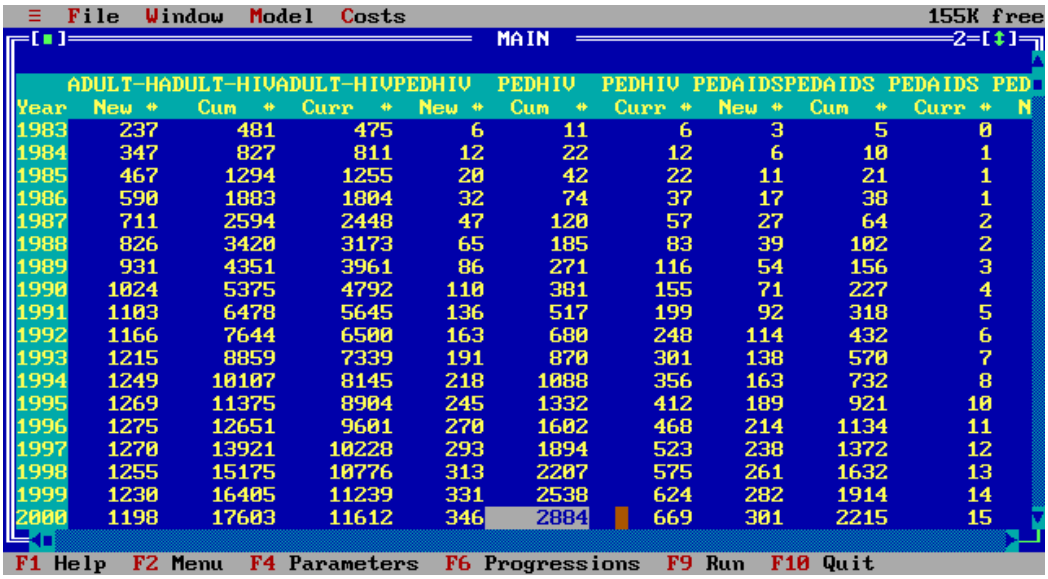
14. The resultant output columns now are slightly different compared to the model run which did not backtrack (**L5-16**). Note that the number of new maternal AIDS orphans under the age of 10 years in the year 2000 is almost identical to the number in the non-backtrack model run, but that the cumulative number of maternal orphans in the year 2000 who will be less than 10 years old when their mothers die of AIDS is about 14,000 more than in the non-backtrack run (**L5-16**). Scroll the output screen to the left and note that the cumulative number of HIV infected children in the year 2000 is about the same as in the non-backtrack run (**L5-17**). The last screen (**L5-18**) shows the output columns of the CHILD module when the output values are rounded off by 1000. This feature, plus the costing module can all be used in the CHILD module to calculate the health and social welfare costs of pediatric AIDS and maternal AIDS orphans. Screens **L5-16** to **18** are shown on the next page.



Year	PEDAIDS Curr	PEDDTH New	PEDDTH Cum	ORPH5 New	ORPH5 Cum	ORPH10 New	ORPH10 Cum	ORPH15 New	ORPH15 Cum	ADULT- New
1983	139	2695	4331	1526	2076	3544	4775	5249	7032	421
1984	281	5478	9809	3748	5824	8944	13718	13370	20402	1080
1985	509	9960	19769	7520	13344	18400	32119	27752	48154	2254
1986	847	16598	36367	13101	26446	32846	64964	49983	98137	4081
1987	1312	25780	62147	20599	47044	52862	117826	81180	179317	6666
1988	1918	37756	99903	29975	77019	78631	196457	121893	301209	10070
1989	2668	52605	152507	41038	118057	109874	306330	171984	473194	14304
1990	3556	70228	222735	53446	171504	145793	452123	230418	703612	19302
1991	4569	90372	313108	66778	238282	185260	637383	295561	999173	24942
1992	5689	112652	425759	80587	318869	227005	864389	365493	1364666	31081
1993	6888	136565	562324	94448	413317	269752	1134140	438229	1802895	37568
1994	8139	161528	723852	107977	521293	312300	1446440	511850	2314745	44257
1995	9410	186919	910772	120846	642140	353581	1800021	584597	2899342	51016
1996	10669	212113	1122885	132791	774931	392684	2192705	654927	3554269	57733
1997	11886	236511	1359396	143607	918538	428868	2621573	721527	4275797	64310
1998	13035	259560	1618956	153140	1071678	461553	3083126	783316	5059113	70671
1999	14091	280764	1899721	161285	1232963	490295	3573421	839379	5898492	76742
2000	15032	299703	2199424	167957	140092[3]	514702	4088123	888783	6787275	82408



Year	ADULT-H New	ADULT-HIV Cum	ADULT-HIV Curr	PEDHIV New	PEDHIV Cum	PEDHIV Curr	PEDAIDS New	PEDAIDS Cum	PEDAIDS Curr
1984	346791	827017	810557	11707	22016	11925	5620	10090	281
1985	466392	1293409	1254409	20029	42045	21766	10188	20278	509
1986	589617	1883026	1803210	31547	73592	36378	16935	37214	847
1987	711001	2594027	2447550	46480	120071	56612	26245	63459	1312
1988	826011	3420038	3172858	64760	184832	83011	38362	101821	1918
1989	931123	4351161	3960935	86075	270907	115732	53354	155175	2668
1990	1023802	5374963	4791715	109928	380835	154543	71116	226291	3556
1991	1102415	6477378	5644701	135720	516555	198878	91386	317677	4569
1992	1166118	7643496	6500000	162793	679348	247900	113771	431448	5689
1993	1214717	8858213	7339034	190415	869762	300550	137765	569212	6888
1994	1248546	10106759	8145010	217851	1087613	355622	162779	731991	8139
1995	1268336	11375095	8903178	244412	1332025	411844	188190	920181	9410
1996	1275111	12650206	9600958	269482	1601508	467954	213372	1133553	10669
1997	1270090	13920296	10227944	292528	1894036	522753	237729	1371283	11886
1998	1254604	15174900	10775833	313094	2207130	575138	260709	1631992	13035
1999	1230036	16404936	11238446	330803	2537933	624121	281820	1913812	14091
2000	1197763	17602700	11612120	345388	2883321	668864	300644	2214456	15032



Year	ADULT-H New	ADULT-HIV Cum	ADULT-HIV Curr	PEDHIV New	PEDHIV Cum	PEDHIV Curr	PEDAIDS New	PEDAIDS Cum	PEDAIDS Curr	PED N
1983	237	481	475	6	11	6	3	5	0	
1984	347	827	811	12	22	12	6	10	1	
1985	467	1294	1255	20	42	22	11	21	1	
1986	590	1883	1804	32	74	37	17	38	1	
1987	711	2594	2448	47	120	57	27	64	2	
1988	826	3420	3173	65	185	83	39	102	2	
1989	931	4351	3961	86	271	116	54	156	3	
1990	1024	5375	4792	110	381	155	71	227	4	
1991	1103	6478	5645	136	517	199	92	318	5	
1992	1166	7644	6500	163	680	248	114	432	6	
1993	1215	8859	7339	191	870	301	138	570	7	
1994	1249	10107	8145	218	1088	356	163	732	8	
1995	1269	11375	8904	245	1332	412	189	921	10	
1996	1275	12651	9601	270	1602	468	214	1134	11	
1997	1270	13921	10228	293	1894	523	238	1372	12	
1998	1255	15175	10776	313	2207	575	261	1632	13	
1999	1230	16405	11239	331	2538	624	282	1914	14	
2000	1198	17603	11612	346	2884	669	301	2215	15	

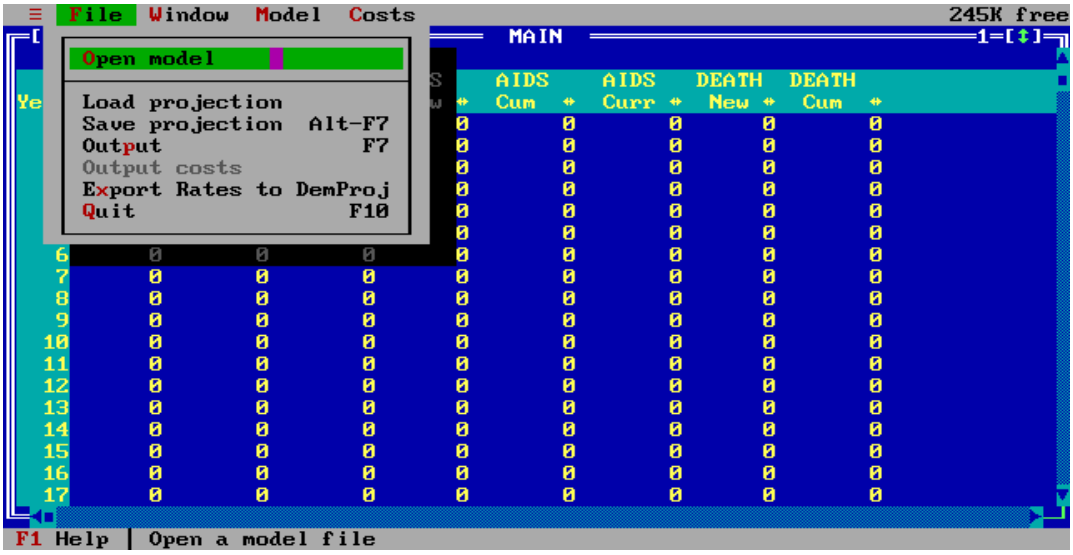
LESSON 5A. Using the MF (Male/Female) CHILD Module

Introduction

EPIMODEL was initially developed to estimate and project adult HIV-related disease (AIDS) and deaths in sub-Saharan Africa. The default adult death rate from the development of AIDS to death that is used in EPIMODEL is very short (averaging about 6 months). This short survival period is believed to be reasonable for most African scenarios, but needs to be increased if EPIMODEL is used to model adult AIDS deaths in developed countries. The initial CHILD module of EPIMODEL was also designed with African default values for age-specific fertility rates, and an equal male:female HIV infection ratio. An earlier revision of EPIMODEL (V2), made alternative age-specific fertility rates from major geographic regions available for rapid change of this model parameter. However, it remained very difficult for the CHILD module of EPIMODEL to accurately model pediatric AIDS and maternal AIDS orphans in populations where the male:female ratio of HIV infection was not equal and was changing over time. The MFCHILD module was designed to replace the CHILD module and to facilitate the modeling of pediatric HIV/AIDS and maternal AIDS orphans in non-African populations.

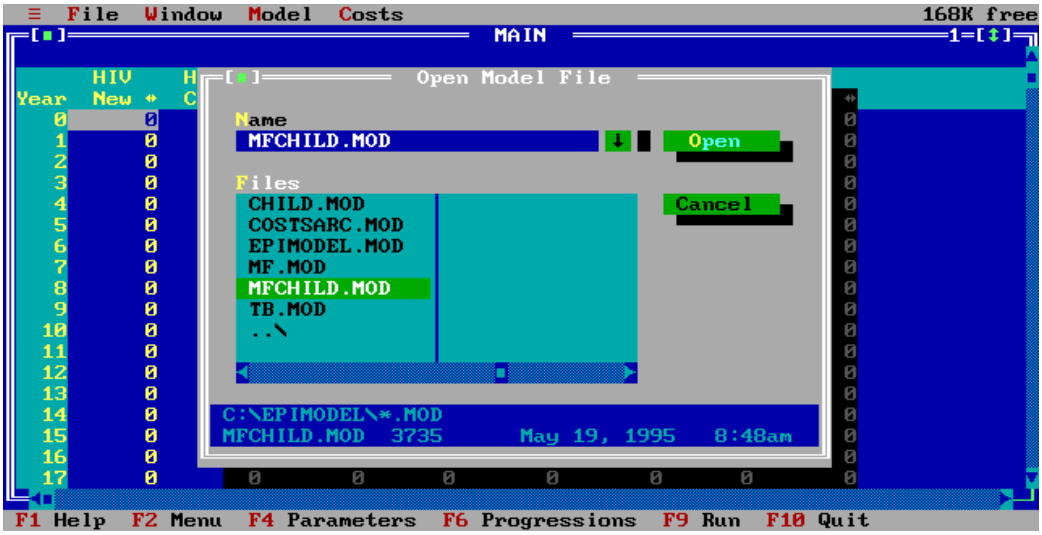
1. To open the MFCHILD module, we need to be in the MAIN output screen from which we open the File menu by pressing the <Alt plus F> keys, or by clicking the mouse on File at the upper left corner of the screen. The cursor bar will be on the Open model option, and we select this option by pressing <Enter> or by clicking the mouse on this first option (**L5A-1**).

L5A-1



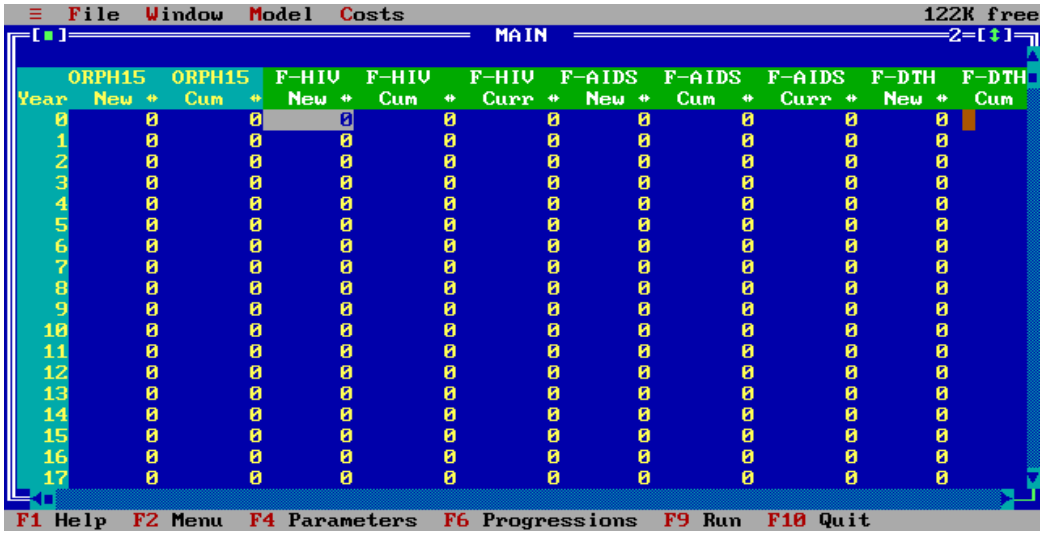
2. This opens the Open Model File dialog box. In the Open Model file dialog box, press the <Tab> key to reach the Files box; move the cursor to MFCHILD.MOD and then press <Enter> or click the mouse on MFCHILD.MOD to select this module. This will result in MFCHILD.MOD showing in the Name box at the top of this dialog box. Open MFCHILD.MOD by moving the cursor with the <Tab> key to the Open box and then press <Enter> or click the mouse on the Open box (**L5A-2**, shown on the next page).

L5A-2



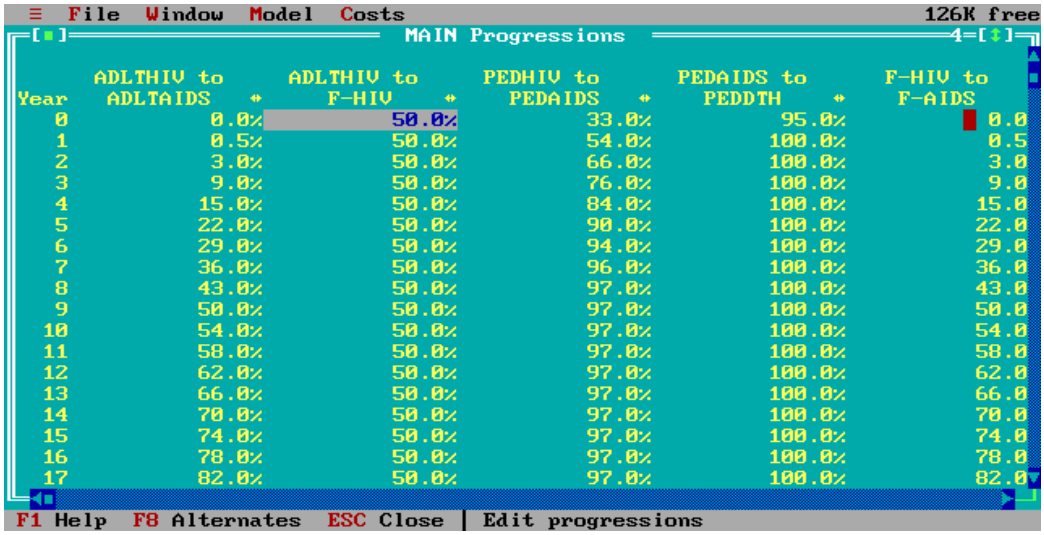
3. The Main output screen of the MFCHILD module has additional output columns showing new, cumulative and prevalent annual totals for HIV infection, AIDS, and death in females. These output columns can be seen when you scroll the screen to the right and they appear after the output columns for ORPH15 (**L5A-3**).

L5A-3



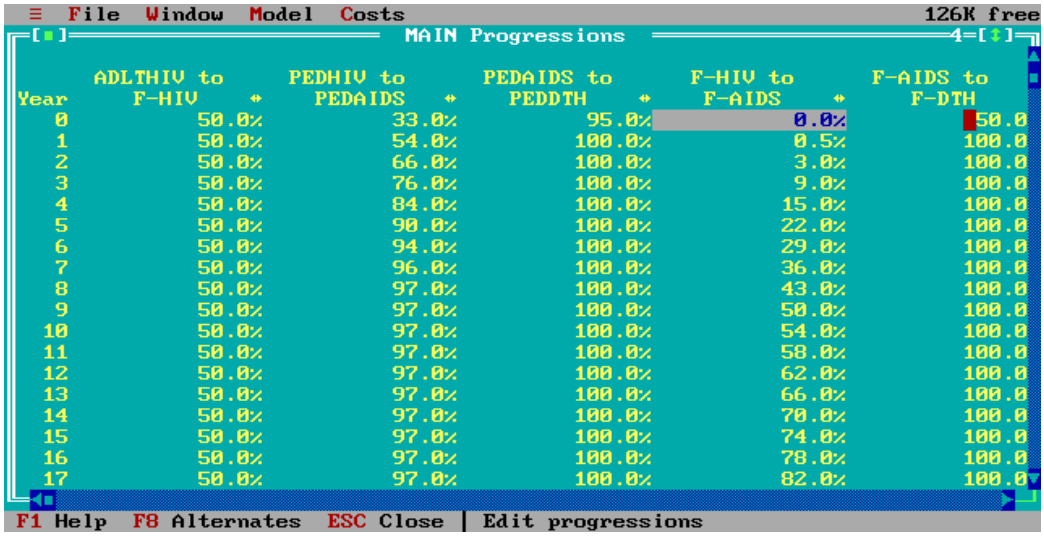
4. To review the major difference between the MFCHILD module and the CHILD module, press the <F6> key or click the mouse on F6 Progressions on the bottom line of the screen. This will open up the Main Progressions window (**L5A-4,** shown on the next page). Note the second column (ADLTHIV to F-HIV) has 50.0% in all of the (Year) rows. This means that the male:female HIV infection ratio is equal for all years. In the MFCHILD module, the male:female HIV ratio can be changed in this window for any year. For now, we will keep the default settings at 50.0%.

L5A-4



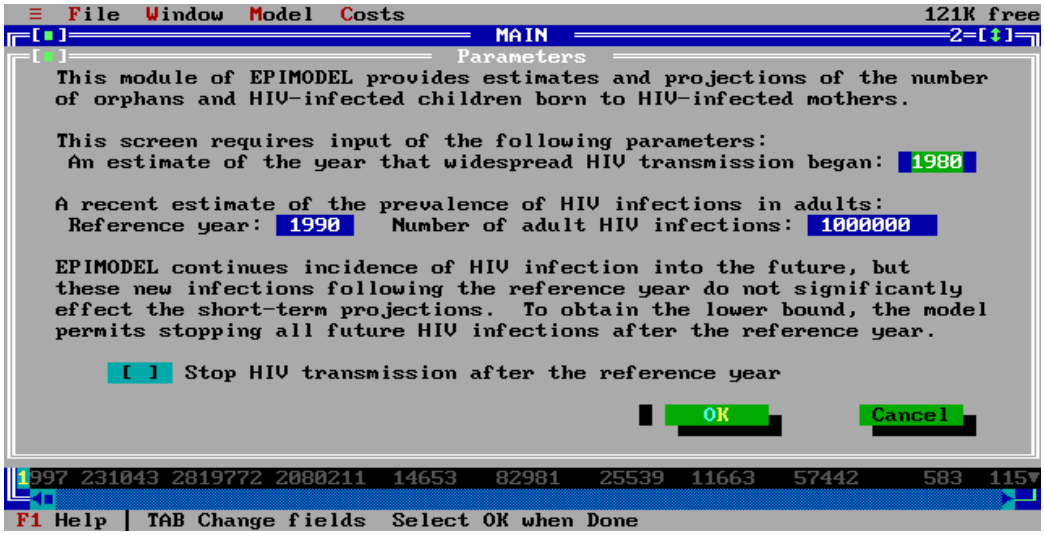
5. In addition to being able to specify the male:female HIV infection ratio for each year of the HIV epidemic, the MFCHILD module also permits you to change the annual progression rate from HIV infection to AIDS, and from AIDS to death for females. Scroll the Main Progression window to the right and two additional columns will appear (F-HIV to F-AIDS and F-AIDS to F-DTH) that have these default values (specifically the progression from AIDS to death) set for an African scenario (**L5A-5**). We will not change these default settings now.

L5A-5



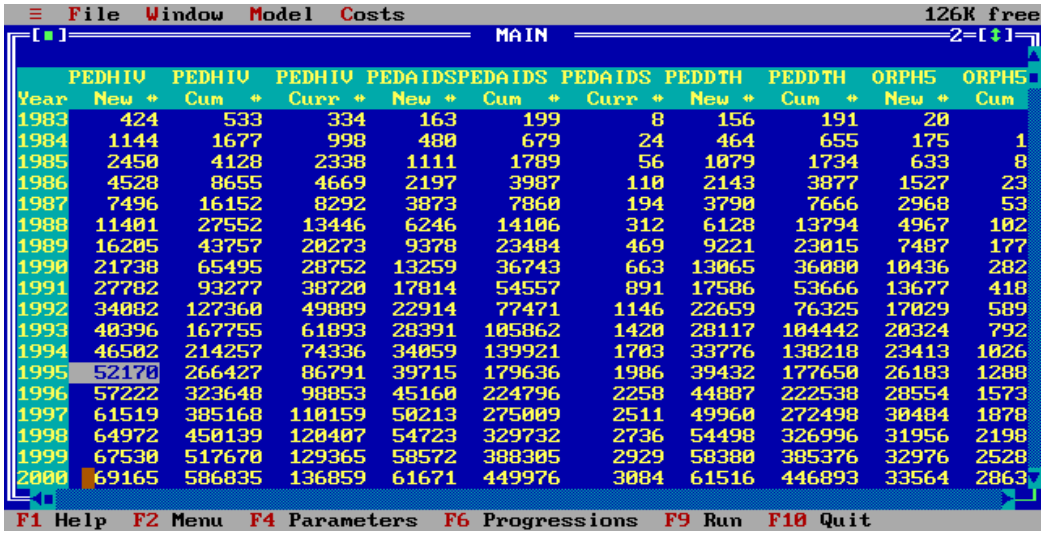
6. To fully illustrate the MFCHILD module, we will use a consistent HIV scenario where the HIV epidemic started in 1980 and by 1990 the prevalence of adult HIV infection was one million (**L5A-6**, shown on the next page). We will also assume that the HIV epidemic is about several years from its peak occurrence (position 249 on the gamma 5 curve).

L5A-6



7. This HIV scenario, with the African default settings results in over 52,000 new pediatric HIV infections in 1995 and in the year 2000, close to 70,000 (**L5A-7**).

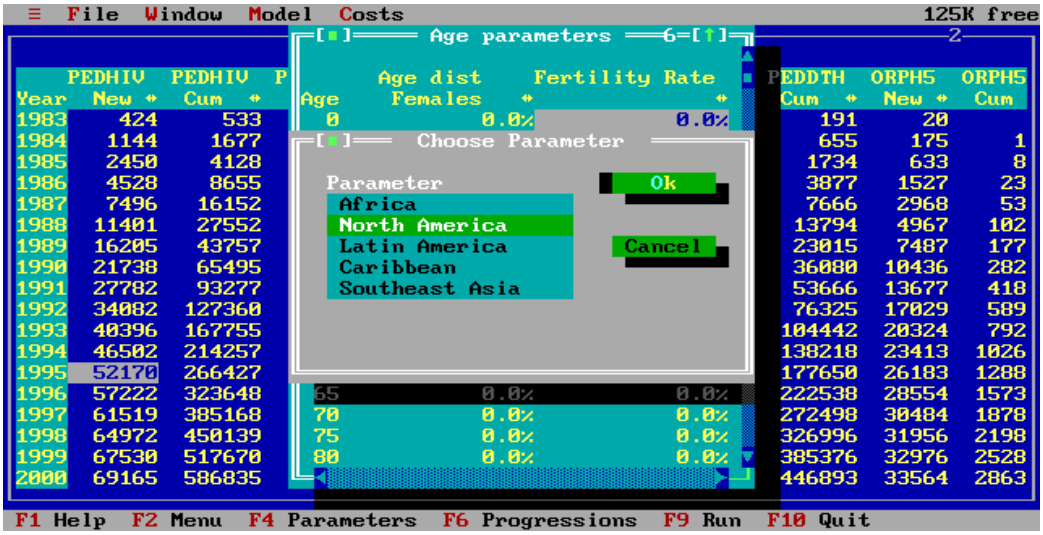
L5A-7



Year	PEDHIV New	PEDHIV Cum	PEDHIV Curr	PEDAIDS New	PEDAIDS Cum	PEDAIDS Curr	PEDDTH New	PEDDTH Cum	ORPHS New	ORPHS Cum
1983	424	533	334	163	199	8	156	191	20	
1984	1144	1677	998	480	679	24	464	655	175	1
1985	2450	4128	2338	1111	1789	56	1079	1734	633	8
1986	4528	8655	4669	2197	3987	110	2143	3877	1527	23
1987	7496	16152	8292	3873	7860	194	3790	7666	2968	53
1988	11401	27552	13446	6246	14106	312	6128	13794	4967	102
1989	16205	43757	20273	9378	23484	469	9221	23015	7487	177
1990	21738	65495	28752	13259	36743	663	13065	36080	10436	282
1991	27782	93277	38720	17814	54557	891	17586	53666	13677	418
1992	34082	127360	49889	22914	77471	1146	22659	76325	17029	589
1993	40396	167755	61893	28391	105862	1420	28117	104442	20324	792
1994	46502	214257	74336	34059	139921	1703	33776	138218	23413	1026
1995	52170	266427	86791	39715	179636	1986	39432	177650	26183	1288
1996	57222	323648	98853	45160	224796	2258	44887	222538	28554	1573
1997	61519	385168	110159	50213	275009	2511	49960	272498	30484	1878
1998	64972	450139	120407	54723	329732	2736	54498	326996	31956	2198
1999	67530	517670	129365	58572	388305	2929	58380	385376	32976	2528
2000	69165	586835	136859	61671	449976	3084	61516	446893	33564	2863

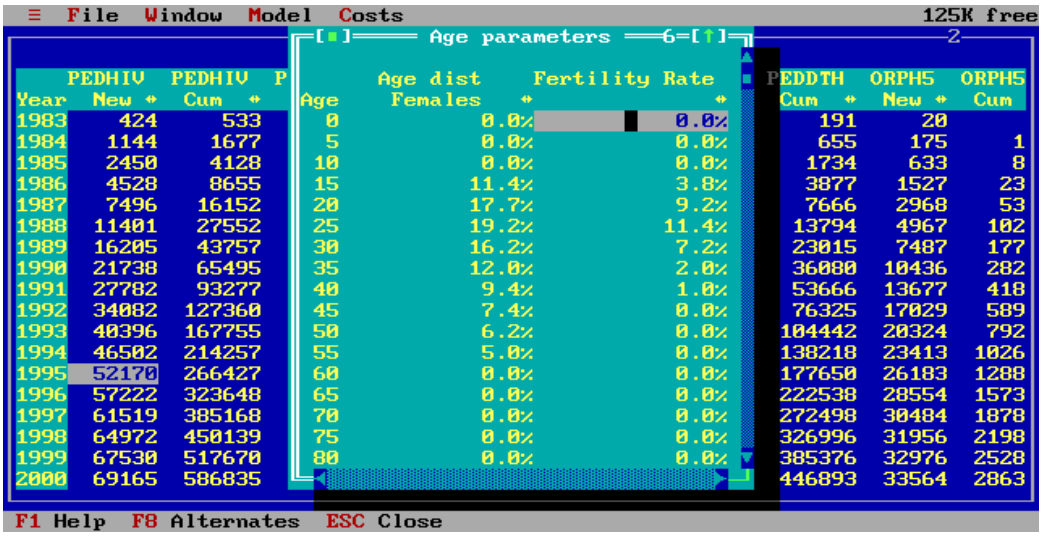
8. Now we will change the African age-specific fertility rates used in the prior run to North American rates. We do this by I) pressing the <Alt plus M> keys or by clicking the mouse on Model at the top of the output screen; ii) selecting and opening the Age parameter option in the Model option dialog box; iii) moving the cursor bar to the Fertility Rate column in the Age parameter dialog box; iv) access alternative age-specific fertility rates by either pressing the <F8> key or by clicking the mouse on F8 Alternates at the bottom line of the screen; v) this opens up the Choose Parameter dialog box (**L5A-8**, shown on the next page); move the cursor bar to North America; and select this option by moving to the OK box and press <Enter> or click the mouse on the OK box.

L5A-8



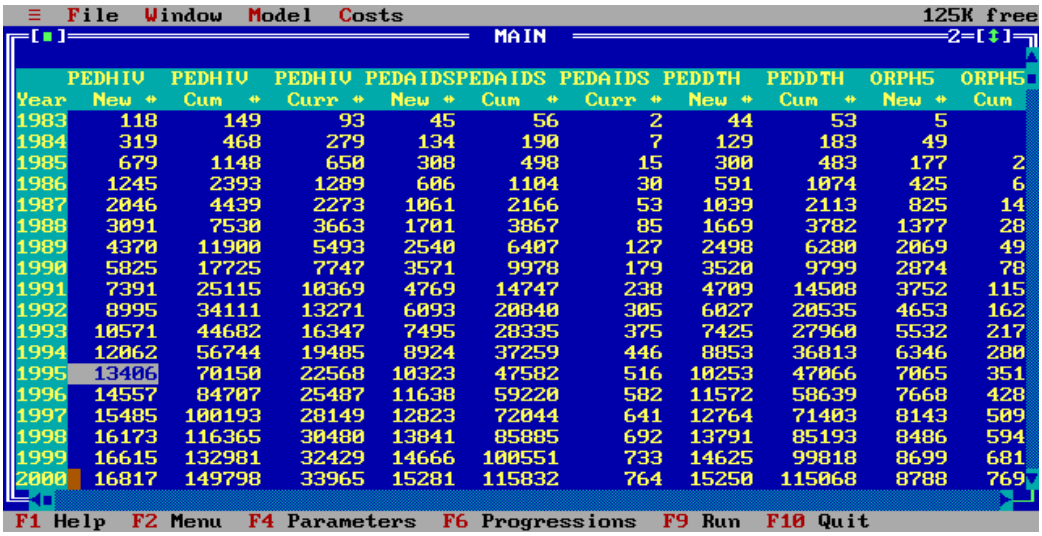
9. After accepting the North American age-specific fertility rates, the Age parameter dialog box will then show these new age-specific fertility rates (**L5A-9**). Note that they are much lower than the default African rates.

L5A-9



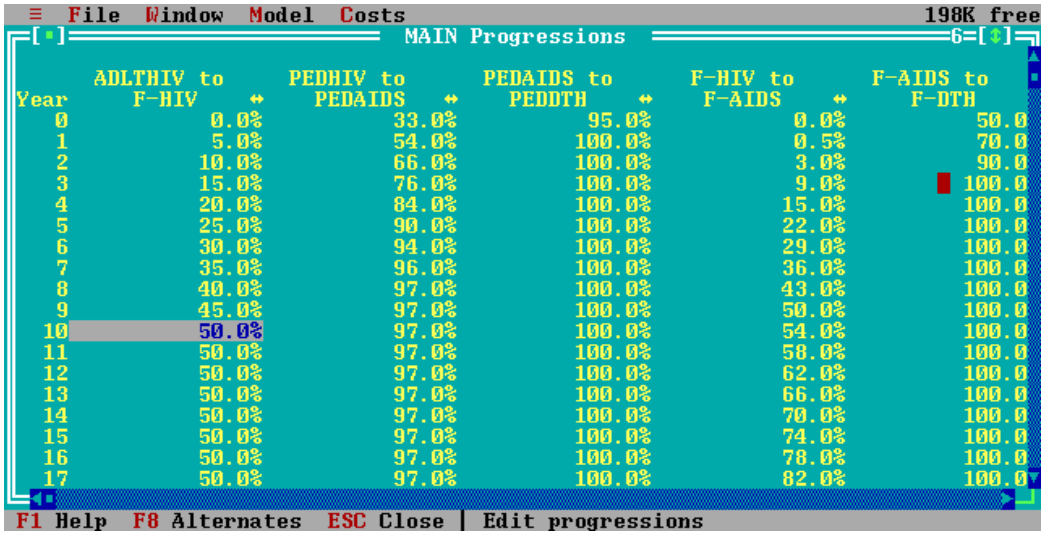
10 By pressing the <Esc> key or by clicking the mouse on Esc Close at the bottom of the screen, EPIMODEL will recalculate its output (**L5A-10**, shown on the next page) based on the revised parameter, i.e., changing the age-specific fertility rates from African to North American. Note that in 1995, the annual number of new perinatal HIV infections is only about one quarter of the previous total.

L5A-10



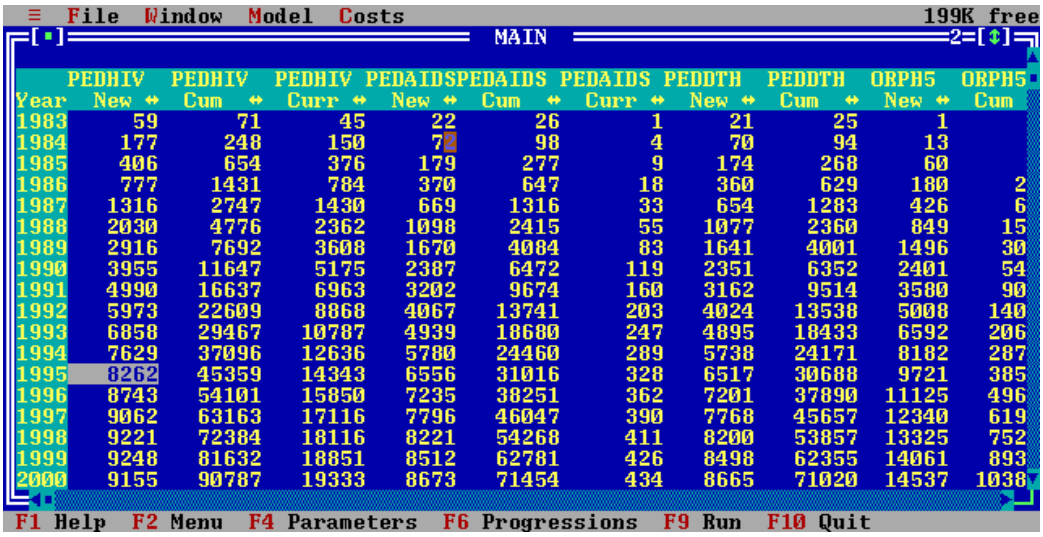
11 We will now change the annual male:female HIV infection ratio by pressing the <F6> key or by clicking the mouse on F6 Progressions at the bottom line of the output screen. We will have no female HIV infections in year 0, and then steadily increase the annual percent of female HIV infections by 5% per year until year 10 when it reaches 50.0%. We will increase the annual survival rate from AIDS to death for females from 100.0% by the first year to 100.0% by the end of the 3rd year (**L5A-11**). Finally, we will reduce the perinatal HIV transmission rate to 20.0%

L5A-11



12 Close the Main Progression window (press the <Esc> key or click the mouse on Esc Close at the bottom line of the screen), and EPIMODEL will recalculate its output with the revised annual male:female HIV infection ratios, the increased survival period from the development of AIDS to death, and the reduced perinatal transmission rate (**L5A-12**, shown on the next page).

L5A-12



Year	PEDHIV New	PEDHIV Cum	PEDHIV Curr	PEDAIDS New	PEDAIDS Cum	PEDAIDS Curr	PEDDTH New	PEDDTH Cum	ORPH5 New	ORPH5 Cum
1983	59	71	45	22	26	1	21	25	1	
1984	177	248	150	7	98	4	70	94	13	
1985	406	654	376	179	277	9	174	268	60	
1986	777	1431	784	370	647	18	360	629	180	2
1987	1316	2747	1430	669	1316	33	654	1283	426	6
1988	2030	4776	2362	1098	2415	55	1077	2360	849	15
1989	2916	7692	3608	1670	4084	83	1641	4001	1496	30
1990	3955	11647	5175	2387	6472	119	2351	6352	2401	54
1991	4990	16637	6963	3202	9674	160	3162	9514	3580	90
1992	5973	22609	8868	4067	13741	203	4024	13538	5008	140
1993	6858	29467	10787	4939	18680	247	4895	18433	6592	206
1994	7629	37096	12636	5780	24460	289	5738	24171	8182	287
1995	8262	45359	14343	6556	31016	328	6517	30688	9721	385
1996	8743	54101	15850	7235	38251	362	7201	37890	11125	496
1997	9062	63163	17116	7796	46047	390	7768	45657	12340	619
1998	9221	72384	18116	8221	54268	411	8200	53857	13325	752
1999	9248	81632	18851	8512	62781	426	8498	62355	14061	893
2000	9155	90787	19333	8673	71454	434	8665	71020	14537	1038

Note that the annual number of new perinatal HIV infections are further reduced from the pervious run, but only by about 40%. The reason for this is that the annual number of total new adult HIV infections during the first 10 years of the HIV epidemic (especially in the first few years) were relatively small. The model input parameter that has the largest impact on the number of perinatal HIV infections and maternal AIDS orphans is the age-specific fertility rate.

LESSON 6. The Tuberculosis (TB) Module[6]

Introduction

Tuberculosis is a bacterial disease that continues to be a major public health problem throughout the world, especially in developing countries. Initial infection (i.e., primary infection) with *Mycobacterium tuberculosis* (*Mtbc*), is primarily via airborne dissemination from persons with pulmonary or laryngeal tuberculosis, and usually goes undetected. Early lung lesions commonly heal, leaving no residual changes except occasional pulmonary or tracheobronchial lymph node calcifications. About 5% of patients will rapidly progress to active pulmonary disease (TB) within the first year after primary infection (early progressive disease), and another 5% will progress to active infection and disease over the remainder of their lives (reactivation disease). WHO**?**s Tuberculosis Programme has estimated that about 1.7 billion persons (i.e., one-third of the total world population) were infected with *Mtbc* in 1990. About 95% of the annual global TB morbidity (8 million) and more than 98% of the annual TB mortality (2.9 million) occur in developing countries. In the developing world, even before the HIV pandemic, TB caused close to 20% of adult deaths and about a quarter of preventable adult deaths.

HIV attacks the cellular immune system. Those human pathogens that are normally controlled by this major part of the human immune system are most commonly seen in "HIV disease": viruses, fungi, parasites and mycobacteria. A number of these "opportunistic" infections are caused by reactivation of existing infections that were acquired much earlier in life. Others reflect those pathogens that exist in the "community" environment and yet others may be rare and characteristic only amongst the immunosuppressed. Potential interactions between HIV and other infectious disease agents have caused great medical and public health concern. A major significant interaction that accounts for the largest number of HIV-related disease is with *Mycobacterium tuberculosis* (*Mtbc*) infection. Persons with latent *Mtbc* infection and who are also infected with HIV develop clinical tuberculosis (TB) at an increased rate. Clinical studies have shown that dually infected persons develop clinical TB (pulmonary or disseminated) when their CD^4 cell counts are moderately depressed (about $350/mm^3$). This contrasts with *Pneumocystis carinii* pneumonia which usually occurs in HIV-infected persons with less than 200 CD^4/mm^3. There are no data to indicate that any infections, including *Mtbc* infections, accelerate the progression to the development of AIDS in HIV-infected persons.

The background prevalence rate of infection with *Mtbc* varies from a low of less than 1% among young and middle-aged white adults in North America to close to 50% among young and middle-aged adults in Central Africa. Since the mid-1980s, reported TB incidence in most sub-Saharan African countries has more than doubled as a result of the HIV epidemic in that region. As of 1995, over 7 million adults worldwide are estimated to be dually infected with HIV and *Mtbc* - the vast majority in sub-Saharan Africa, South and Southeast Asia.

EPIMODEL and the Modeling of TB Cases Related to HIV Infection

EPIMODEL is a simple epidemiologically based software program. It was originally designed to estimate past, current, and short-term (3 to 5 years) projections of adult AIDS cases. The model was designed to derive estimates and projections of the number of AIDS cases and deaths to assist in the development of plans and policies for health and social welfare systems for populations where the reporting of AIDS cases is incomplete and inaccurate and where reliable data on behavioral and biological variables are also lacking.

The basic module of EPIMODEL uses epidemiologically derived estimates of HIV prevalence and distributes this prevalence by annual HIV-infected cohorts back to the start of the HIV epidemic along a theoretical epidemic curve. EPIMODEL then applies annual progression

rates from HIV infection to the development of AIDS to each of the annual HIV cohorts to calculate annual numbers of adult AIDS cases and deaths. The TB module of EPIMODEL provides estimates of the annual number of clinical tuberculosis (TB) cases related to HIV infections. The following assumptions are used:

1. Persons with *Mtbc* infection and who subsequently acquire an HIV infection have an increased rate of developing TB.

2. The clinical stage of HIV infection or the degree of immunodeficiency due to HIV directly increases the development of TB in those persons with dual infections.

3. There is no increase in the annual progression rate from HIV infection to the development of AIDS in those persons with dual infections.

4. Persons with HIV infection, but no pre-existing *Mtbc* infection have an annual risk of contracting a *Mtbc* infection similar to the annual risk present in the general population.

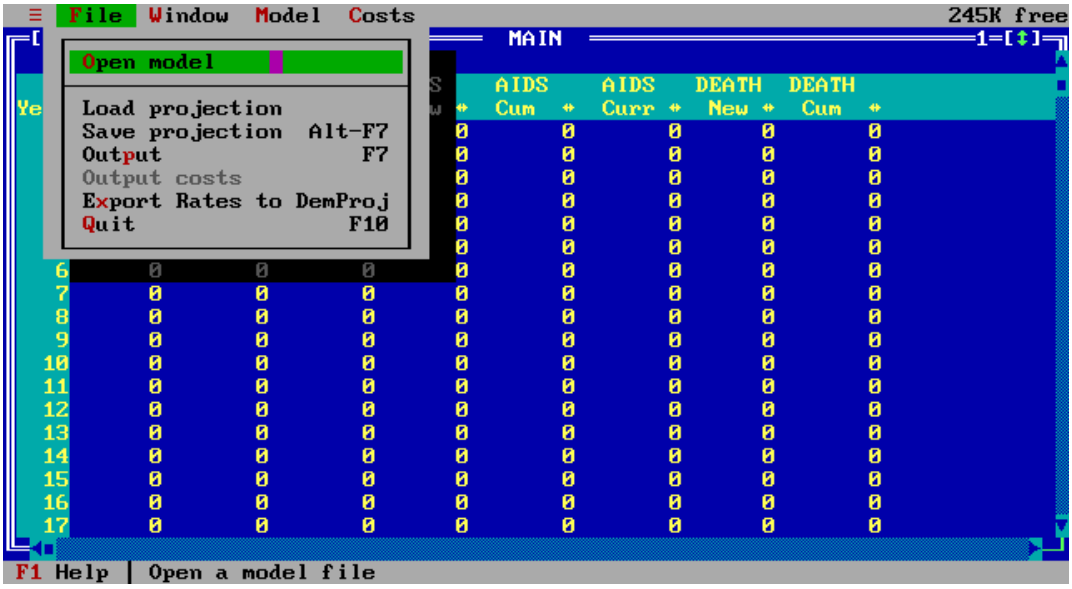
5. Persons with HIV infection and who subsequently acquire a *Mtbc* infection also have a greater risk of developing TB. This increased risk is directly proportional to the stage of their HIV infection at the time of acquiring their *Mtbc* infection.

EPIMODEL divides the estimated annual cohort of adult HIV infections into two separate groups - those with *Mtbc* infection (*Mtbc*/HIV) and those without *Mtbc* infection. These two groups are then modeled separately. Each group is progressed to AIDS with rates that can be easily changed. Increased rates for the development of TB can be applied to the *Mtbc*/HIV group to estimate the increased number of TB as a result of HIV infection. The *Mtbc* uninfected group has a constant annual risk of acquiring a *Mtbc* infection. If they acquire a *Mtbc* infection, EPIMODEL estimates the clinical stage of HIV infection at the time of their *Mtbc* infection and assigns a specific increased risk of their developing TB. There have been sufficient HIV-infected cohort studies to estimate progression rates from HIV infection to the development of AIDS to enable EPIMODEL to model or calculate annual and cumulative AIDS cases. Data from which the probable increased rates for the development of TB related to HIV infection are not generally available and will initially have to be arbitrarily set to begin the modeling process.

Running the TB Module

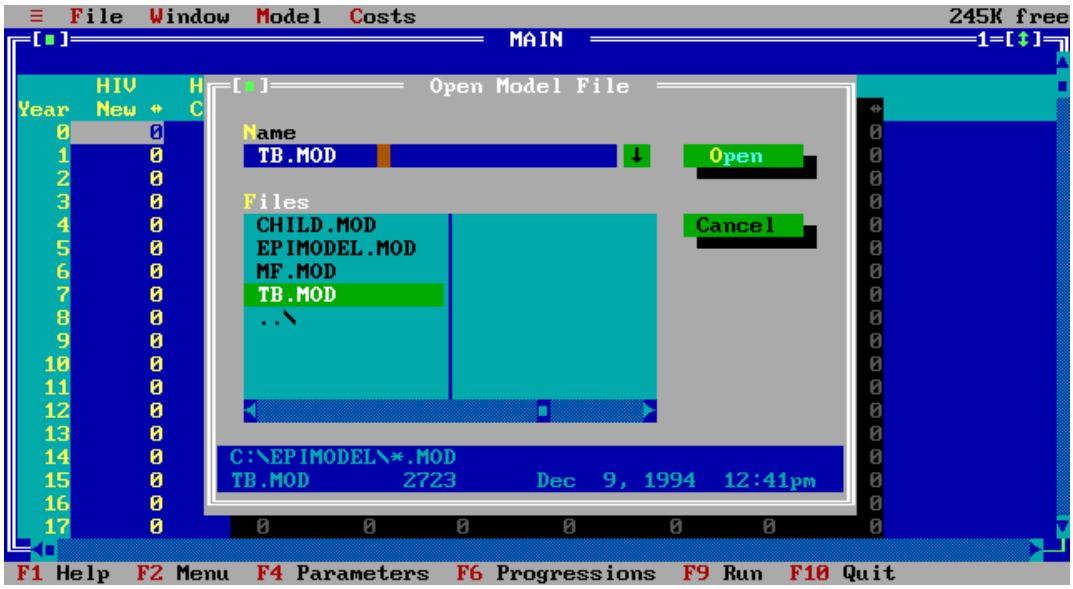
1. To open the TB module, we need to be in the MAIN output screen from which we open the File menu by pressing the <Alt plus F> keys or by clicking the mouse on File at the upper left corner of the screen. The cursor bar will be on the Open model option, and we select this option by pressing <Enter> or by clicking the mouse on this first option (**L6-1**).

L6-1



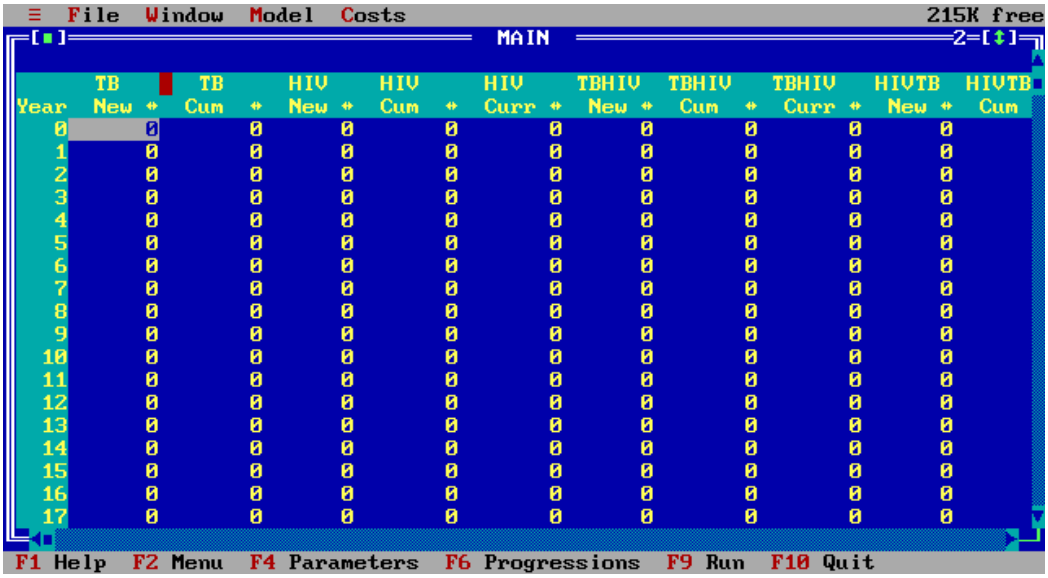
This opens the Open Model File dialog box. We need to press the <Tab> key to the Files box, and then with the cursor bar on TB.MOD we press <Enter> or click the mouse on TB.MOD to select this module. This will result in TB.MOD showing in the Name box at the top of this dialog box (**L6-2**).

L6-2



2. We now open TB.MOD by moving the cursor with the <Tab> key to the Open box and then pressing <Enter> or by clicking the mouse on the Open box. This gets us to the Main output screen of the TB module which has two additional output columns - New (annual) TB and Cum (cumulative) TB (**L6-3**).

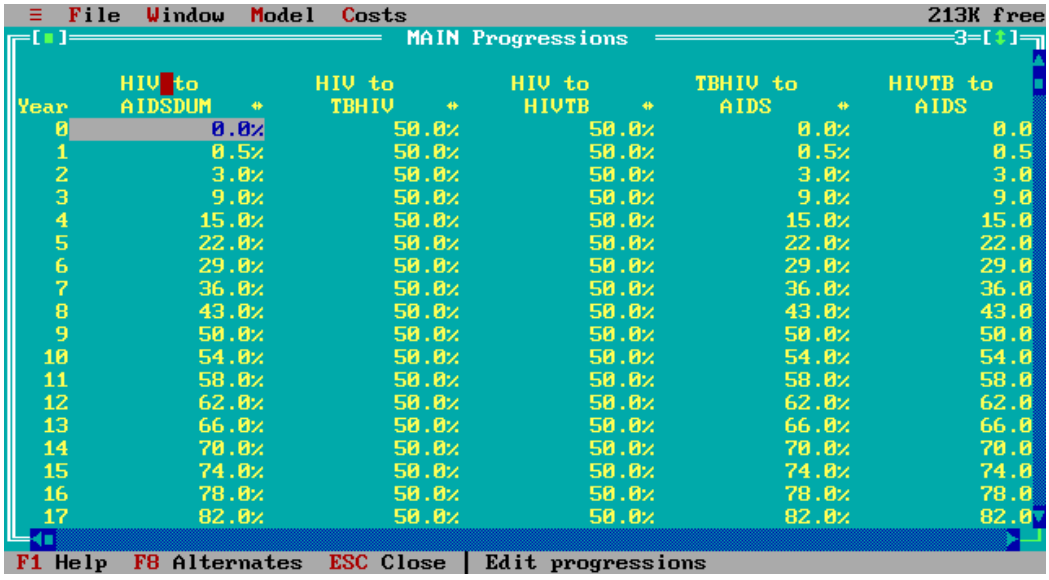
L6-3



Year	TB New	TB Cum	HIV New	HIV Cum	HIV Curr	TBHIV New	TBHIV Cum	TBHIV Curr	HIVTB New	HIVTB Cum
0	0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	
2	0	0	0	0	0	0	0	0	0	
3	0	0	0	0	0	0	0	0	0	
4	0	0	0	0	0	0	0	0	0	
5	0	0	0	0	0	0	0	0	0	
6	0	0	0	0	0	0	0	0	0	
7	0	0	0	0	0	0	0	0	0	
8	0	0	0	0	0	0	0	0	0	
9	0	0	0	0	0	0	0	0	0	
10	0	0	0	0	0	0	0	0	0	
11	0	0	0	0	0	0	0	0	0	
12	0	0	0	0	0	0	0	0	0	
13	0	0	0	0	0	0	0	0	0	
14	0	0	0	0	0	0	0	0	0	
15	0	0	0	0	0	0	0	0	0	
16	0	0	0	0	0	0	0	0	0	
17	0	0	0	0	0	0	0	0	0	

3. We next need to become familiar with the additional parameters and the default values used in the TB module. A total of ten parameters can be accessed by pressing the <F6> key or by clicking the mouse on F6 Progressions at the bottom line of the screen. This opens up the MAIN Progressions screen. Table T1 on page 4a shows all of these parameters. The first three columns in this screen are shown in **L6-4**:

L6-4



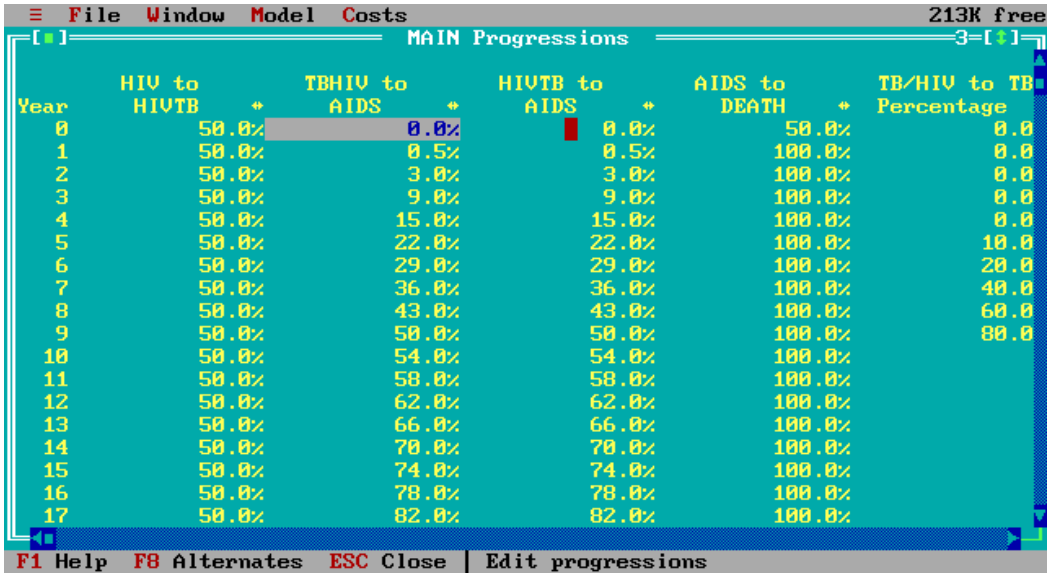
Year	HIV to AIDSDUM	HIV to TBHIV	HIV to HIVTB	TBHIV to AIDS	HIVTB to AIDS
0	0.0%	50.0%	50.0%	0.0%	0.0
1	0.5%	50.0%	50.0%	0.5%	0.5
2	3.0%	50.0%	50.0%	3.0%	3.0
3	9.0%	50.0%	50.0%	9.0%	9.0
4	15.0%	50.0%	50.0%	15.0%	15.0
5	22.0%	50.0%	50.0%	22.0%	22.0
6	29.0%	50.0%	50.0%	29.0%	29.0
7	36.0%	50.0%	50.0%	36.0%	36.0
8	43.0%	50.0%	50.0%	43.0%	43.0
9	50.0%	50.0%	50.0%	50.0%	50.0
10	54.0%	50.0%	50.0%	54.0%	54.0
11	58.0%	50.0%	50.0%	58.0%	58.0
12	62.0%	50.0%	50.0%	62.0%	62.0
13	66.0%	50.0%	50.0%	66.0%	66.0
14	70.0%	50.0%	50.0%	70.0%	70.0
15	74.0%	50.0%	50.0%	74.0%	74.0
16	78.0%	50.0%	50.0%	78.0%	78.0
17	82.0%	50.0%	50.0%	82.0%	82.0

(1) HIV to AIDSDUM - the default annual progression rate from HIV infection to the development of AIDS (median of 10 years);
(2) HIV to TBHIV - the percent of the adult population who have a pre-existing *Mtbc* infection (the default value is 50%); and
(3) HIV to HIVTB - the percent of the adult population who do not have a *Mtbc* infection (the default value is 50%).

NOTE: The total percentage for columns 2 and 3 should be set so that they always sum to 100% since if 50% of HIV-infected persons have a pre-existing *Mtbc* infection, then the remainder of HIV-infected persons (50%) do not have a pre-existing *Mtbc* infection. If data indicates that 30% of the adult population are infected with *Mtbc*, then 30% should be entered for column 2 and 70% for column 3. Frequently it is desirable to rapidly change all of the values in a column such as for columns 2 and 3. This can be accomplished by entering the number and pressing the <Ctrl plus D> keys (D for "down"). This will cause the number to be copied to each cell below the current cursor position. If the cursor is at the top of the column, this sets the entire column to be equal to the value at the top of the column.

4. Scroll the screen to the right by moving the cursor with the <right arrow> key or by clicking the mouse on the bottom bar to visualize the next three columns (**L6-5**):

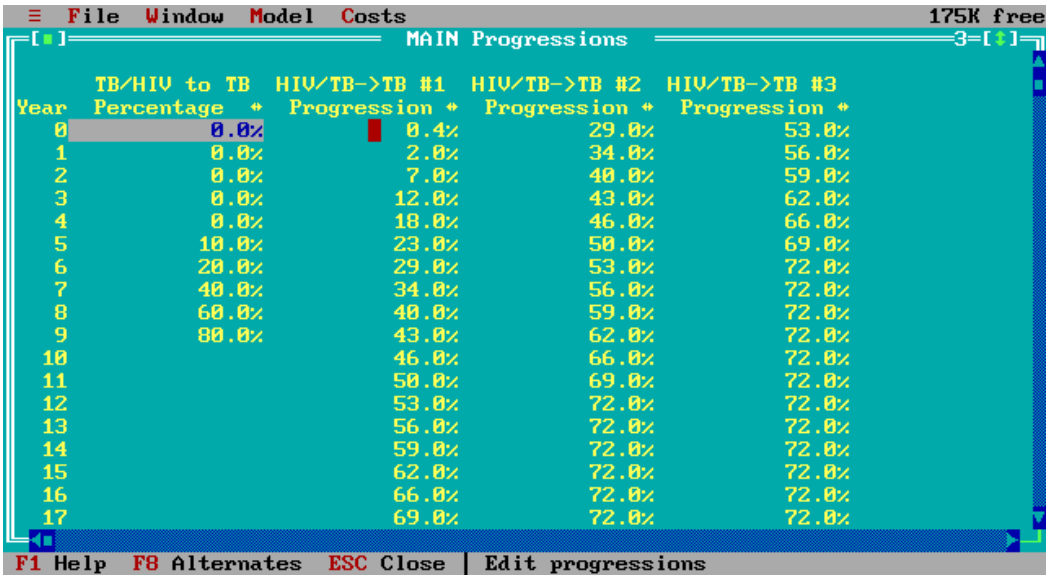
L6-5



(4) AIDS to DEATH - the annual mortality rate after the development of AIDS (the default rate is that used for sub-Saharan Africa with half (50%) of AIDS cases dying in the year that they developed and 100% of cases dying by the next year;
(5) TBHIV to AIDS - annual progression rates from HIV infection to the development of AIDS that are used for those HIV-infected adults who had a pre-existing *Mtbc* infection (the default rates used have a median of 10 years); and
(6) HIVTB to AIDS - annual progression rates from HIV infection to the development of AIDS that are used for those HIV-infected adults who did not have a *Mtbc* infection when they acquired their HIV infection, but who in subsequent years acquire a *Mtbc* infection (the default rates used have a median of 10 years).

5. Scroll the screen further to the right to visualize the last four columns (**L6-6**).

L6-6



(7) TB/HIV to TB (Percentage) - this column divides the total period from HIV infection to the development of AIDS into 10 equal parts and permits us to vary for each of these intervals the cumulative percent of TB that develops in those HIV-infected persons who had a pre-existing *Mtbc* infection. The default values are 0.0% for the first five percentiles, then 10% for the sixth percentile and increasing to 80% by the last or tenth percentile. These default values will result in 10% of HIV-infected persons developing clinical TB after the midpoint of their progression from HIV infection to AIDS and increasing to a cumulative percentage of 80% by the time they develop AIDS - i.e., for those HIV-infected persons who will develop AIDS in 10 years, 10% will develop TB in year 6, an additional 10% in year 7, and increasing to a cumulative percentage of 80% by year 10; for persons who will develop AIDS in 15 years, 10% will develop TB from year 7.5 to year 9 (6th percentile), and increasing to a cumulative percentage of 80% during the last (10th) percentile - years 13.5 to 15.

(8) HIV/TB ->TB #1 (Progression) - the annual rate of development of TB in those adults who first acquire a *Mtbc* infection during the "early" phase (first third) of their HIV infection period from infection to AIDS. The default values will result in about 80% of these dually infected persons developing clinical TB a couple of years before they develop AIDS;

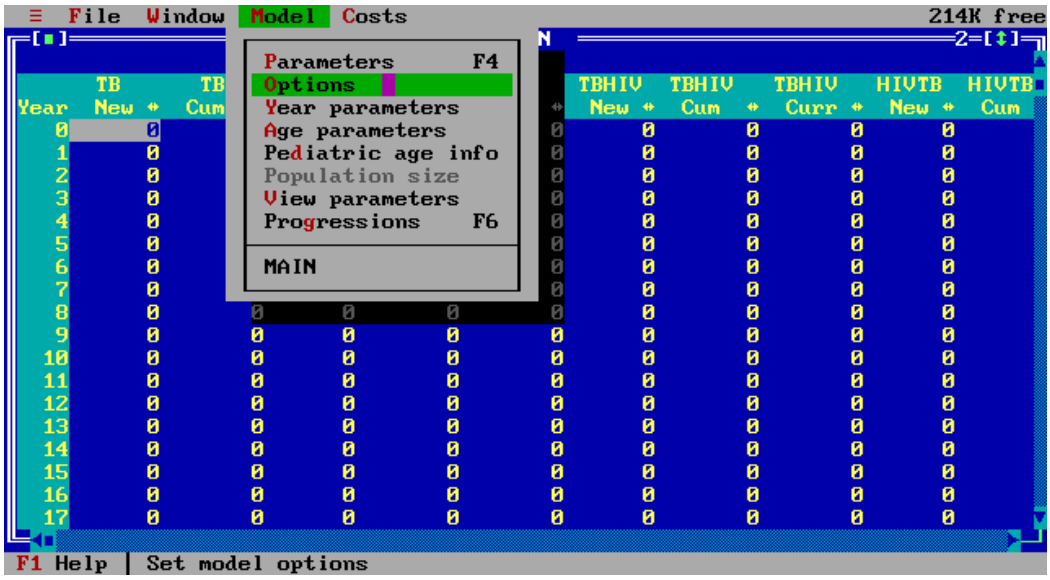
(9) HIV/TB ->TB #2 (Progression) - the annual rate of development of TB in those adults who acquire a *Mtbc* infection during the "middle" phase (second third) of their HIV infection period from infection to AIDS. The default values are set as in the previous column to result in about 80% of these dually infected persons developing clinical TB within a couple of years of developing AIDS; and

(10) HIV/TB ->TB #3 (Progression) - the annual rate of development of TB in those adults who acquire a *Mtbc* infection during the "last" phase (last third) of their HIV infection period from infection to AIDS. As with the previous two columns, the default values are set to result in about 80% of these dually infected persons develop TB within a couple of years of their developing AIDS. Press the <Esc> key to return to the Main output screen.

6. We are almost ready to begin modeling TB cases related to HIV infection in SSA. Before we

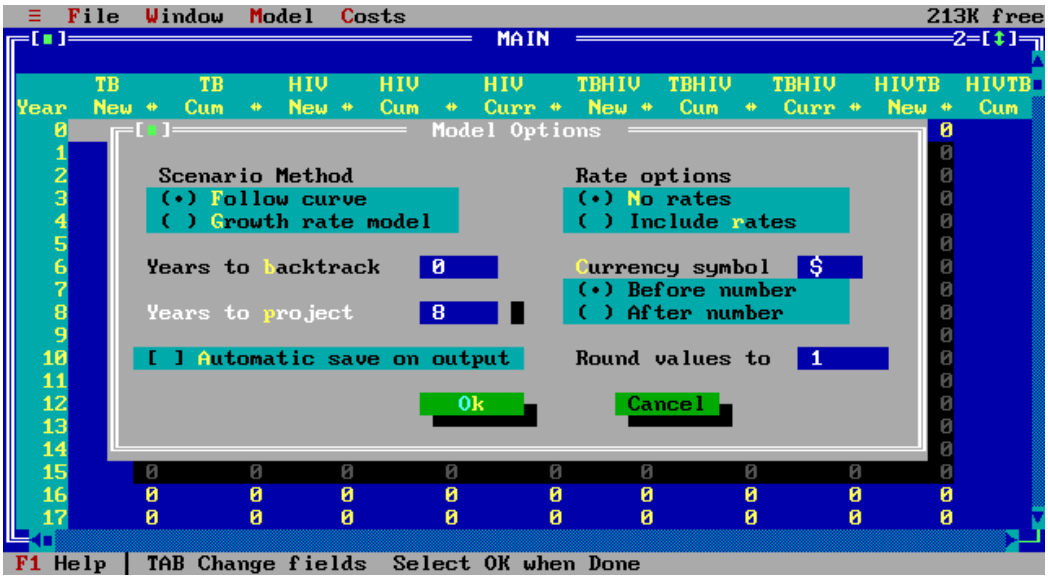
do, we need to access EPIMODEL's Option dialog box to specify the time period that we want to project. Press the <Alt plus M> keys or click the mouse on Model shown at the top line of the screen to open the Model drop down menu (**L6-7**).

L6-7



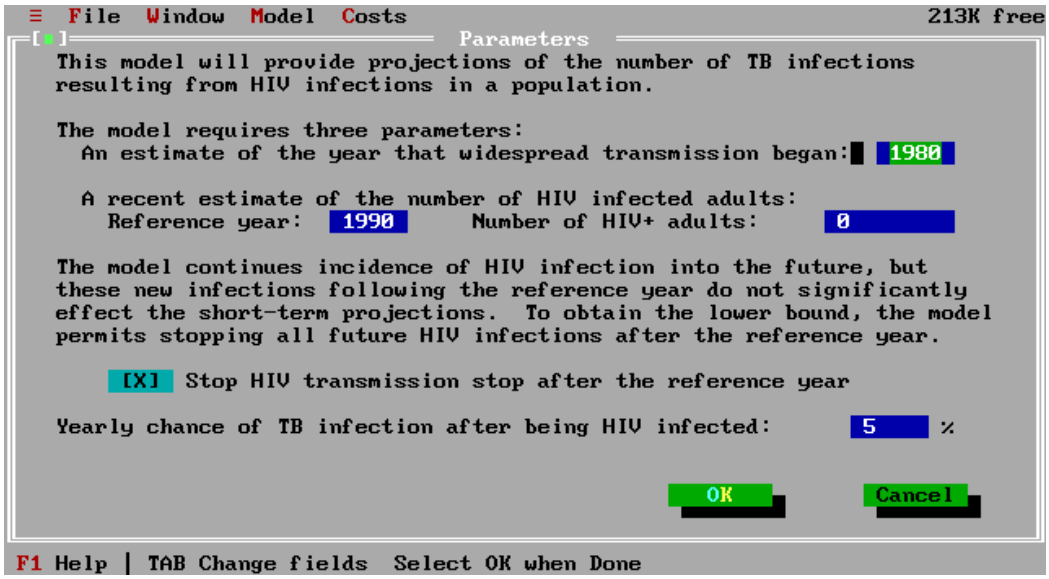
Eight choices are listed. For now, we will only access Options by moving the cursor down to Options with the down arrow key and then press <Enter> or click the mouse on Options to open the model options window. We will not change any of the default settings in this window now except the Years to project option that is near the bottom left of the options window. The default setting is 15 years. For this run we will change the default setting from 15 to 8 years - because the reference year for our test run will be 1992 and we want to project AIDS and TB cases to the year 2000. Move to this option by pressing the <Tab> or <Enter> keys or by clicking the mouse in this option box. Change the Years to project from 15 to 8 by first deleting the numerals in this box and then tying in 8 (**L6-8**).

L6-8



7. Now press the <F4> key or click the mouse on F4 at the bottom of the screen to access the Parameters entry screen (**L6-9**).

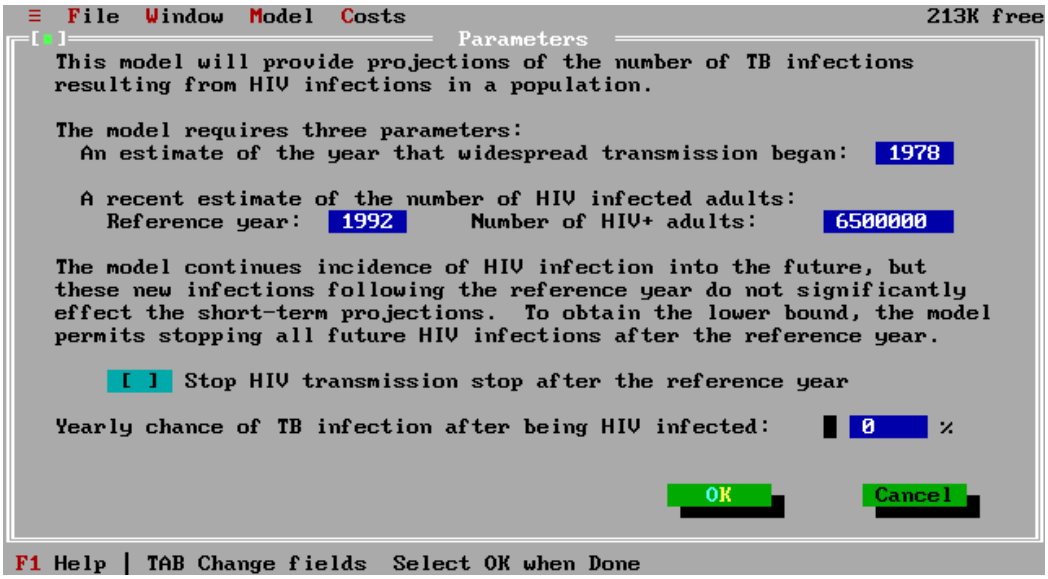
L6-9



This screen is self explanatory and we will enter the following values for the parameters requested. Box 1 - The default setting for An estimate of the year that widespread transmission began is 1980. To change the starting year for sub-Saharan Africa (SSA) to 1978, we type 1978 then press <Enter>. The cursor will then move to Box 2 where the default setting for the Reference year is 1990. The reference year is the year for which an HIV point prevalence is made. WHO estimated the 1992 HIV point prevalence in SSA was about 6.5 million. Thus, we will type 1992 in the Reference year Box and then press <Enter>. The cursor will then move to Box 3 that is blank - Number of HIV+ adults (for the reference year) - Type 6500000 then press <Enter>. The cursor will move to Box 4 that is an option box to Stop HIV transmission after the reference year (in this run - 1992). For this run, we will continue HIV transmission after 1992 by removing the X in Box 4 by pressing (toggling) the <Space> bar and then press <Enter>. The cursor will move to Box 5 - Yearly chance of TB infection after being HIV infected. The default setting is 5%. We will change this value to 0% for this run by typing 0 when the cursor is in this box and then pressing <Enter>.

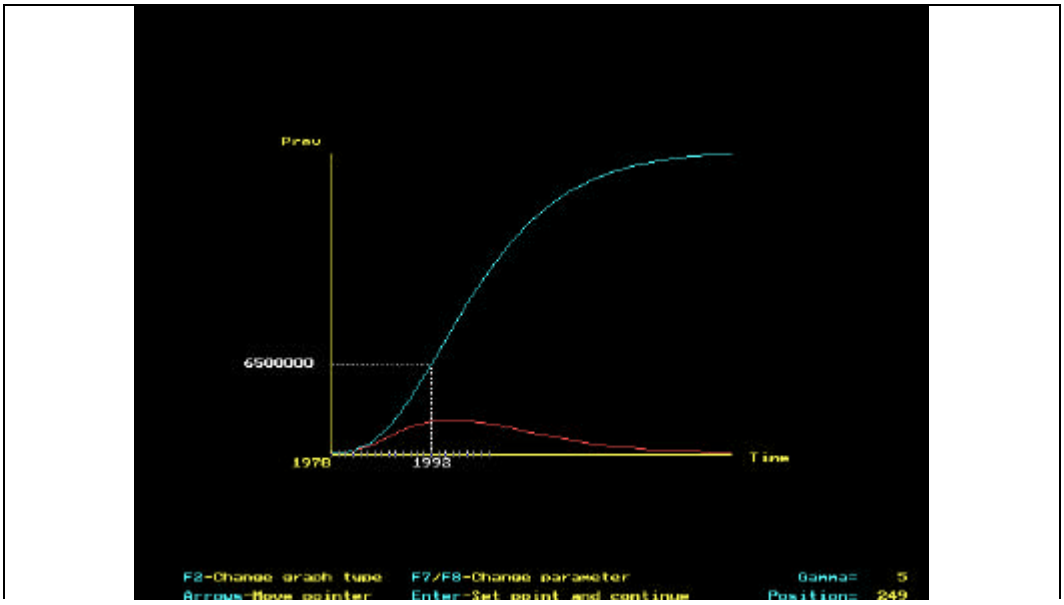
To accept all of the values entered in this screen (**L6-10**, shown on the next page) press <Enter> after moving the cursor to the OK box or click the mouse on the OK box.

L6-10



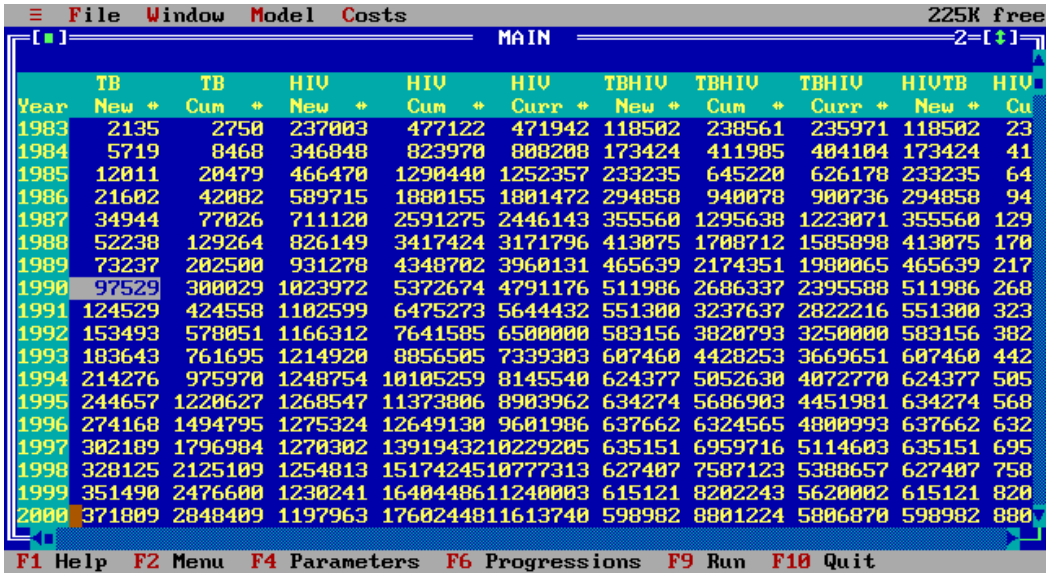
8. The next screen (**L6-11**) is a graphic presentation of the input HIV parameters entered on the prior screen. The default curve used for annual HIV incidence or the HIV epidemic curve is a gamma 5 curve and the default position on this curve for the reference year (1992 in this run) is about three years before the peak annual incidence point on the annual epidemic curve (the bottom curve). The top curve is the HIV prevalence curve. The exact position on the gamma curve is shown in the bottom right corner of the screen as 249. These default settings are considered to represent a reasonable HIV scenario for SSA as of 1995.

L6-11



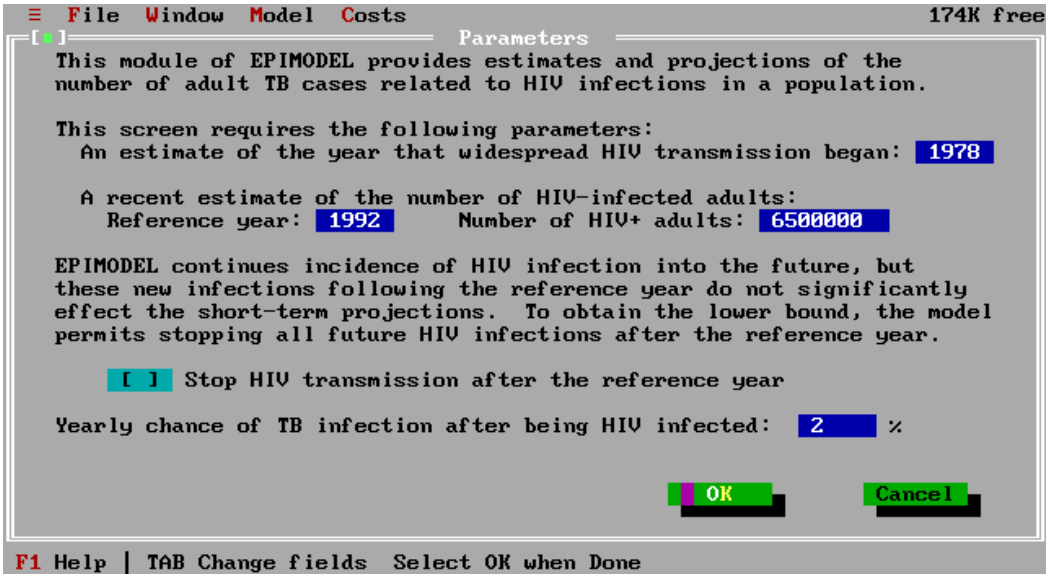
Press <Enter> to exit to the main output screen.

9. Note the first two output columns TB new (annual) and TB cum (cumulative) - **L6-12**. In 1990, over 97,000 new TB cases and about 300,000 cumulative TB cases had developed in HIV-infected persons who had a pre-existing *Mtbc* infection. In the year 2000, over 370,000 new TB cases and over 2.8 million cumulative TB cases had developed in this group of HIV-infected persons. No TB cases developed in HIV-infected persons who did not have a *Mtbc* infection prior to their HIV infection because in this run we set 0 (zero) as the annual risk of acquiring a *Mtbc* infection. **L6-12**



Year	TB New	TB Cum	HIV New	HIV Cum	HIV Curr	TBHIV New	TBHIV Cum	TBHIV Curr	HIVTB New	HIV Cu
1983	2135	2750	237003	477122	471942	118502	238561	235971	118502	23
1984	5719	8468	346848	823970	808208	173424	411985	404104	173424	41
1985	12011	20479	466470	1290440	1252357	233235	645220	626178	233235	64
1986	21602	42082	589715	1880155	1801472	294858	940078	900736	294858	94
1987	34944	77026	711120	2591275	2446143	355560	1295638	1223071	355560	129
1988	52238	129264	826149	3417424	3171796	413075	1708712	1585898	413075	170
1989	73237	202500	931278	4348702	3960131	465639	2174351	1980065	465639	217
1990	97529	300029	1023972	5372674	4791176	511986	2686337	2395588	511986	268
1991	124529	424558	1102599	6475273	5644432	551300	3237637	2822216	551300	323
1992	153493	578051	1166312	7641585	6500000	583156	3820793	3250000	583156	382
1993	183643	761695	1214920	8856505	7339303	607460	4428253	3669651	607460	442
1994	214276	975970	1248754	10105259	8145540	624377	5052630	4072770	624377	505
1995	244657	1220627	1268547	11373806	8903962	634274	5686903	4451981	634274	568
1996	274168	1494795	1275324	12649130	9601986	637662	6324565	4800993	637662	632
1997	302189	1796984	1270302	1391943210229205	635151	6959716	5114603	635151	695	
1998	328125	2125109	1254813	1517424510777313	627407	7587123	5388657	627407	758	
1999	351490	2476600	1230241	1640448611240003	615121	8202243	5620002	615121	820	
2000	371809	2848409	1197963	1760244811613740	598982	8801224	5806870	598982	880	

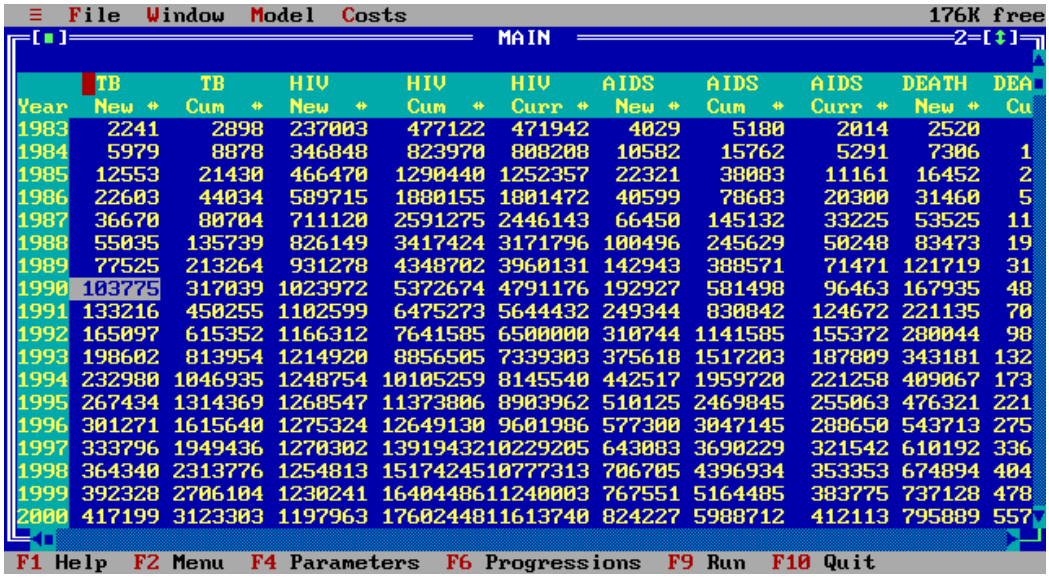
10 Press the <F4> key to return to the (input) Parameters screen. Use the <Tab> or <Enter> keys to move the cursor to the "Yearly chance of TB infection after being HIV infected:" box (or click the mouse on this box) and type in 2 to set the annual risk of acquiring a *Mtbc* infection at 2% (**L6-13**). **L6-13**



11 Accept these settings and exit this screen by pressing <Enter> when the cursor is in the OK box or by clicking the mouse on the OK box. Press the <Enter> key again to exit from the graphics screen and EPIMODEL will recalculate the new TB case numbers taking into account that 2% of HIV-infected persons will be acquiring a *Mtbc* infection each year.

12 Note the revised totals in the first two columns (**L6-14**). In 1990, the annual number of new TB cases is now about 104,000 or about 7,000 more than in the first run, and the cumulative number is now about 20,000 more. In the year 2000, close to 420,000 or about 50,000 additional new TB cases are now shown compared to the first run and 3.12 million cumulative TB cases compared to 2.8 million in the previous run. According to these modeling results, about 90% of the TB cases related to HIV infections are derived from those persons who had a pre-existing *Mtbc* infection at the time they acquired their HIV infection.

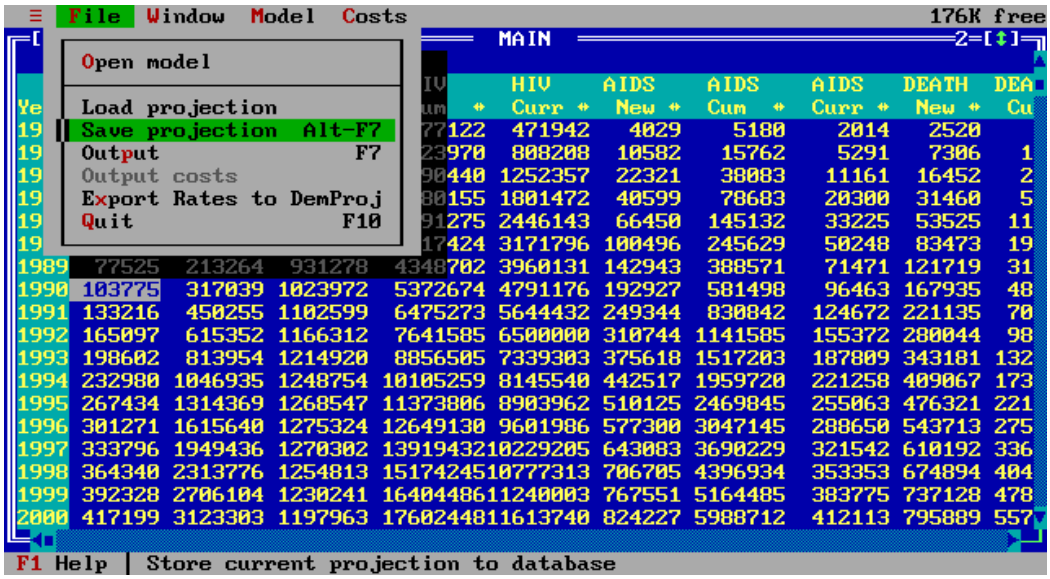
L6-14



Year	TB New	TB Cum	HIV New	HIV Cum	HIV Curr	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEA Cu
1983	2241	2898	237003	477122	471942	4029	5180	2014	2520	
1984	5979	8878	346848	823970	808208	10582	15762	5291	7306	1
1985	12553	21430	466470	1290440	1252357	22321	38083	11161	16452	2
1986	22603	44034	589715	1880155	1801472	40599	78683	20300	31460	5
1987	36670	80704	711120	2591275	2446143	66450	145132	33225	53525	11
1988	55035	135739	826149	3417424	3171796	100496	245629	50248	83473	19
1989	77525	213264	931278	4348702	3960131	142943	388571	71471	121719	31
1990	103775	317039	1023972	5372674	4791176	192927	581498	96463	167935	48
1991	133216	450255	1102599	6475273	5644432	249344	830842	124672	221135	70
1992	165097	615352	1166312	7641585	6500000	310744	1141585	155372	280044	98
1993	198602	813954	1214920	8856505	7339303	375618	1517203	187809	343181	132
1994	232980	1046935	1248754	10105259	8145540	442517	1959720	221258	409067	173
1995	267434	1314369	1268547	11373806	8903962	510125	2469845	255063	476321	221
1996	301271	1615640	1275324	12649130	9601986	577300	3047145	288650	543713	275
1997	333796	1949436	1270302	13919432 10229205	643083	3690229	321542	610192	336	
1998	364340	2313776	1254813	15174245 10777313	706705	4396934	353353	674894	404	
1999	392328	2706104	1230241	16404486 11240003	767551	5164485	383775	737128	478	
2000	417199	3123303	1197963	17602448 11613740	824227	5988712	412113	795889	557	

13 We will now save this test run for future retrieval by pressing the <Alt plus F> keys or by clicking the mouse on File at the left corner of the top line. This opens the File menu (**L6-15**).

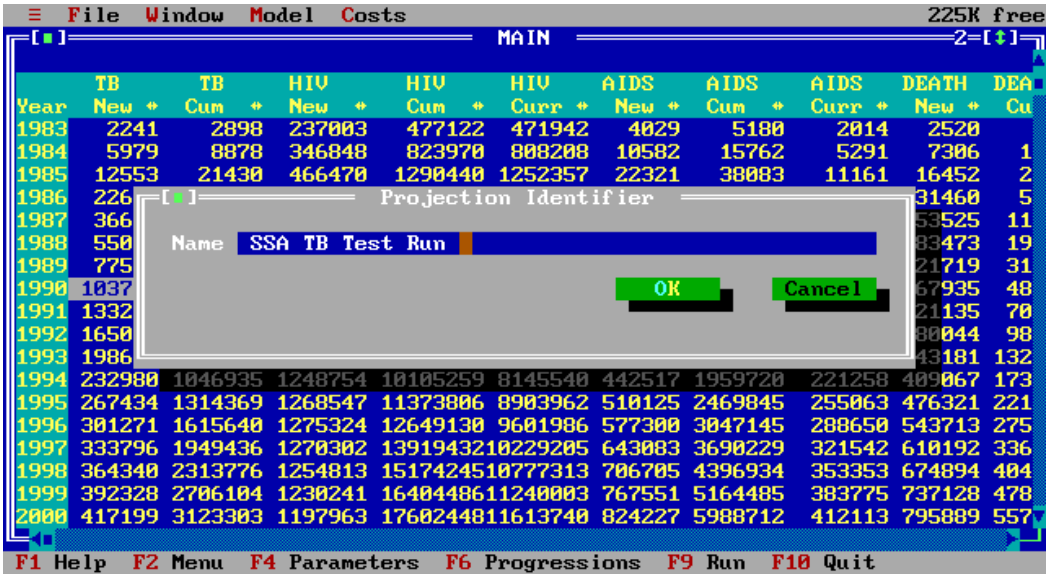
L6-15



Ye	HIV Curr	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEA Cu
19	471942	4029	5180	2014	2520	
19	808208	10582	15762	5291	7306	1
19	1252357	22321	38083	11161	16452	2
19	1801472	40599	78683	20300	31460	5
19	2446143	66450	145132	33225	53525	11
19	3171796	100496	245629	50248	83473	19
1989	3960131	142943	388571	71471	121719	31
1990	4791176	192927	581498	96463	167935	48
1991	5644432	249344	830842	124672	221135	70
1992	6500000	310744	1141585	155372	280044	98
1993	7339303	375618	1517203	187809	343181	132
1994	8145540	442517	1959720	221258	409067	173
1995	8903962	510125	2469845	255063	476321	221
1996	9601986	577300	3047145	288650	543713	275
1997	13919432 10229205	643083	3690229	321542	610192	336
1998	15174245 10777313	706705	4396934	353353	674894	404
1999	16404486 11240003	767551	5164485	383775	737128	478
2000	17602448 11613740	824227	5988712	412113	795889	557

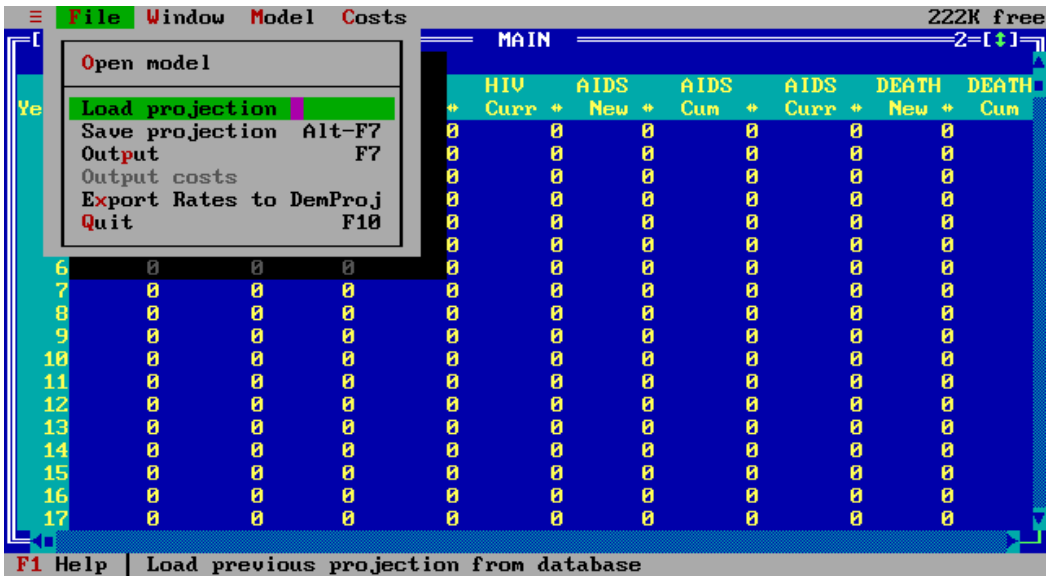
14 We need to move the cursor down to the Save projection option by the down arrow key or by clicking the mouse on that option; alternatively we can select this option by pressing the <Alt plus F7> keys. This opens up the Projection Identifier dialog box where we will type SSA TB Test Run as the name of this projection (**L6-16**) and then exit this dialog box by moving the cursor to the OK box and pressing the <Enter> key or by clicking the mouse on the OK box. Now we will exit the TB module and close EPIMODEL by pressing the <F10> key or by clicking the mouse on F10 Quit at the right corner on the last line of the screen.

L6-16



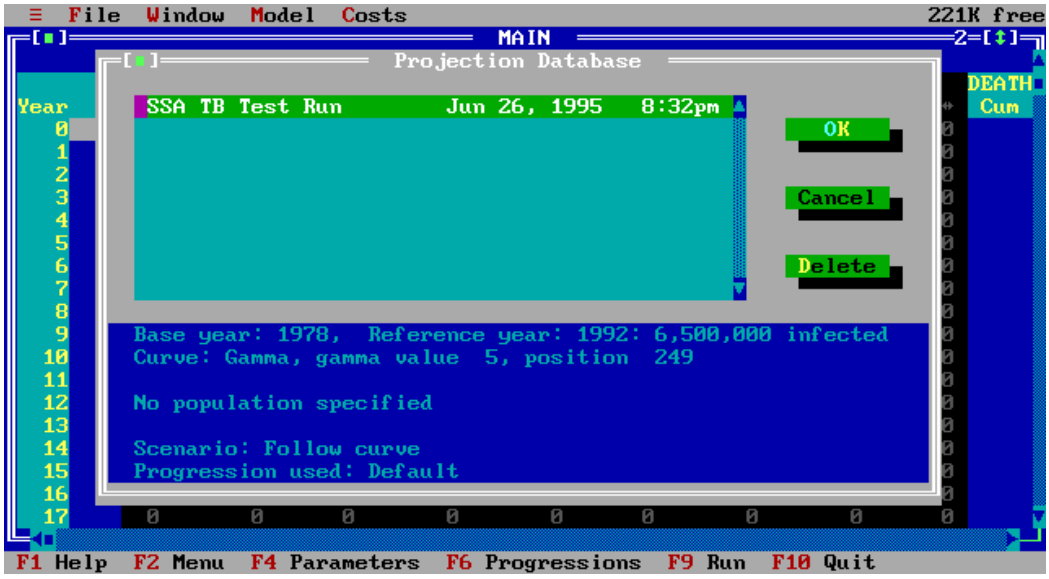
15 To retrieve the saved projection, we need to re-open EPIMODEL, and return to the Main output screen of the TB module as described in instruction #1. To open or load the saved projection we need to (I) open the File options menu by pressing the <Alt plus F> keys or by clicking the mouse on File at the left corner of the top line on the screen, (ii) move the cursor to the Load projection option with the down arrow key and (iii) press the <Enter> key or by clicking the mouse on this option (**L6-17**).

L6-17



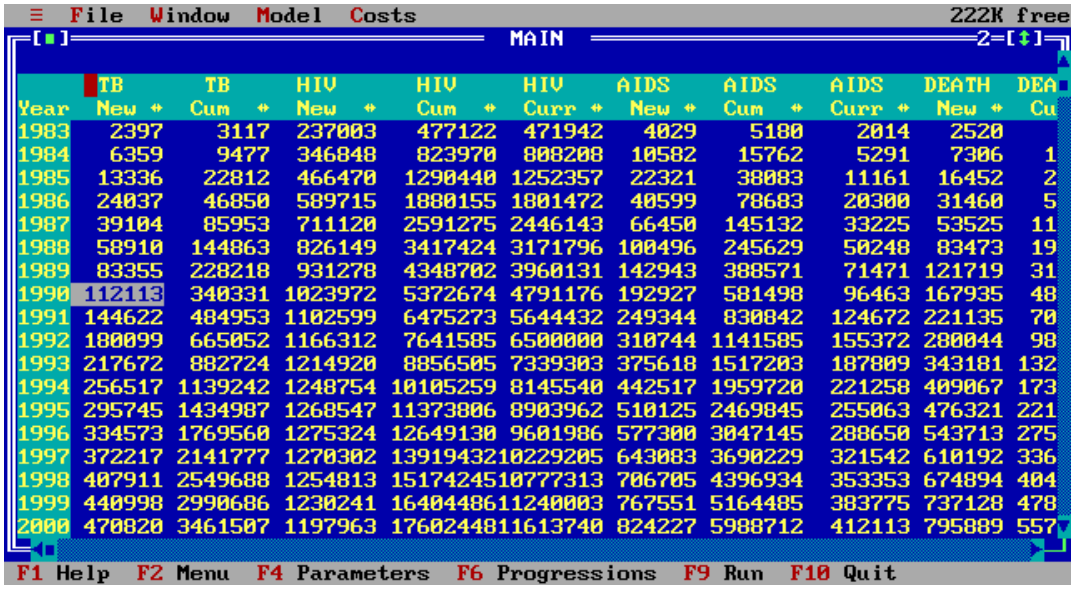
16 This opens up the Projection Database dialog box (**L6-18**). Note that this database includes the name of the projection run - SSA TB Test Run - as well as the date and time when the projection was saved. Also at the bottom of the dialog box, the major input parameters of the test run are provided. To retrieve the SSA TB Test Run, we need to move the cursor to the OK box with the <Tab> key and then press the <Enter> key or we can click the mouse on the OK box.

L6-18



17 The Main output screen now has the retrieved SSA TB Test Run (**L6-19**). However, the numbers of TB cases are higher than in the projection that was initially saved - note that the annual number of TB cases in 1990 is 112,533 and the cumulative number in 1990 is over 341,000. The reason for this is that the default value for the annual risk of TB infection after being HIV infected is 5% and this default value is routinely applied to all saved projections, i.e., the test run's annual risk of TB infection of 2% was not saved.

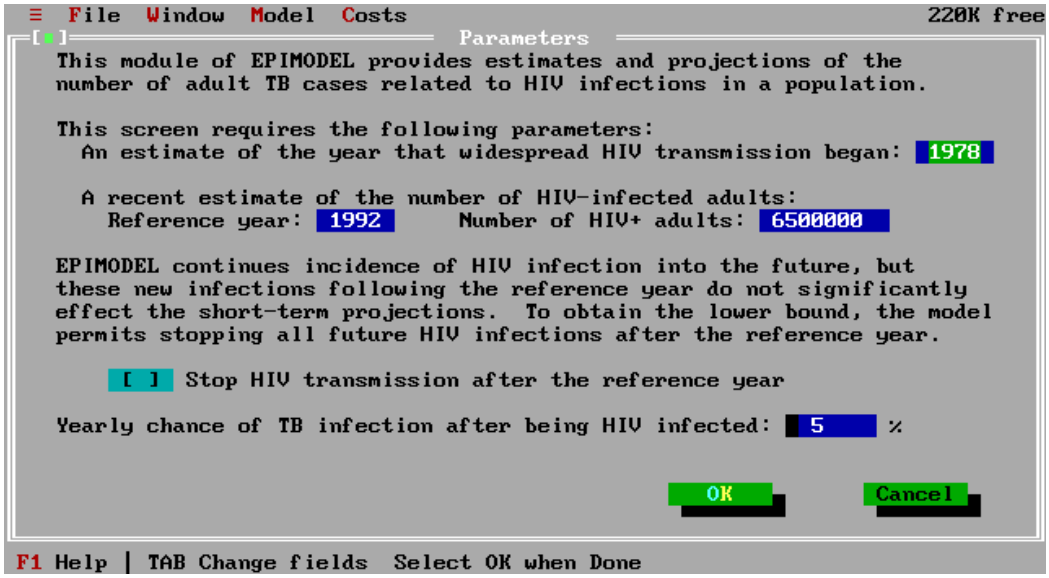
L6-19



Year	TB New	TB Cum	HIV New	HIV Cum	HIV Curr	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DEA Cu
1983	2397	3117	237003	477122	471942	4029	5180	2014	2520	
1984	6359	9477	346848	823970	808208	10582	15762	5291	7306	1
1985	13336	22812	466470	1290440	1252357	22321	38083	11161	16452	2
1986	24037	46850	589715	1880155	1801472	40599	78683	20300	31460	5
1987	39104	85953	711120	2591275	2446143	66450	145132	33225	53525	11
1988	58910	144863	826149	3417424	3171796	100496	245629	50248	83473	19
1989	83355	228218	931278	4348702	3960131	142943	388571	71471	121719	31
1990	112113	340331	1023972	5372674	4791176	192927	581498	96463	167935	48
1991	144622	484953	1102599	6475273	5644432	249344	830842	124672	221135	70
1992	180099	665052	1166312	7641585	6500000	310744	1141585	155372	280044	98
1993	217672	882724	1214920	8856505	7339303	375618	1517203	187809	343181	132
1994	256517	1139242	1248754	10105259	8145540	442517	1959720	221258	409067	173
1995	295745	1434987	1268547	11373806	8903962	510125	2469845	255063	476321	221
1996	334573	1769560	1275324	12649130	9601986	577300	3047145	288650	543713	275
1997	372217	2141777	1270302	13919432	10229205	643083	3690229	321542	610192	336
1998	407911	2549688	1254813	15174245	10777313	706705	4396934	353353	674894	404
1999	440998	2990686	1230241	16404486	11240003	767551	5164485	383775	737128	478
2000	470820	3461507	1197963	17602448	11613740	824227	5988712	412113	795889	557

18 To accurately retrieve the SSA TB Test Run, we need to change the Yearly chance of TB infection after being HIV infected in the Parameter screen from 5% (**L6-20**) to 2% and then recycle back to the Main output screen without changing any of the other parameters. The Main output screen will then show the exact numbers of TB cases that were in the saved SSA TB Test Run.

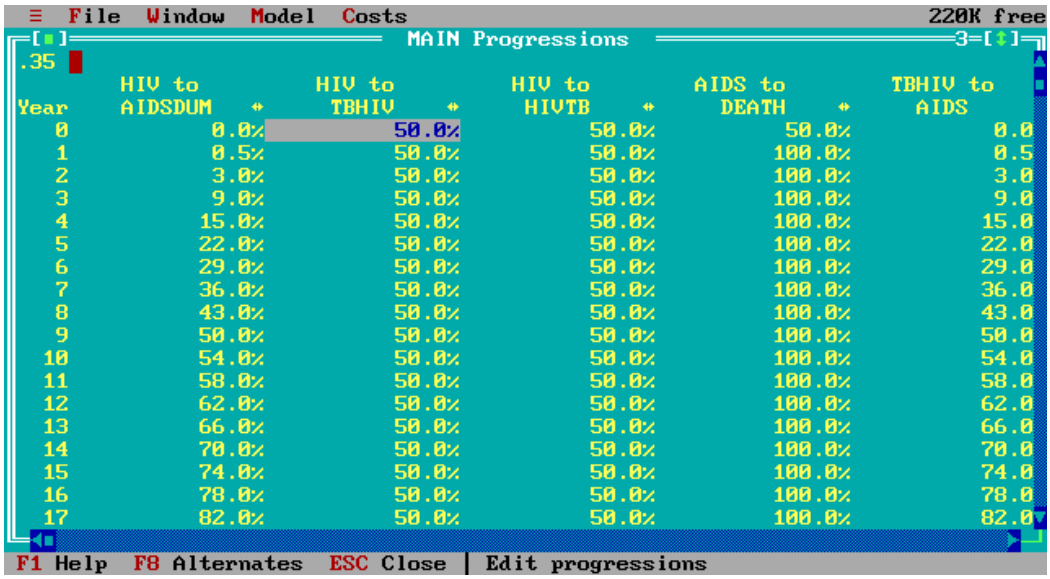
L6-20



19 The last part of this lesson will show how to change the percentage of pre-existing *Mtbc* infections in the modeled population. If data were made available to indicate that the *Mtbc* infection rate in young and middle-aged adults in sub-Saharan Africa is not 50% but about 35%, we would need to change this parameter for another model run. To do this we first need to access or open the Main Progressions screen by pressing the <F6> key or by clicking the mouse on F6 Progressions at about the middle on the last line of the Main output screen.

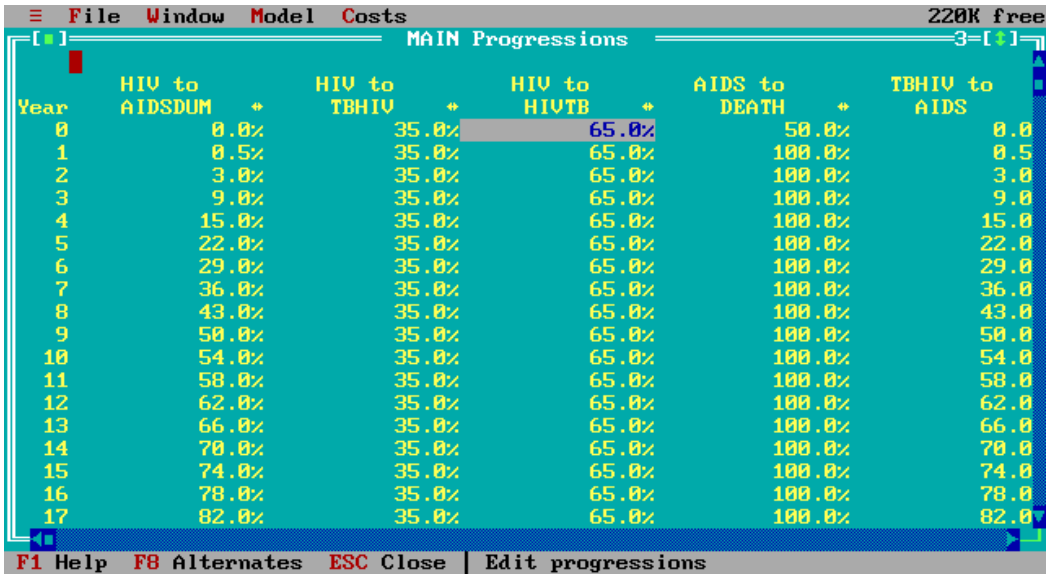
20 In the Main Progressions screen, move the cursor to the top of the second (2) parameter column (HIV to TBHIV) and then type .35[7], which will appear at the upper left corner of the screen (**L6-21)**. After typing .35, we press the <Ctrl plus D> keys to enter 35% for the entire column - HIV infected persons with a pre-existing Mtbc infection.

L6-21



21 Repeat this process by next moving the cursor to the top of the third (3) parameter column (HIV to HIVTB), type .65 and then press the <Ctrl plus D> keys again to enter 65% for this entire column - HIV infected persons with no pre-existing Mtbc infection (**L6-22**).

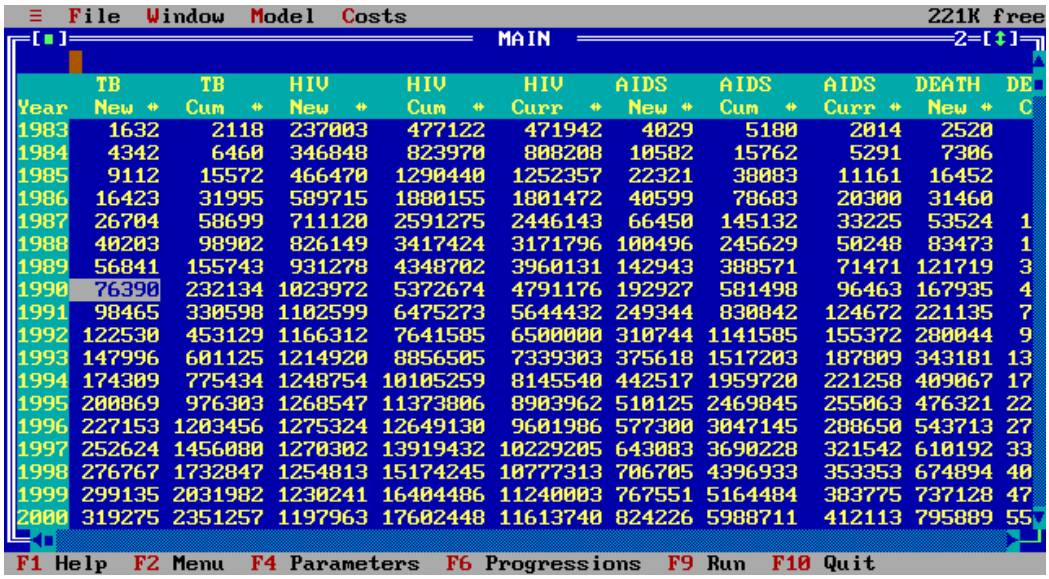
L6-22



22 After changing parameters (2) and (3), press the <Esc> key and EPIMODEL will recalculate the TB cases related to HIV infections with the revised parameter values (**L6-23**). Note that

the numbers of TB cases related to HIV infections are now much lower because the number of dually infected persons are now much lower, i.e., the percent of HIV infected persons with a pre-existing *Mtbc* infection was changed from 50% to 35%.

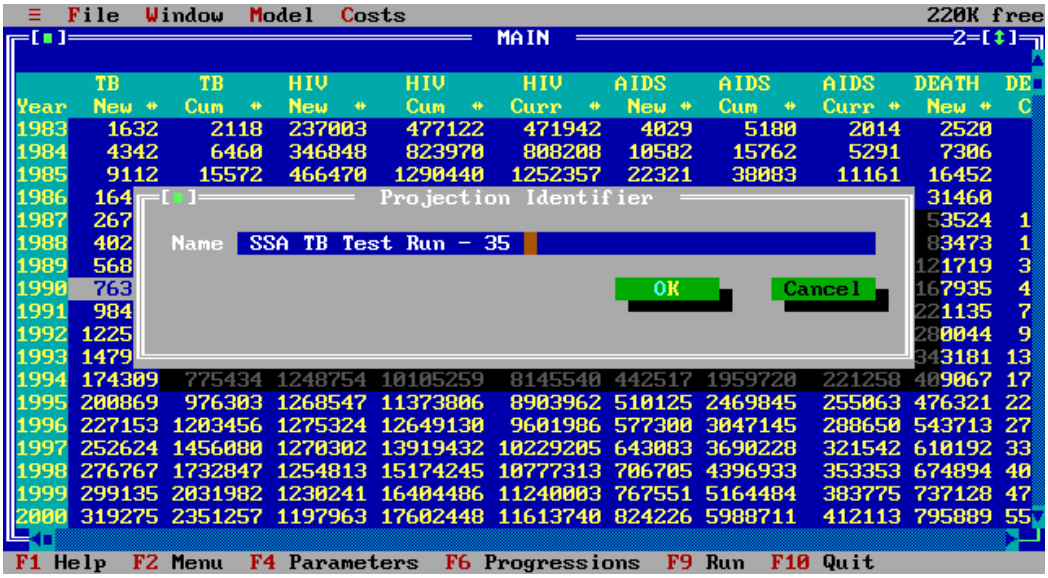
L6-23



Year	TB New	TB Cum	HIV New	HIV Cum	HIV Curr	AIDS New	AIDS Cum	AIDS Curr	DEATH New	DE C
1983	1632	2118	237003	477122	471942	4029	5180	2014	2520	
1984	4342	6460	346848	823970	808208	10582	15762	5291	7306	
1985	9112	15572	466470	1290440	1252357	22321	38083	11161	16452	
1986	16423	31995	589715	1880155	1801472	40599	78683	20300	31460	
1987	26704	58699	711120	2591275	2446143	66450	145132	33225	53524	1
1988	40203	98902	826149	3417424	3171796	100496	245629	50248	83473	1
1989	56841	155743	931278	4348702	3960131	142943	388571	71471	121719	3
1990	76390	232134	1023972	5372674	4791176	192927	581498	96463	167935	4
1991	98465	330598	1102599	6475273	5644432	249344	830842	124672	221135	7
1992	122530	453129	1166312	7641585	6500000	310744	1141585	155372	280044	9
1993	147996	601125	1214920	8856505	7339303	375618	1517203	187809	343181	13
1994	174309	775434	1248754	10105259	8145540	442517	1959720	221258	409067	17
1995	200869	976303	1268547	11373806	8903962	510125	2469845	255063	476321	22
1996	227153	1203456	1275324	12649130	9601986	577300	3047145	288650	543713	27
1997	252624	1456080	1270302	13919432	10229205	643083	3690228	321542	610192	33
1998	276767	1732847	1254813	15174245	10777313	706705	4396933	353353	674894	40
1999	299135	2031982	1230241	16404486	11240003	767551	5164484	383775	737128	47
2000	319275	2351257	1197963	17602448	11613740	824226	5988711	412113	795889	55

23 To end this lesson, save this revised projection as SSA TB Test Run - 35 (**L6-24**).
REMEMBER - when this projection is retrieved in the future all the input parameters will be saved except for the Yearly chance of TB infection after being HIV infected.

L6-24



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APPENDIXES

A. The Window Menu

There are six functions on the window menu, all of which are related to managing the size and position of the windows on the screen. First we have to recognize and understand the "active" window. The active window is the window that is on "top" of the stack of windows on the screen. When a window is active, its border is drawn in gray, single lines. The following functions are useful only when there is more than one window on the screen such as when one window displays the projection numbers and another window displays cost information based on the projection numbers.

Resize/move - This allows you to move or change the size of the active window. Select this item, and then use the arrow keys to position the window where you want it to be. Using the shift key together with the arrow keys resizes the window.

Zoom - This increases the size of the active screen so that it takes up the whole screen. Selecting zoom again will cause it to return to its original size.

Next - This makes the next window in the window stack the active window and brings it to the top. Repeatedly selecting this item cycles through all the stacked windows.

Close - This closes the active window and removes it from the screen. This is useful if you are finished looking at a cost estimate and do not want the window to remain on the screen.

Tile - This reorganizes the windows so that each window is roughly the same size and each window is somewhat unobscured by other windows.

Cascade - By selecting this function, the bottommost window is increased to full size, the second from the bottom is resized to be one row and one column smaller, etc. This function also causes each window's title bar to be visible, so you can quickly tell what windows you have open. Clicking the mouse on a window's title bar is a quick way of making that window the active window.

B. EPIMODEL Outputs

The Output command in the File menu is the means for printing selected data from an EPIMODEL projection, or saving this data to a file, in one of several formats. When you select Output from the File menu, a dialog box will appear on your screen. This dialog box is used to select the data that will be output, the format in which it will be output, and the location of the output. The items in the dialog box are:

Fields to Output - This box allows you to select which fields you would like to output. Only fields with a triangle next to them will be output. You can toggle the output status of a field with the space bar.

Period - This allows you to select a range of years to output. This is useful if you only want to output a subset of the years in your projection. The default of 0 to 9999 includes all years. You could output only the years 1980 to 1985 by filling in those values in the blanks, for example.

Output Format - This allows you to choose the location and format of your output. There are four choices

Epi Info file - Data will be output to an Epi Info file, with one record per year of the projection. Field names will be constructed from the names of the columns in the spreadsheet view of the projection (for example, HIV New). This format is most useful to process the data in Epi Info and then produce output using the LIST command in the Analysis program.

Normalized Epi Info file - Data will output to an Epi Info file, with one record per value of the projection. This produces many more records than the plain Epi Info option. The Epi Info file will contain fields called PERIOD, VALUE, VARIABLE, and VARIABLE 2. The PERIOD variable holds the year, the VARIABLE field holds the state (e.g., HIV), the VARIABLE 2 field holds the variable type (e.g., NEW, CUM, or CURR), and the VALUE field holds the projected value for that year and variable combination. The normalized format is useful for performing further analysis on the data in Epi Info.

Standard Report to File and Standard Report to Printer - These options produce textual output that simply displays the data of the projection in columns.

Output Options - This option is only meaningful if you've selected one of the Standard Report formats in the Output Format box. It allows you to select either horizontal (years across the top of the output and variables down the side) or vertical (years down the side of the output and variables across the top) formats.

Page width - This option is only meaningful if you've selected one of the Standard Report formats in the Output Format box. It allows you specify how wide the output is, enter a large value (like 999).

To continue, select the OK button in the dialog box. At this point, if you've selected an output format that outputs to a file (i.e., any of the formats except 'Standard report to printer'), a

dialog box will appear which asks for output file name. If you select an existing file, the output will be appended to this file. This is particularly useful for the two Epi Info output formats, since it allows multiple projections to be put into one data file and analyzed as a unit. This might included combining the two projections by summing their results, for example.

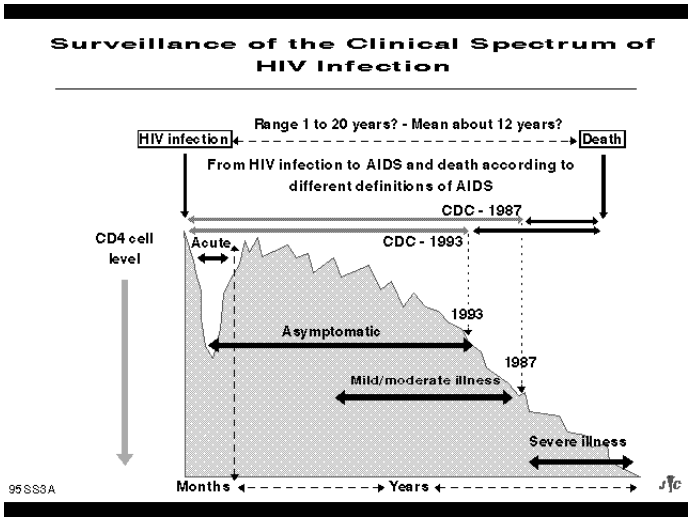
The final dialog box appears, asking for a description of the output. This is included in the output to identify it. If you've selected the 'Automatic save on output', then this string is also used as the name for an automatic Save projection command. The data that was output can then be later recalled using the Load projection command. Saving projections takes up quite a bit of memory, however, so this option is off by default.

PRECAUTIONARY NOTE!!!!

The Save projection command will save all of the inputed parameters used, including all changes that were made to any of the default parameters, for future retrieval in a specific .HIS file for each module of EPIMODEL.[8] **You need to be careful when you run EPIMODEL from a floppy disk or another computer and then want to load or copy saved projections to your hard disk or to another computer.** The specific .HIS file (EPIMODEL.HIS, CHILD.HIS, MFCHILD.HIS, TB.HIS) from the floppy disk or from another computer will totally replace the .HIS file in your hard disk or in the other computer. This will eliminate all saved projections in that specific .HIS file in your hard disk or in the other computer.

C. Natural History of HIV Infection and AIDS

This figure shows the different clinical stages and approximate times from acquisition of an HIV infection to the development of AIDS (according to different public health surveillance definitions), and from AIDS to death.

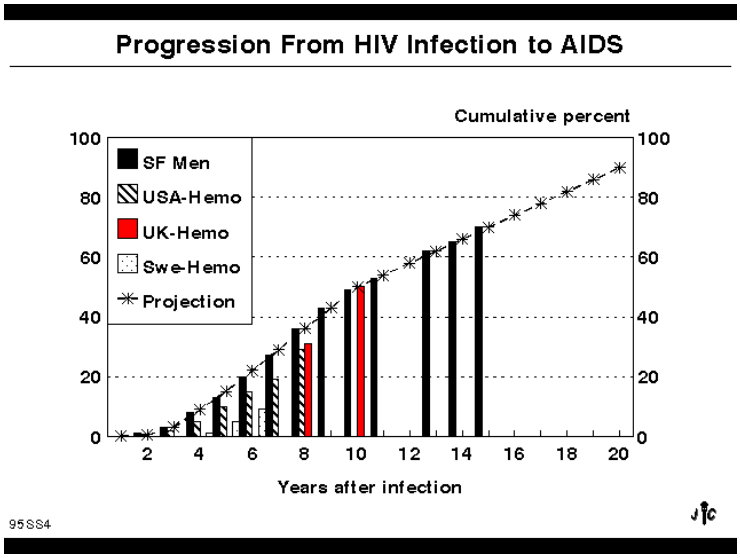


Initial infection is indicated by the presence of antibodies often without any other signs or symptoms though a substantial minority experience a short, mononucleosis-like illness about 2 to 5 weeks after infection. During this acute phase of infection, there may be a significant depression of the cellular immune system. Subsequently, the immune system rebounds to "normal" levels and the infected person becomes asymptomatic for periods ranging from many months to many years. Antibody to HIV are detectable, but individuals experience no symptoms.

Progression to symptomatic disease is highly variable and may rarely occur within a year, or take more than 10 years. Based on detailed cohort follow-up studies described on the next page, it is believed that the mean period to the development of severe immune deficiency as measured by a $CD4^+$ cell count of less than $200/mm^3$ may be about 8 to 10 years. The individual begins to have clinical disease related to progressively increasing immune deficiency, and early symptoms may include swollen lymph nodes, night sweats, fever, diarrhea, profound weight loss, fatigue, and uncommon infections. Continued progression leads to AIDS which is characterized by life-threatening opportunistic infections and cancers.

Survival after onset of severe illness is also variable, but limited. In most developed countries average survival is now about 2 years. In developing countries, about 6 months. The shorter survival in developing regions is most likely due to diagnosis at a later stage of disease and limited access to medical care.

This figure presents the results of studies that followed HIV seropositive men from the time they became infected, until they developed AIDS. The San Francisco cohort of white homosexual or bisexual (gay) men has been followed longer than any other group. Few of the HIV-infected men progressed to AIDS in the first 3 years (less than 3%), but by the end of the fourth year close to 10% had developed AIDS, and after that there was a steady progression rate of 6% to 7% per year. By the end of the tenth year, half had developed AIDS, and by 15 years about 70% had progressed to AIDS. Data are less complete for cohorts of men with hemophilia, so the figure shows fewer observation points. While the observed progression rates are similar to those for the San Francisco gay cohort, they are generally a bit lower for each time period.



There has been ample speculation and concern that progression rates from infection to AIDS is shorter on average in females compared to males, and in developing countries compared to developed countries, but the limited data available suggests that no major differences exist. Scant data are available for determining HIV incubation periods for other ethnic or racial populations, and the prospects of obtaining reliable data on other populations are not good. Limited data from developing countries suggest that rates of progression to AIDS do not differ greatly; however, survival time once AIDS has developed appears to be much shorter in developing countries. Of all the host factors that have been studied, only age at the time of acquisition of HIV infection appears to have a major effect on progression rates to the development of AIDS. A detailed analysis of annual progression rates to AIDS by age at HIV acquisition for the USA hemophilia cohort showed that the younger members of this cohort progressed to AIDS more slowly than the older men. The average time to AIDS when infection was acquired after age 35 was about 7-8 years, while that for males who were initially infected when they were less than 35 years of age was about 12 years. Several reports during the early 1990s of female cohort studies in European countries suggest that the age-specific progression rates in women are similar to those reported for men.

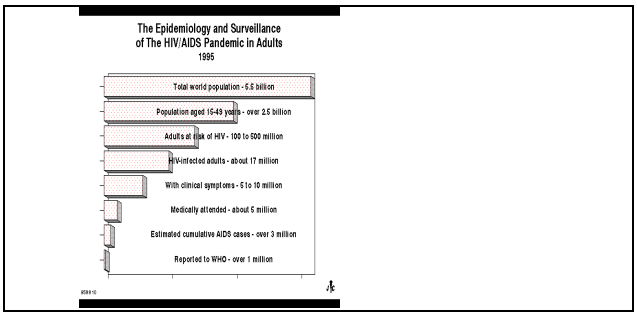
The projected curve assumes that after 20 years 90% of all HIV- infected adults will have developed AIDS. Since HIV-infected adults have been observed for only about 15 years, it is not possible as of mid-1995 to judge how reasonable these projections may be. Most experts believe that almost all persons infected with HIV will eventually develop AIDS. Fewer data are available on the natural history of HIV-2 infection, but what data are available suggests that the rate of progression from acquisition of HIV-2 infection to the development of AIDS is slower.

D. Public Health Surveillance of HIV Infection and AIDS Cases

Introduction

Public health surveillance can be defined as "the collection, analysis, and dissemination of data relevant to the prevention or control of a public health problem." The general methods used for public health surveillance of acquired immunodeficiency syndrome (AIDS) cases and human immunodeficiency virus (HIV) infections are, in general, no different from those used for other diseases and infections. However, the methods used must be adapted to the unique epidemiology, wide variation in prevalences, and the very long incubation period of HIV infection. In addition, the severity of AIDS and the extreme social and personal implications of identifying HIV-infected persons make surveillance of AIDS and HIV infections much more difficult and make issues such as anonymity and confidentiality of paramount importance.

Recognition, diagnosis and reporting of HIV/AIDS is very incomplete so HIV infections and AIDS cases reported to health authorities throughout the world constitute a variable and usually only a small fraction of the estimated global total, i.e., “the tip of the iceberg,” especially in developing countries. Reporting of HIV infections is much more incomplete and inaccurate, those even in those countries where such reporting is required. Therefore the reported numbers of AIDS cases and HIV infections should only serve as a starting basis for the estimation of the actual numbers of HIV infections and AIDS cases that have occurred.



The figure shows the specific sub-populations that need to be routinely measured by public health surveillance systems. The total world population in 1995 is estimated to be more than 5.5 billion. Of that total, over 2.5 billion are aged 15-49, the group most active sexually. HIV is primarily a sexually transmitted disease agent. Of the 2.5 billion sexually active young and middle-aged adults, from 5-20% (100-500 million) are estimated to be at moderate to high risk of HIV infection because they have unprotected intercourse with multiple sexual partners.

Of the 100-500 million estimated to be at risk, about 17 million are estimated to have been infected with HIV; and, of those infected, 5-10 million are estimated to have developed some clinical symptoms of HIV infection as of 1995. However, only about 4 to 6 million of those with clinical symptoms are estimated to have received some medical attention. Of those who may have received medical care, over 3 million were individuals with AIDS. Of these AIDS cases, only a little over 1 million had been reported to WHO by mid-1995.

HIV Surveillance

Estimates of the prevalence of HIV are essential for monitoring the actual epidemiological patterns and scope of the HIV/AIDS epidemics and the overall pandemic. In addition, future cases of HIV-related diseases, including AIDS, will depend on the number of persons infected with the virus. Reported HIV data are of limited use in estimating the actual number of infections that have occurred. In addition, HIV seroprevalence data obtained by the majority of studies performed during the 1980s and early 1990s must be interpreted and compared with extreme caution because of the wide differences in the survey methods used and in the populations covered. Despite these differences, thousands of HIV serological surveys and studies of hundreds of million persons have been carried out over the past decade: collectively, they have been used to describe the distribution and prevalence of HIV infections in most areas of the world.

Routine HIV surveillance systems are being developed worldwide. Such systems must be adapted to the prevailing epidemiological situation: the sampling methods used in populations with very low HIV prevalence must necessarily differ from those where it is moderate to high. Large-scale population serosurveys demand considerable time and resources, and their results may be of limited accuracy because of serious problems arising from selection and participation bias. Furthermore, they may become rapidly out-dated in areas where there is a high incidence of infection. As a result, the development of sentinel systems for routine public health surveillance of HIV infection has been recommended.

Sentinel HIV surveillance involves the routine study of well-defined and accessible population groups. Initially those groups who are at increased risk of HIV infection should be selected for such surveillance, and a predetermined number of individuals from each group should be consistently sampled. The sampling frequency will depend on the estimated incidence of infection in the sentinel group, and the predetermined number of samples should be collected in as short a period as possible to measure more accurately the HIV point prevalence. Lot quality assurance (LQA) sampling techniques can be used for sentinel surveillance of populations with a low prevalence of HIV. In collecting blood samples from sentinel groups, attempts should be made to minimize participation bias in order to produce reliable estimates of HIV prevalence. Since the mid-1980s, the use of unlinked anonymous screening of sentinel group has been increasingly advocated as an accurate and cost-effective method for the public health surveillance of HIV infection.

AIDS surveillance

Reported numbers of AIDS cases are generally more complete than reported HIV infection, but are still of limited value for public health planning in most developing countries. Significant "adjustments" usually have to be made to the reported data so that they more accurately reflect the real situation. In areas where the reporting infrastructure is very weak, estimates of actual AIDS cases must be made virtually independently of the official data.

It needs to be emphasized that current definitions of AIDS were developed for public health surveillance purposes. As such, they are of limited value for clinicians, who need greater sensitivity and specificity. For clinical treatment and for research purposes, a more detailed and sophisticated clinical classification or staging system is needed, and several have been developed, but these detailed definitions of the clinical spectrum of HIV infection are of no practical use for public health surveillance.

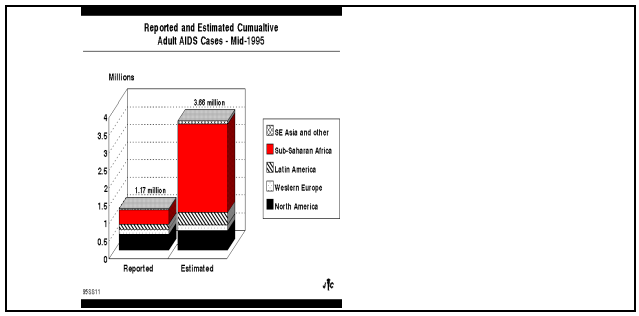
For public health purposes, the surveillance definition of AIDS should be kept as simple and consistent as possible, and suggestions for increasing the sensitivity and/or specificity of definitions of AIDS made by laboratory or clinical specialists need to be evaluated critically. The marked changes made in 1987 to the CDC/WHO surveillance definition of AIDS resulted in temporal "distortions" of the reported case curve, which in turn, caused confusion and debate about trends in the occurrence of AIDS cases. For example, it was estimated that 15-25% of AIDS cases reported in the USA and Spain during 1988, using the 1987 revised definition, would not have been diagnosed as AIDS had the older definition been applied strictly.

In 1993, the Centers for Disease Control and Prevention (CDC) revised its 1987 public health surveillance definition of AIDS to include pulmonary tuberculosis, recurrent pneumonia and invasive cervical cancer in HIV-infected individuals. In addition, all HIV-infected persons with a CD4+ cell count of less than 200/mm^3 or a $CD4^+$ T-lymphocyte percentage of total lymphocytes of less than 14 percent, regardless of their clinical status, are now considered AIDS cases. The CDC's 1993 definition has not been accepted for public health surveillance use outside of the USA.

The 1993 expanded CDC definition of AIDS has resulted in a marked increase of reported AIDS cases in the USA during 1993 and 1994. However, over the long-term, this change of the public health surveillance definition of AIDS in the USA will not cause any real increase of AIDS cases. This definition change, which enables a diagnosis of AIDS to be made at an earlier stage of HIV infection in some persons, will result in a relative decrease in diagnosed and reported AIDS cases in the next few years because AIDS cases who are diagnosed earlier (1993-1994) will not be diagnosed later (1995-1996) when they would have met the older (1987) AIDS definition.

Developing countries often lack adequate laboratory facilities for the histologic or culture diagnosis of the specified surrogate indicator diseases to meet the CDC's 1987 or 1993 AIDS definition. In 1985, WHO developed a clinical case definition of AIDS for public health reporting that relies on specific combinations of major and minor signs/symptoms and diseases for a diagnosis of AIDS. In 1994, an expanded WHO case definition for AIDS surveillance for adults and adolescents was developed; the 1994 WHO surveillance definition incorporates major features of the WHO clinical definition and the 1987 CDC definition. Major features of the 1994 WHO definition are that it includes both pulmonary and extrapulmonary manifestations of tuberculosis associated with features of the wasting syndrome, and it incorporates HIV serologic testing.

This figure compares the distribution of the 1.17 million reported AIDS cases, with the more than 3.5 million adult AIDS cases estimated to have occurred, as of mid-1995, on the basis of available data on the prevalence of HIV infection worldwide.



Reported cases. The stacked column on the left shows that, by mid-1995, North America had reported about 40% of the more than 1 million cases reported to WHO, sub-Saharan Africa about 35%, Europe about 13%, Latin America 12%, and other areas, including Asian and Pacific countries, less than 5%.

Estimated cases. The stacked column on the right indicates that most of AIDS cases (over 65%) of the estimated more than 3.5 million cumulative adult AIDS cases have occurred in sub-Saharan Africa; North America accounts for a little over 15%; Latin America about 12%; and Europe 5%. These estimates are consistent with the available HIV serologic survey/study data, which indicates that about 11 million adults in sub-Saharan Africa have been infected with HIV, and that HIV-infection rates there, as of mid-1995, are about 1 in every 20-30 men and women.