

**HUMAN RESOURCES FOR HEALTH (HRH)
PROJECTION MODELS**

World Health Organization

August 1998

STEP-BY-STEP INSTRUCTIONS FOR USING THE MODELS

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This step-by-step guide will lead you through the main features of Version 3.0 of the HRH supply and requirements scenario projection models. The first section describes how to install and load the runtime models, the second one provides a tour of the supply model, and the last one, of the requirements model. Each major step is separated by a centered line. Follow the steps in order and review the supply spreadsheet first. Later on, once you are more familiar with the program, you can proceed through the models in any sequence desired. Each row is numbered to facilitate reference to specific sections when these instructions are used in a teaching session.

Getting started

- # Install the HRH projection models on your hard disk by inserting disk #1 in the disk drive and following the instructions on disk #2. We suggest accepting the proposed Program Group, *HRH*, but you may give it another name if desired. The total program will occupy approximately 7 megabytes of hard disk space.
- # You may review the README file now or later. It provides a summary of the basic instructions for loading and operating the models program.
- # In *Windows95* you can create a shortcut for loading the models program by clicking with the right mouse key on the red and yellow toolkit icon and, while holding the key depressed, dragging the toolkit to your desktop display. Release the key and then with the left button, click *Create Shortcut Here*. You can now click and drag the toolkit icon in the usual manner to place it in a convenient location on your desktop for use in loading the program.

Getting around the models

This section briefly outlines how to move around the spreadsheet models and provides certain cautionary notes. Most of these instructions are repeated when you are first asked to take the action. Throughout these step-by-step guidelines we use the convention of putting in *italics* all computer commands and row or column labels, and in **boldface** font words or terms requiring special emphasis. Suggestions for improving these guidelines will be appreciated and should be sent to the address at the end of this document.

- # **Parts of the screen display.** There are three bars at the top of the display and one at the bottom. From the top down they are: blue caption bar which shows the name of the model that has been loaded; the pulldown menu bar (*File, Edit, etc.*); the icon bar, which has icon buttons designed specifically for the HRH model; and at the bottom of the screen, the page tab bar which shows the various "pages" in the model.
- # **Loading a model.** After loading the HRH program, click the desired Supply, Require, or Combine model, and then *OK*.
- # **Closing a model.** If you wish to close one model so that you can open another, use the *File/Close* command and then the *File/Open* command. If you wish to exit the HRH program, click the *green door with footsteps* icon toward the right side of the icon bar. When asked if you wish to save the BWB file, answer No# Do **not** answer *Yes* since this will result in saving the large (>700 KB) file along with any changes or data you have placed in it.
- # **Loading a data set.** Click the *small spreadsheet with an inward pointing arrow* icon near the top left of the icon bar, and select the desired bdt data set file, ie, demo-sup.bdt for the supply file, and demo-req.bdt for the require file. The bdt files are typically less than 20 KB in size and provide only the numbers and text that go in the yellow, unprotected cells. This icon performs the same tasks as would the *File/Get Version* command.
- # **Saving a data set.** These step-by-step guidelines do not ask you to save any data sets. However, if you wish to save your own simulation data set, click the *small spreadsheet with an outward pointing arrow* icon on the right half of the icon bar. Enter a new filename not exceeding 8 characters, click *OK*, and then *OK* to the next dialog box. This icon performs the same tasks as would the *File/Put Version* command. Do **not** save either the demo-sup.bdt or demo-req.bdt demonstration data sets since you may thereby introduce changes which will conflict with the numbers given in these instructions.
- # **Clearing or re-loading a data set.** You may clear a data set by using the *File/Clear Data* command. Alternatively, you can load another data set or re-load the same set by clicking the *Get Version* icon; this will automatically replace the existing data set with the new one. **IMPORTANT NOTE:** If your numbers start

to disagree with those given in this document it probably means you have changed a input variable but forgot to return it to the original value. You can always return to the original data set by re-loading the demo-sup or demo-req data set with the *Get Version* icon. For this reason you should never save one of the demonstration data sets.

- # **GOTO a page.** Along the bottom of the screen are page tabs, eg, Info, Occup1, etc., in the supply spreadsheet, or Info, Core, Econ, etc., in the require spreadsheet. Access a page by clicking its tab. You can also turn the pages to the right by pressing <Ctrl> <PgDn>, and to the left by pressing <Ctrl> <PgUp>. To put the cell pointer on cell A1 of a page, press <Home>.
- # **GOTO a table.** There are three ways to access, or "GOTO" a table: (1) Use the *Go To../pagename/tablename* command on the menu bar; (2) Press <F5> and then enter the desired table name; (3) Click the desired light-blue table name located either on the appropriate Info page or at the bottom of the previous table in the series.
- # **Seeing a formula.** With the cell pointer over the desired white, write-protected cell, click the yellow *Fx* icon. Click *OK* to close the displayed formula.
- # **Splitting a screen.** Place the cell pointer on the row or column where you would like to split a table. Click the *Window/Split/Horizontal/Vertical* command, and then uncheck the *Synchronize* box. If you do not uncheck this box, when you move either the upper or lower screen, the other screen will move in tandem. The macro <Ctrl> D can perform the above task more quickly. Place the cell pointer on the row where you would like to split the screen; press <Ctrl> D; use the mouse or <F6> key to place the pointer on the desired screen.
- # **Clearing a split screen.** Click the *white icon with a red diagonal slash* in the icon bar.
- # **Getting help.** With the cell pointer anywhere within the boundaries of a table, press the <F1> key. You can move the help screen in the usual way and close it with the <Esc> key. You can also access help files for Windows, Baler, and the WHO models by clicking the *yellow ?* icon.
- # **Gaining access to the top of a table (Mouse shown with a diagonal line across it).** Some of the tables are quite long and hence are not fully displayed on a single screen. The HRH program "freezes" the titles on many tables so that as you scroll down the table, you can continue having the table headings displayed at the top. Occasionally this will result in a situation where your mouse cell pointer appears on the upper part of the screen as a mouse with a diagonal line through it, and you are unable to enter data. You can demonstrate this situation to yourself in the supply model by using the pulldown menu command *Go To../Occup1/Retention*. To clear

this situation use the *Windows/Titles/Clear/OK* command, or access the table using one of the other methods available to you.

SUPPLYSUPPLY

The HRH supply model....

- # Projects the active supply of health personnel, that is, health workers who are working in the health field
 - Users can specify up to five occupational categories on one supply spreadsheet. Additional spreadsheets can be used to project as many different categories as desired, five at a time.
 - Projections are made for 5, 10, 15, 20, 25, and 30 years and intermediate year projections are possible
 - Two methods for projecting losses are available, depending on data availability
 - Training and loss rate assumptions can be easily varied
 - In- and out-migration flows across provincial or national boundaries can be taken into account
 - Summary statistics, ratios and figures are provided
- # Combines projections of up to five occupational categories on each supply spreadsheet
- # Can make a simple test of economic feasibility; the requirements model can make a more complex, and realistic, test of feasibility

The supply model spreadsheet consists of eight *pages*....

- # The *Info* page records basic identifying and demographic data applicable to all five occupational categories
- # Five *Occup* pages, one for each of five occupational categories; you do not have to complete all the pages and you can use a separate supply spreadsheet for additional sets of five occupations

- # The *Region* page which (1) combines the five projections in one table, (2) provides a simple economic feasibility test, and (3) makes possible a supply projection to an intermediate year other than the default five-year intervals.
- # The *Program* page, which contains programming code and which requires no user attention.

The supply model also comes with a simulated data file (*demo-sup.bdt*) for demonstration and training purposes.

Supply projections are based on...

Existing base year supply of active personnel

plus

Additions (new graduates and in-migration)

minus

Losses (deaths, retirements and out-migration)

equals

Target year supply of active personnel

Load the supply model by double clicking the red and yellow toolkit button, select Supply, and click OK. When preparing a supply projection model you will need to provide basic identifying and demographic data on the Info page. This includes....

- # *Date*
- # *Country and projection name*
- # *Base year of the projection*
- # *Base year population size*
- # *Projected population growth rate by decade*

To help you get acquainted with the supply file we have provided a demonstration data set, called *demo-sup.bdt*, which will be used in the remainder of this step-by-step description. Load this file by clicking the small *Get Version* button with the inward pointing arrow near the top left of the screen, and then select *demo-sup.bdt*. (For your information, the *Get Version* button in the toolbar accomplishes the same task as the *File/Get Version* command in the menubar.) Note the information provided on the Info page, including the list of five occupations at the bottom of the screen.

- # GOTO the *Occup1* page, for Doctors. You can "Go To" a page either by clicking the appropriate tab at the bottom of the screen or using the <Ctrl> <PgDn> keys to

turn pages to the right, or <Ctrl> <PgUp> to turn them to the left. All five Occup pages are the same, though in the simulated data set each contains the supply projection of a different occupational category.

- # Note the yellow shaded cell with the word *Doctors* entered. If you entered a different category in this cell it would change the labels on all the tables on this page. Review the display for this page, which is typical of all Info pages. Under *TABLE NAME* are four light blue words (*GRADUATES*, *RETENTION*, *TRAINING*, *PROJECTIONS*) and to the right of each name is the table title. When the table names are in light blue you can double click on them to go directly to the desired table. You can also go to another table by clicking the Go To command in the pulldown menubar and then selecting the desired page and within that page, the desired table. Note the cross-hatched blue box with a black border around it in cell D18. This *Print tables* box can be clicked later if you are connected to a printer and wish to print all the tables on this page, but do not click it now.

- # GOTO the GRADUATES table by double clicking CELL 11A that displays in light blue the word GRADUATES. Note that the GRADUATES table is in two parts.

-- The top, small boxed section that displays the label *Less precise method* applies the simpler, **Annual Loss Rate method** of projection. With this method you assume a fixed annual percentage loss to the active supply of **past** graduates during each five-year period, a rate that will usually be between 2% for a young, rapidly growing workforce, and 5-10% for a predominantly female workforce that is experiencing relatively high loss rates. The RETENTION table, described below, will apply to **future** graduates. Use this upper boxed section if you lack reasonably complete information about the number of graduates over the past 30-40 years and/or you have no idea of likely cohort-specific loss rates. If you enter any number (other than 0) in row 7 under the number of male or female active health workers, the computer will use this upper table to project the base year supply to the future. The annual loss rates you assume will likely be somewhere between 2% and 10%, the lower values applying to young and rapidly growing occupations, and the higher ones to predominantly female occupations and/or those with a high turnover rate and a short worklife.

-- The lower, much larger table labelled *More precise method* shows the number of graduates, national and overseas, by gender, over the past 40 or more years. Many countries may not have information in this detail but reasonable estimates can often be made, as described in the full documentation.

Before leaving this table, place the cell pointer anywhere within the boundaries of this table and press the <F1> key to see the on-line help notes. The <F1> key can be used in this way to obtain help with any of the tables in the model. Press the <Esc> key or click outside the help panel to return to the table.

- # Use the <PgDn> key to go to the bottom of the GRADUATES table and then double click the button for the RETENTION table. The RETENTION table allows you to use the **Cohort method of projection** by assuming cohort retention rates for both past and future male and female graduates. By way of explaining this table, look at row 10, starting at the far right column. The **default** rate of 25% indicates that 25% of male graduates who completed their training 50-54 years earlier will still be found in the active workforce. In cell Q7 the number "95" has been entered, indicating that the user assumes that the actual retention rate for **future** graduates is 95% of the default rate, resulting in the number 94 in cell Q20. In cell O7 the number "90" has been entered, indicating that for **past** graduates the retention rate is assumed to be only 90% of the default rate. Yellow columns are available to enter occupation and country-specific rates, if available. To use this table you have three options: (1) Use the *default rate*, based on high retention rates observed among U.S. physicians; (2) assume a fixed *% of default rate*, eg, 95%, or 102%, in which case the default rates are decreased or increased as desired; or (3) enter your own, *data-based estimate of the cohort rate*. The computer will look first to #3, then to #2, and if no numbers are in either of these columns, then to #1, the default rate. The cohort retention rates are in two sections, for *Past graduates* and for *Future graduates*. If you complete the lower section of the GRADUATES table and you have no number (other than 0) in the upper section, then the supply of past graduates will be projected using the cohort rates for graduates up through the base year. If you have a number in the upper section, then the base year supply will be projected using the Annual Loss Rate method. The supply of future graduates will be based on the cohort retention rates assumed for future graduates, whichever method is used.

- # GOTO the TRAINING table by double clicking the button on the bottom of the RETENTION table. Review the rows and follow the logic. Values given for the *Ist year class* and the *% who graduate* make it possible to project the number of graduates. The *% males* makes it possible for the computer to take into account different retention rates for males and females. The *years of study* entry makes it possible to calculate total class size, adjusted downward for intra-school losses. The *net annual flow of foreign and out-of-area graduates* makes it possible to adjust the annual increments for the net annual flow of graduates into or out of the planning region or country. Only assumed permanent losses should be counted here, and **not** graduates who leave or come for short-term postbasic studies, which are taken into account by either the annual loss rates or cohort retention rates. Lastly, the bottom section makes it possible to calculate the likely requirements for faculty of the **same** discipline as students, that is, doctors teaching medical students, nurses teaching nursing students, and so on.

- # GOTO the PROJECTIONS table and review the row labels and the red-numbered row 27 with the projected active supply, by five-year period. If there was no number or only a "0" in the upper section of the GRADUATES table you will see all the cells filled with numbers in the top section of the PROJECTIONS table, indicating that the computer used the number of past graduates and the cohort-

specific retention rates to project the supply of persons graduating up through the base year.

The supply model displays graphically projections for each occupational category and for all of them together. Click the *Graph/View/Occup1* command, and then enlarge the display by clicking the small square box in the upper right hand corner of the graph that has a black bar across the top. Note that the left vertical scale (*Health Workers*) applies to the red and blue lines, while the right scale (*Population per worker*) applies to the green line. Since the blue line indicates the number of persons trained **after** the base year, it will always start at zero in the base year and will always be lower than the red line, which is the total supply of health workers. The blue line will have special significance if a new type of training is introduced around the time of the base year since it will indicate how quickly the workforce will acquire the new skills. Click the small "X" at the top right of the graph to close it.

GOTO the Region page and review the three tables, SUPPLY, COSTS, and INTERYR.

-- SUPPLY summarizes all five supply projections; note the summary values in rows 23-24 and 28-29. Both the supply and requirements models make frequent use of **index values**, a convention that makes it possible to quickly compare rates of change in variables expressed in widely differing units (eg, millions, thousands, hundreds). Since the base year is set at 100, you can subtract 100 from any subsequent year's index value to obtain the percentage change. For example, if population rises to an index value of 210 and the health workers to 252, this means population has increased 210 - 100 or 110%, and the health worker supply, 152%.

-- COSTS can be used to make a rough test of economic feasibility. You will soon see how the four main assumptions regarding changes in available funds, salaries, percent of **full-time equivalent personnel** (FTE) in the public sector, and relative incomes can affect public sector costs.

-- INTERYR makes it possible to project to an intermediate years, other than one of the stated five-year intervals.

Now let's try some supply projection tasks using the demo-sup.bdt data set. If not already loaded, use the Get Version icon to load demo-sup.bdt.

GOTO the Occup1 GRADUATES table. Put the cell pointer on any cell in row 16 and split the screen by clicking *Window/Split/Horizontal* and then un-checking the *Synchronize* box. A click in the latter box unsynchronizes the screen so you can put different tables in the upper and lower screen. Click anywhere in the lower screen and then use the *Go To../Occup1/PROJECTIONS* command in the menubar to display the PROJECTIONS table. You should now have the GRADUATES table in the upper screen and the PROJECTIONS table in the lower screen. If necessary,

press the down arrow key until row 27 with the red figures is visible at the bottom of the lower screen.

- # Click the *Males* cell (cell I-7) in the upper screen and enter 3000. Do **not** use a comma (,) either here or anywhere else in the model since the commas are entered automatically by the computer. Note that all the numbers in the upper part of the lower screen are now zeros, indicating that the cohort method is no longer being used. Enter 2000 in the *Females* cell. Note that the combined total supply of 5,000 in the base year (row 17, lower screen) decreases with time to 2,005 over the 30-year period.
- # Enter the number 6 under the year 2010 in the upper screen, indicating an assumed 6.0% annual loss rate during the period 2006-2010, and note in row 27 of the lower screen that the projected total supply for the year 2025 is now 9,443, down from 9,734, and the number of past graduates is 1,714, down from 2,005. Re-enter 3.0 under the year 2010 and delete the 3,000 males and 2,000 females. Your projection will now use the cohort method based on the past number of graduates and licentiates shown in the lower section of the GRADUATES table.
- # With the cell pointer in the upper screen, GOTO the RETENTION table. Click the lower screen and with the down arrow, scroll down until the red row 27 is visible at the bottom of your screen. Note that the total supply in 2025 (cell AK27) is 10,303. Click cell Q7 in the upper screen and replace the number 95 with 80; note that the total supply now drops to 9,718. This drop is the result of changing the retention rates for future male graduates from 95% of the default rate to 80% of the default rate. The default rate is the approximate rate you could expect in a country with a high rate of retention over time. Replace the 80 with 95 in cell Q7; the total supply returns to 10,303.
- # You can use the default rates, or a percentage increase or decrease of the default rates, or your own rate, if available. To demonstrate using your own rate, enter 70 in cell P17 in the upper screen and note that the target year supply drops to 10,169, reflecting the lower retention rate entered for future doctors 15-19 years following graduation. Delete the number 70 to return to the original projection of 10,303.
- # With the cell pointer in the lower screen use the up arrow to display the upper portion of the PROJECTIONS table and note that you now have the age/cohort structure of past graduates as well as for future graduates. Row 36, *Average age of workers*, also has some meaning since it can calculate the approximate average age of the workforce based on the numbers active in each five-year cohort.
- # Using yet another method of selecting a table and with the cell pointer in the upper screen, press <F5> and enter the word TRAINING. You are now in the TRAINING table, which determines how many new graduates will be entering the workforce. Click cell W9 in the upper screen, enter 640 (twice the 320 value), and note the increase in the total supply from 10,303 to 11,445, the effect of increasing

student intakes to 640 during the five-year period 2001-2005. Replace the 640 with 320.

[NOTE: The TRAINING table makes an important simplifying assumption that somewhat reduces the accuracy of the projected numbers of new graduates. This assumption is that the number of first year students entering in each five-year cohort, minus the assumed losses, is also the number of graduates during the same cohort. In reality, especially for occupations that require three or more years of study, most persons entering in any one five-year period, will actually graduate in the next five-year period. With stable student intakes the errors will be negligible. Without correction, with rising intakes the projection may tend to overestimate output and with falling intakes, it may underestimate output. By adjusting intake assumptions appropriately, these errors can be minimized. For example, if base year intake was 100 students in a 5-year program of studies, and this was to be increased to 150 per year starting one year later, you should leave cell V9 at 100 and enter 150 in cell W9. This would reflect the reality that the increased intake would not result in increased output until five years after the base year.]

- # Click cell X13 in the upper screen and replace the value 47 with 20; note the total 2025 supply decreases slightly from 10,303 to 10,287, due to the smaller percentage of male graduates. In this demonstration data set males are assumed to have a 5% higher retention rate than females.

At this point let's go back to the original data set and try some illustrative tasks. To make sure you have the same starting values use the *File/Get Version* command to re-load the demo-sup.bdt data set. You should now see a projected 2025 supply of 10,303, in the lower screen and the top part of the TRAINING table should still be in the upper screen.

- # Click the lower screen and use the down arrow to put row 25 (*New grads =*) at the top of the lower screen. Click the upper screen. Change the student intakes in row 9 starting from column V to achieve a target supply of about 9,000 by the year 2010 (column AH, lower screen), and only about 9,500 by the year 2025. The values in column U are only to remind you of the approximate values that existed in the base year and do not have an effect on the projections. Enter in the spaces below the student intake values that would produce a target supply of about 9,000 by 2010 and 9,500 thereafter.

Student intakes during: 1996-2000 _____; 2001-05 _____; 2006-10 _____;
2011-15 _____; 2016-2020 _____; 2021-2025 _____.

-- To achieve these targets you will have to increase student intakes substantially during the first several five-year periods and then to avoid overshooting the 9,500 target, to reduce intakes sharply thereafter. While these large changes would neither be easy or desirable, they illustrate how you can use the model to attain almost any proposed target supply.

-- To view the effects of your changes, click the *Graph/View/Occup1* command to see a graph of your supply projection. You can enlarge the graph by clicking the small square box in the upper right corner that has the line across the top of it, and then close the graph by clicking the "X" box.

- # Click the *Get Version* button, select demo-sup.bdt to restore the original values. In the upper screen press <Home> and click RETENTION to display the RETENTION table. If a 95% (of default) retention rate for future male graduates will result in a 2025 supply of 10,303, what will be the supply in that year if the retention rate is 100% of default (_____), or 90% of default (_____)? In this way you can test the sensitivity of the different output values to changes in the input values.

We will now look at the combined projections and economic feasibility test in the supply model.

- # Click the *Clear screen* button with the red diagonal bar on it to clear the split screen and re-load the demo-sup.bdt data set. Click the Region page tab at the bottom of the screen. If the cell pointer is not at the top left of the screen, press the <Home> key.
- # Click the light blue SUPPLY cell to display the SUPPLY table. Briefly review this table again and then click the COSTS cell to display the COSTS table. Note that *Staff costs* show an index value of 309 (cell T15) as compared with an *Available funds* value of 281 (cell T14). This indicates that costs have increased at a slightly faster rate than funds, though given the many uncertainties in long range projections the 10% difference can really be considered acceptable.
- # Try the following: Enter 1.5 in cell N5, for the *Average annual % change in real public sector salaries*. Now projected staff costs are 358, well above available funds. Re-enter 1.0.

[NOTE: All money projections are in terms of *real*, or uninflated money with the same approximate purchasing power as was the case in the base year. The underlying assumption is that government, over the long run, will try to adjust salaries to keep up roughly with inflation. Long range projections of inflation rates cannot be made.]

(1) In cell N4, what *Average annual % change in available real funds for personnel* would be necessary to equal the rise in costs? (____.____%) Re-enter the original value of 3.5.

(2) In cell P11, what percent of all full-time equivalent (FTE) doctor time could be supported in the public sector on the funds available from a 3.5% annual increase in funds? In other words, if 70% of doctor time is in the public sector in the base year, what percent could be paid for in the target year such that staff costs would be

close to the 281 value for available funds? (____%) Re-enter the original value of 65 in cell P11.

- # Note the *Relative Incomes* column (Q). If you replace the relative income of 4.0 for doctors (meaning that doctors earn four times what the lowest of the five income categories earns) with 7.0, staff costs go **down** from an index value of 308 to one of 291. Since the **percentage** of doctors in the workforce declines from 34% to 25% over the 30-year projection period, their relative **weight** in the projection declines and their high relative incomes count for less in the projected staff costs. Conversely, if doctors earn a relative income of 2.0, then staff costs increase to 329, since now most of the occupational categories are in the 2-3 range. Re-enter the 4.0 value for doctors' relative income.

You now have a general idea of how the economic feasibility test works. The computer multiplies the number of base year health workers in each occupational category by the percentage assumed to work in the public sector, by the relative salary values. In the case of doctors this means: 5,490 base year doctors are multiplied by 70% and the result is multiplied by 4.0. The five occupational totals are then summed, and the total becomes the base year staff costs. The same calculations are then made for the target year, eg, 10,303 target year doctors x 65% x 4.0. The calculated base year staff costs are assumed to be the same as the base year available funds. Target year available funds are then calculated by applying the assumed average annual percentage change (cell N4, or 3.5% in the demo-sup.bdt data set) to the base year available funds divided by staff costs. Target year costs are divided by base year costs, and the result multiplied by 100 to get the index value for target year costs. The same procedure is used with target year funds and base year funds. Cells T14 and T15 then show the results, and the user can determine whether costs and funds are increasing at similar or dissimilar rates.

[NOTE: Each supply spreadsheet can project only five occupational categories, far less than the total number that make up the health workforce. Since the simple economic feasibility test used in the supply model does not include the entire health workforce, the potential for test errors will increase to the extent that there is large variability in the rate of increase experienced by different occupational categories. The feasibility test used in the requirements model should be the preferred method for testing scenario projection feasibility.]

Lastly, GOTO the INTERYR table. Enter 2003 in the single shaded cell, Z4. You now have the interpolated supply to the year 2003.

CONGRATULATIONS# You have now completed a review of the main features of the supply model. Close the model by clicking the *green door with footsteps* icon on the toolbar and **VERY IMPORTANT, be sure to click No when the dialog box asks if you want to save changes to SUPPLY.BWB.** If you had clicked *Yes* you would have saved your entire supply spreadsheet, with the demonstration data in it. To regain the empty file you would need to re-load the HRH program from your master diskette.

REQUIREMENTSREQUIREMENTS

The HRH requirements model....

- # Projects the active (that is, **working in the health field**) requirements for health personnel in the public and private sectors
 - Users can specify up to 15 occupational categories on one spreadsheet
 - Projections can be made for any period (20-30 years are recommended) and for a country, province, region, or health system
- # Provides five optional modules to assist with decisionmaking
 - Test of economic feasibility of the projection
 - Potential production and per capita utilization of hospital and ambulatory care services
 - Potential urban/rural distribution of services
 - Requirements for up to 9 named categories of medical and of nursing specialists
 - Projections to an intermediate projection year
- # Provides many summary tables, graphs and utility tables to help with common planning tasks
- # Makes side-by-side comparisons of multiple alternative scenario projections based on the same base year estimates
- # Combines projections made for different provinces, regions or health systems in order to produce a national projection

The requirements model spreadsheet consists of nine pages....

- # The *Info* page lists all the tables and graphs
- # The *Core* page contains the 15 core input and output tables
- # The *Econ*, *Serv*, *Dist*, *InterYr*, and *Utilities* pages together contain the 16 input and output tables of the optional modules and the utility tables

- # The *Program* page contains programming code and requires no user attention.
- # The *Translate* page, which provides two summary tables with open labels so that users can enter labels in the local language

The requirements model also comes with a simulated data file (*demo-req.bdt*) for demonstration and training purposes.

Requirements projections are based on a variant of the target-setting method in which users specify, by means of various indicators, assumed or desired changes in (1) the numbers, characteristics and geographic distribution of hospitals and clinics, (2) staffing densities, (3) relative growth rates of the public and private sectors, and (4) growth rates for the public health and academic sectors.

Load the requirements model by double clicking the red and yellow toolkit button, select the Requirements model and click OK; you should now be on the Info page. If the cell pointer is not at the top left of the screen, press the <Home> key. To help you get acquainted with the requirements file we have provided a demonstration data set, called *demo-req.bdt*, which will be used in the remainder of this step-by-step description. Load this file by clicking the small *Get Version* button with the inward pointing arrow near the top left of the screen, and then select *demo-req.bdt*. Scroll down the page and note the listing of various modules and their tables. By double clicking a light blue table name in column A you can immediately go to that table. The cross-hatched boxes (*Print ... tables*) located to the right lower section of each module make it possible to print out all the tables of the specified module with a double click.

Before reviewing the model in some detail and doing exercises, let's take a quick look at the three main output tables. These tables will give you better sense of how the model can help with decisionmaking.

- # On the Info page, double click the REQuirements table name. This table presents target year requirements projections for each of the specified occupations and their distribution by work location.
- # GOTO the COMPARE table by clicking this word at the bottom of the REQuirements table. This table compares projected requirements with supply, the latter generated by the supply model.
- # GOTO the SUMMARY table by clicking *Go To.../Core/Summary* in the pulldown menu at the top of the spreadsheet. This menu can be used to access any table in model. Note the comparison of base and target year values as you scroll down the long table. This table captures the key values from many other tables to provide you with a reasonably complete view of how the projected scenario compares with the base year situation.

Now that you have seen some of the model's outputs, let's see what input estimates and assumptions are required to produce them. We will now make a more systematic tour of the model and try a few exercises.

Core moduleCore module

GOTO the DEMOgraphic table on the Core page. Note that this page is similar to the demographic table in the supply model except that it allows you to specify the target year of your projection and asks for the estimated base year urban/rural distribution of the population and the assumed target year of distribution. The first four letters are capitalized in the DEMOgraphic table name, indicating that when you specify a table name for printing or other actions, all you need to enter is the capitalized letters and not the full word. This convention is used throughout the WHO models.

- # In the DEMOgraphic table note the planning assumptions. The population growth rate is assumed to drop from 3% to 2% over the 30-year projection period, though it will still be high. During this period the population will grow from 10,000,000 (the last three zeros are omitted) to almost 21 million. The urban population is assumed to rise from 35% to 50% of the total population. The resulting calculated urban and rural growth rates are shown at the bottom. To see what would result with a longer projection period, enter 2095 in cell A4 (Target year), thus making this a 100-year projection. The population now rises from 10 to 118 million, and if the projection is extended to 1000 years, a short time in the history of human existence, the population would reach 525 quadrillion. Obviously, all countries will be obliged to slow population growth to replacement levels in the near future if they wish to avoid demographic catastrophe. Re-enter the year 2025 in cell A4. Below the bottom line of each table is a suggestion as to which table should next be accessed. The proposed sequence will be useful when first completing the requirements spreadsheet, but once filled, users can access tables according to their particular needs.
- # GOTO the SUPPLY table by clicking the light blue table name at the bottom of the DEMOgraphic table. In this table you specify the occupational categories, the estimated base year supply of each category, and the estimated number of full-time equivalent personnel in the private sector. The occupation names will be entered by the computer in many of the remaining tables. With the cell pointer anywhere in this table, press the <F1> key to see the on-line help notes. The <F1> key can be used in this way to obtain help with any of the tables in the model. Press the <Esc> key or click outside the help panel to return to the table.
- # GOTO the OCCUPREF table. This table, abbreviated from "OCCUPation REFERENCE," tells the computer in which row it can find *doctors*, in which row it can find *nurses*, and so on, in order to make special calculations regarding the workforce composition, and the row locations of up to three different occupational

categories that provide ambulatory visits, eg, doctors, dentists, nurses. The bottom section of this table makes it possible for the computer to determine the proportion of the workforce that can be considered high, mid- and support level personnel.

GOTO the HOSP table. Note the seven types of hospitals (including a bedded Type A health center, abbreviated *Hlth Ctr-A*) that are assumed, the calculated base year (B-Y) population/hospital ratios (row 10), and the proposed target year (T-Y) ratios (row 16). The summary statistics in rows 19-22 show that in comparison with the B-Y, the T-Y will have a reduced percentage of beds in national hospitals, a increased percentage in regional and district hospitals, and a considerably improved national beds/1000 population ratio (1.7 to 2.4 beds/1000). Starting in row 24 is an optional table that allows you to estimate the average population **actually** served by each type of facility, ie, the **catchment population** or **service area population**. Detailed instructions on the uses and limitations of this optional table are provided in the manual. Finally, review the boxed note at the bottom of this table.

-- To see how table inputs affect the model, replace the 2500 value in cell K16 with 1000. Do **not** use a comma (,) either here or anywhere else in the model since the commas are entered automatically by the computer. By changing cell K16 you have changed the ratio of large national level hospitals from one per 2.5 million population to one per 1.0 million. Since the last three zeros are omitted, 2500 actually equals 2.5 million and 1000 equals 1.0 million. By changing the theoretical ratio of *Population(000) per hospital* (row 10), you have:

(1) increased the number of hospitals from the original value of 8.4 in cell K13, to 21

(2) increased the percentage of public sector beds in national hospitals from 14.5% to almost 30% (cell K20)

(3) and increased the beds per 1000 from 2.4 to 2.9 (cell Q22)

Re-enter the original value of 2500 in cell K16.

-- Since this and a similar table for ambulatory health facilities are major determinants of public sector staff requirements, let's stop a moment to show how they work. In the demo-req.bdt data set there were 3 large national hospitals in the base year. Since the base year population was 10 million, this gives a ratio of 3.333 million population per hospital. Note that this is a "theoretical ratio," which has nothing to do with the **actual** population served by an **average** hospital. In the target year it was assumed that this ratio would be reduced to 2.5 million per hospital which, when divided into the projected population of 20.9 million, means a "requirement" for 8.4 hospitals. This number, 8.4, is then multiplied by the assumed average staff (HOSPSTAFF table) of **each** occupational category required for an average national-level hospital to obtain the projected total staff required for

this type of hospital. In cell K15 it is assumed that the average national-level hospital will have 900 beds, the basis for developing the appropriate staffing norm. The same logic is used for each of the seven hospital types (including their outpatient clinics), and for each of the seven types of ambulatory facilities without beds. The totals for the various facility types are then summed to determine the required number of public sector clinical personnel. The full documentation goes into this process in much more detail and considers such details as fractional (eg, 8.4) facilities, catchment populations, methods for developing the various planning assumptions, etc., but this will provide you with a basic understanding of this part of the model.

- # GOTO the AMBUlatory table and observe the major improvements proposed in the target year *population per location* ratios in row 11, consistent with policies to strengthen primary care, especially for the rural population. The average population per location drops from one per 12,000 to one per 9,000 (cells Z13-14), and the number of ambulatory facilities increases threefold from 819 to 2,436 (cells T13-14), as compared with a doubling of the population.
- # GOTO the PRIVHOSP table and note the assumed 4.0% annual change in the number of private hospital beds. This rate is slightly higher than the calculated growth in the urban population (3.9%) that was shown at the bottom of the DEMOgraphic table (and which is reproduced at the bottom of the PRIVSTAFF table). No one can predict what the growth rate of private sector beds will be but in the absence of major government policies either promoting or slowing growth of the private sector, a growth rate close to that of the urban sector will probably not be in much error. Moreover, since private sector beds usually represent only a small portion of total beds, errors will not have great impact on the final projections. Unlike the HOSPital table, the PRIVHOSP table makes no attempt to project private hospitals according to size or characteristics. In most countries private hospitals will be relatively small (<200 beds) and long-range prediction of hospital characteristics and staffing in relation to size would be pure speculation.
- # GOTO the HOSPSTAFF table and review the proposed T-Y staffing standards. **These standards are purely hypothetical for purposes of this simulation, and should not be regarded as desirable standards for any given country or type of facility**# Note the summary statistics at the bottom of the table which shows how staff are distributed among the various facilities and the FTE staff available per bed. As might be expected, larger acute care hospitals have higher ratios than smaller hospitals. The Type A health center that has inpatient beds (referred to as *Hlth Ctr-A*) has a relatively high ratio (1.4 staff per bed in cell P93) due to an assumed relatively high number of auxiliary and public health staff allocated to the ambulatory and community outreach programs.
- # Use the *Go To..|Specialists/HOSPSPEC* pulldown menu command to display the HOSPSPEC table and review the optional module that makes it possible to project requirements for up to nine (plus *All other specialties*) of user-defined medical and

nursing specialists. Note in column K that the 170 doctors and 280 nurses assumed for the average 900-bed national hospital are distributed among various specialties.

- # GOTO the AMBUSTAFF table. Note that the proposed staffing standards are expressed to one decimal place since some clinics are assumed to use part-time staff that visit different facilities on a rotating basis, eg, a doctor visiting the average rural clinic for one half-day clinic session per week would represent 0.1 FTE doctor-time.
- # GOTO the PRIVSTAFF table and review the logic of these estimates. The *Total FTEs* values come from the SUPPLY table. In column AD (*Total B-Y*) of the PRIVSTAFF table you must estimate the number of *self-employed FTEs*, which will usually apply only to independent practitioner categories such as doctors, dentists, pharmacists, and perhaps a few midwives and technicians. The computer calculates B-Y *salaried staff FTEs* (column AG) by subtracting values in column AD from those in column AC. Annual change assumptions will usually be close to and perhaps somewhat above the urban population growth rates unless the country anticipates major public sector policies affecting private sector growth. Since you will probably use similar growth rates for the salaried and independent practice categories, precise estimates of the proportion of personnel in each group is not necessary.
- # GOTO the PUBHEALTH table. The red note at the bottom of this table indicates the kinds of personnel to be counted in this table. The assumed annual percentage change in the public health category will usually be well above the population growth rate, possibly above the urban growth rate, and the rates will vary according to occupational category. Exceptions to this norm would be in situations where the Ministry of Health is grossly over-staffed or the economic growth rate is very low or negative. Once you have reasonable differential growth rates for the various categories, you can then use the *Adjustment factor* to adjust up or down, in parallel, all categories together. This will be useful later on when you are fine tuning your projection. For now, try entering 2.00 in cell AK73 and observe the effect on columns A0 (Adjusted FTE numbers) and AQ (index values). Re-enter 1.00 before leaving this table.
- # GOTO the ACAD table and note the logic of the model to project teaching personnel and the boxed note at the bottom of the table. The annual enrolment changes (column AW) shown on this simulation are probably too low since the population is increasing at an average rate of 2.5% annually. Note the substantial improvements assumed in the T-Y ratio of students per FTE instructor (column AX) as compared with the B-Y ratio (column AV). Try changing the assumptions regarding the annual change in medical student enrolment (cell AW75) or students/FTE (cell AX75) and observe the resulting changes on instructor requirements. Leave the values at 1.1 and 7.0 when you leave this table.

- # GOTO the REQSPEC table and note the distribution of doctors and nurses according to specialties. This capability of the model can help greatly to guide postbasic specialist training programs.
- # GOTO the REQuirements table. This computer-generated table summarizes the projected requirements based on earlier estimates and assumptions. The results are displayed graphically by selecting *Graph/View* on the menubar, and then selecting HWNUMBER. Note the other graphs that are also available for viewing.
- # GOTO the COMPARE table. Later on, when you develop a projection for your own country, you can enter the projected supply (from the supply model) in this table and note the calculated surplus or deficit in each occupational category.
- # GOTO the SUMREQ table, which provides many useful summary comparisons between the base and target years. Index values are provided so that the percentage changes can be calculated by subtracting 100 from the index value. In some cases a higher index value reflects improvement (eg, health workers per 1000), while in others a lower value reflects improvement (eg, population per health worker). Scroll down to review the whole table. You have already seen the SUMMARY table, which combines in one display summary information from this and other summary tables.

ECONomic moduleECONomic module

This optional module makes it possible to test the economic feasibility of each projection. Even when some of your input estimates are quite uncertain, this module can provide useful guidance regarding the likely feasibility of your projections. Appendix D, Section 2 (Summary effects of increased inputs on outputs) in the full documentation indicates the relative importance of errors in each input variable on the model outputs. The module can be completed quickly and then refined as improved data become available.

- # Use the *Go To../Economic/INCOMES* pulldown menu to display the INCOMES table. Note that the table requires estimates of the average annual FTE public sector income of workers in each occupational category, and the assumed rates of real income growth. The **relative** accuracy of the several income estimates is much more important than their **absolute** accuracy. In other words, if the relative incomes shown in column B are reasonable, it doesn't matter much if all incomes are estimated on the high or low side of what is actually the case. In this simulation it is assumed that the *relative income*, or what might be termed the **income gradient**, shown in column C of 7.5:1 (ie, doctors earn 7.5 times what the lowest paid category earns) is too great, and hence the planning assumptions assume that doctor and dentist incomes will increase more slowly (1% per year) than other incomes, with the result that the target year gradient is somewhat reduced (to 7.1:1). In many countries it will not be possible for health authorities to change the

relative incomes earned by the different occupational categories since salary policy is made outside the health sector, and in any event, differential rates of salary growth must usually be introduced gradually and with care due to the potential for controversy. Note again the use of an *Adjustment factor* in cell A6 that makes it possible to change all incomes up or down in parallel to test the effect of different rates of income growth on costs. We will demonstrate use of this factor shortly.

- # GOTO the COSTS table. The upper section is entirely computer-generated and for various reasons, eg, inflation, cannot be used to project actual budgets. It is used by the computer to complete the economic feasibility test. The optional lower section makes it possible to estimate private sector incomes obtained from fees for a hypothetical health worker spending full-time in the care of ambulatory patients. These income estimates, while useful, have several important limitations, specifically: they are **average** incomes and therefore cover a broad range according to practitioner location, type of service, and specialty; they are **FTE** incomes, even though many practitioners work only part-time in private practice; they are **gross** incomes derived from patient visits, and hence are considerably higher than what is actually received by practitioners, since part of these earnings must be spent on such items as rent, utilities, supplies, equipment, support staff; and they are based only on **fees derived from ambulatory patients** and do not include income received from the sale of medicines, attention to private inpatients, and other services. Even with these significant limitations, however, the income estimates can help suggest the possible magnitude of the public-private sector income differential and its potential effects on the recruitment and retention of public sector professionals.

- # GOTO the ECONTEST table and review the upper section through row 9. The result of the economic feasibility test is shown in red in cell Q9. In this case, the value of 149% indicates that projected costs are 49% greater than projected funds and hence the projection scenario, even though attractive, is quite a bit too expensive. If funds and costs are in balance, the test value will be close to 100%, if funds exceed costs it will be <100%, and if costs exceed funds, >100%. The key input value in this upper section is the *assumed average annual % change in funds available to pay public sector personnel* (cell Q5). Try entering numbers in Q5 to determine what rate of increase will result in a feasibility test value of about 100%? Note the proper value here, (__.__), and then replace it with the original value, 4.7.

- # Now let's look at the optional lower section of the table. This can help you develop a realistic assumption for the rate of growth of funds to pay for public sector health personnel. Note that the red output value in cell S32 (4.7%) of this section is the same as that used above in cell Q5. The shaded cells in rows 14-19 have estimates of base year GDP and expenditures, and the assumed annual change in the GDP during the projection period. Note that planning assumptions in cells S23-S25 call for: increasing from 15% to 18% the percentage of the GDP allocated to the public sector; increasing from 4.7% to 5.0% the percentage of the public sector allocated to health; and decreasing from 85.7 to 70.0 the percentage of the public health

sector allocated to health personnel. The first two assumptions are consistent with the prevailing patterns of national development (at least in countries with rising per capita incomes), and the last one seeks to correct the tendency in many countries to spend too much on personnel, with consequent underspending on drugs, equipment, supplies, and maintenance. With these values the computer calculates the resulting average annual growth rate of personnel expenditures of 4.7%. Recalling the value you calculated above for cell Q5 that would make the projection scenario feasible, determine the following values. After answering each question, re-enter the original value before answering the next question. To be economically feasible.....

-- The assumed 4.5% annual GDP growth rate would have to increase to _____.__%

-- The assumed 18% of the GDP allocated to the public sector would have to increase to _____.__%

-- The assumed 5% of public sector expenditures allocated to health would have to increase to _____.__%

-- The assumed 70% of public health expenditures allocated to personnel would have to increase to _____.__%

From this small exercise you can see how each of the major economic assumptions affects the average growth rate of funds available to pay personnel. You can also appreciate the magnitude of the change that would be required in **any one variable** to make the demonstration projection feasible, a change that would clearly be unrealistic in most countries. A combination of smaller changes might, however, make it possible to approach feasibility, especially if matched by changes that reduced costs. The simulation data set was intentionally designed to show a major improvement in the provision of services that, on further analysis, would be economically not feasible. We will briefly review the remaining optional modules and then return to the important question of feasibility, and how the model can be used to bring supply and requirements, and costs and funds, into balance.

SERVICES module SERVICES module

This optional module makes it possible to project the **potential** production of hospital days, patient discharges, and ambulatory visits by up to three categories of health personnel that would result from your requirements projection. The word potential is emphasized to highlight the reality that the projected production of services is based on explicit assumptions regarding health worker productivities, and the implicit assumption that the future population will actually seek and use these services.

- # Recall, or if desired, GOTO the OCCUPREF table and review the text. In that table we had specified that we would like to calculate the ambulatory visits produced by doctors, dentists, and nurses.
- # Use the *Go To./Services/BASESERV* pulldown menu to display the BASESERV table. Most countries will be able to provide estimates of the total number of hospital discharges and ambulatory visits in the public sector, and assumptions about hospital and clinic productivities are used to estimate the number of private sector discharges and visits. The full-time equivalent number of hours can be calculated using the HOURS table in the Utilities page.
- # GOTO the HOSPSERV table and review the various assumptions used to estimate the target year production of services. The target year bed occupancy rate was assumed in the HOSPital table. Note that the assumed average percent of hospital-based doctor time actually spent attending ambulatory patients is 50% or less. Hospital doctors also attend hospitalized patients, provide support services (eg, laboratory, pathology, radiology, administration) not involving direct patient contact, and spend time in consultations with other staff, inservice training, and the like. A reasonable assumption will be that as hospital size and complexity increase, the percent of doctor time spent actually with ambulatory patients will decrease as will the number of patients seen per hour. The bottom section of this table provides the basis for projecting private hospital discharges.

-- The interaction between length of stay and occupancy rates make it possible to project the number of discharges. Try increasing substantially the assumed average target year length of stay in national hospitals (cell J7) and observe the effect on the three cells immediately below cell J7. Re-enter 12 in cell J7.

-- Ambulatory visits are estimated using the relationships:

$$\begin{aligned}
 & \text{Hours worked per FTE worker per year} \\
 & \quad \times \\
 & \quad \text{\% time actually spent with patients} \\
 & \quad \quad \times \\
 & \quad \quad \text{Patients seen per hour} \\
 & \quad \quad \quad = \\
 & \quad \quad \quad \text{Patients seen per worker per year} \\
 & \quad \quad \quad \quad \times \\
 & \quad \quad \quad \quad \text{Number of FTE workers in each clinic type} \\
 & \quad \quad \quad \quad \quad = \\
 & \quad \quad \quad \quad \quad \text{Number of patients seen per year}
 \end{aligned}$$

- # GOTO the AMBUSERV table and note the similar estimates generated for public sector ambulatory facilities not based in hospitals. For example, looking at column S for the Poly Clinic type of facility, it is assumed that full-time equivalent doctors average 1700 work hours per year, they spend 70% of this time attending patients

at an average rate of five patients per hour for a total of 5,950 patients per FTE doctor per year, and 41,600 patient visits per polyclinic per year. At the bottom of that table in the section starting in row 33, are assumptions for estimating the production of visits by the private sector. Projections of services produced by independent practitioners are made using the same formula as was used for public sector workers. By linking the private sector estimates of patient visits to the COSTS table the computer can calculate the average annual FTE income from patient visits.

- # GOTO the SUMSERV table to review the summary results of this module. Some of these results are also displayed on the AMBUSERV and HOSPSERV graphs, displayed by selecting *Graph/View* on the menubar, followed by the desired graph.

DISTribution module

This optional module makes it possible to estimate the approximate geographic distribution among urban and rural residents of the hospital and ambulatory services produced. The calculated rates are based on assumptions regarding the relative utilization by urban and rural residents of different types of services in different types of facilities. The estimates will be much more useful as indicators of the likely urban-rural **service gradient** given the various planning assumptions, than as indicators of the actual number of services received by urban and rural residents. The full documentation goes into some detail about how to define urban and rural, and how to estimate the distribution of services. No countries will have actual data on the proportion of urban and rural patients served by each type of hospital or clinic, but reasonable estimates can easily and quickly be made of these variables to within perhaps $\pm 15\%$ of the true values. This level of accuracy should be adequate to provide policymakers some guidance regarding the likely urban-rural gradient in the provision of services based on their planning assumptions. Since all countries have an urban-rural imbalance in the provision of health services the challenge is not to eliminate it, but to ensure that it doesn't become excessive; the requirements model can help in this task.

- # Use the *Go To./Distribution/LOCATIONS* pulldown menu to display the LOCATIONS table. Although the table is very large, only rows 13 and 15 require data inputs, and all the rest are numbers calculated by the computer for use in the SUMDIST table. Use the right arrow key to see the right side of this table. The underlying assumptions used in the demonstration data set are as follows:

-- Patients are likely to travel farther for serious illness requiring hospitalization than for ambulatory care. According to this assumption if all patients attended by a hospital were classified by residence, one would find a higher proportion of rural residents among hospital discharges than among ambulatory patients. Thus in the demo-reg data set it is assumed that for national-level hospitals urban residents accounted for 90% of all hospital discharges and 95% of ambulatory visits.

-- For most countries, the smaller the public sector hospital the higher the proportion of rural residents, since small hospitals are usually located in relatively small population centers. However, since virtually all hospitals with, say, 50+ beds will be located in towns, the majority of their patients are still apt to be urban residents. These assumptions are reflected in cells E13 and E15 for district hospitals, where urban residents account for 75% of all discharges and 85% of all ambulatory visits.

-- Small rural facilities such as health centers and posts will have a low proportion of urban residents. Depending on how *urban* and *rural* are defined, this proportion may approach zero.

-- Most private sector patients are assumed to be urban residents, occasional exceptions being for countries with a substantial number of health facilities operated in rural areas by churches or agricultural enterprises.

- # GOTO the SUMDIST table and review the summary calculations. In earlier versions of the WHO-HRH model we attempted to compare base and target year urban and rural utilization rates but the uncertainties were too great so now the model is limited to only the target year.

Intermediate year (INTERYR) projection module

This optional module makes it possible to interpolate a target year projection back to a user-specified intermediate year. The WHO projection models are based on the assumption that health personnel planning must **plan long, act short, and update often** (ie, every 2-3 years). This means that the projection period should be for at least several decades, since it takes that long to make significant changes in the numbers and distribution of higher level personnel, but policies based on these projections are likely valid for only several years before requiring reassessment and update. The requirements model therefore makes it possible to develop an intermediate year projection that can provide some guidance as to where a country should be, say, five years in the future, based on a 20- or 30-year target projection. The phrase **some guidance** is important since the intermediate year projection has one major limitation. Of necessity it is a straight-line interpolation between the base and target years, and hence cannot take into account two important considerations, lag periods and phasing.

Lag periods refers to the unavoidable delay that occurs between taking a decision, say, to increase medical school enrollments, and the production of new doctors. By interpolation a country with 1000 doctors in the base year should have 1500 doctors within five years if it plans to have 3000 by a target year 20 years in the future, ie, 25% of a 2000-doctor increase. This may be possible if the base year medical school output is already high, but

if the output barely covers losses, a major expansion would be necessary and this would not start having effect for at least 7-10 years.

Phasing refers to the relative priority given to different parts of an integrated HRH plan over time. For example, during the first few years priority might be given to nurse and technician training, while later on, to doctor and dentist training. These phasing differences cannot readily be incorporated into the computer model. Accordingly, though the ability to make an intermediate year projection is useful, adjustments will need to be made in the calculations presented in the SUMYEAR table.

- # GOTO the YEARDATA table, which requires only specification of the desired intermediate year.
- # GOTO the INTERREQ table, which is similar to the REQ table except that it shows interpolated requirements projections to the intermediate target year.
- # GOTO the INTERCOMP table, which compares the projected requirements with the projected supply. The supply projection would have to be developed from the HRH supply model.
- # GOTO the SUMYEAR table, which provides similar indices as did the SUMREQ table.
- # You have now completed a review of the requirements tables. We will now review ways in which users can adjust their projections to make them economically feasible.

Achieving economic feasibility

Entering data into the requirements model is only the first step in developing a projection; next come the tasks of testing model sensitivity to input errors, to exploring the effects of alternative planning assumptions, and to bringing the preferred projection in line with economic realities. This section illustrates how you can make the public sector portion of your projection **economically feasible**. You have already seen in the supply model exercise how changes in variables affecting the funds available to pay for personnel can radically change the feasibility of a projection scenario. We will now consider changes that affect **personnel costs** as a way of bringing costs and funds into balance. The three ways of reducing costs are to reduce average target year incomes, reduce the number of health personnel, and change the mix of health personnel in favor of lower cost personnel. The impact of each variable will be examined independently, in isolation of changes in other variables, though in real life matching supply, funds and requirements will involve changing multiple variables and not just one alone.

To make sure you get the same numbers as are listed below, use the *Get Version* button to re-load the demo-req.bdt data set. This will overwrite any numbers you entered earlier but forgot to replace with the original number.

Reducing incomes. GOTO the ECONTEST table and split the screen at row 11 (*Window/Split/Horizontal* and uncheck *Synchronize*). Press <F6> or click on the lower screen to put your cell pointer there. GOTO the INCOMES table. The *Adjustment factor* in cell A6 of the lower screen should equal 1.0 and the target year costs as a percentage of funds should equal 149% in the upper screen (cell Q9). Note in the lower screen that real incomes, as shown in column H, increase over the 30-year period from 35% to 52%, based on assumed average annual income changes ranging from 1.0% to 1.4% (column D).

-- Determine what adjustment factor number will bring the 149% down to <110%, thus making the projection feasible? (____). The adjustment factor makes it possible to change all target year incomes at once, in the same proportion, rather than having to change each one individually. The values in column E are each multiplied by the adjustment factor in cell A6 to obtain the values observed in column G.

-- What will this do to the percentage change in real incomes over the projection period? (Lower the % change / Raise the % change) Do you think this change will be acceptable to the public sector workforce? (Yes / No) Re-enter 1.00 in the adjustment factor.

-- What will be the economic feasibility value if doctor incomes increase by only 0.5% per year? (____%)

-- Projected auxiliary nurse requirements are almost three times than for doctors, and the proposed rate of income growth for auxiliaries is 1.4% as compared with 1% for doctors. If you reduce the annual increase in auxiliary nurse incomes by half, to 0.7, will the savings be more or less great than for doctors? (More / Less) You can see with this exercise how the large income differences between the two occupations affects costs.

Reducing personnel by decreasing facilities. Public sector personnel can be reduced by reducing the number of institutions, by reducing staffing norms, or both. In the lower screen GOTO the HOSPital table and place the cell pointer on cell K16.

-- What will be the economic feasibility value (cell Q9, upper screen) if you keep the same population per national hospital ratio of 3333 in the target year (cell K16) as in the base year (cell K10)? (____%) This ratio means that there is one national hospital per 3.333 million population. Re-enter 2500 in cell K16.

-- There are many more district hospitals than national hospitals. If you enter the same target year population per district hospital ratio (417 in cell M16) as in the base year, will the savings on costs be more or less than would be obtained in the case of the national hospitals? (More / Less). Re-enter 250 in cell M16.

-- It is interesting to note that if you replaced all the values in K16 through Q16 with the same values that you see in row 10, the economic feasibility value would drop from 149% to 121% and the public sector beds-per-1000 population would remain at 1.7. Clearly, the increased number of hospitals is a major factor in increasing costs, but not the only one. In contrast, if you equalized the target and base year population per clinic ratios in the AMBUlatory table, the economic feasibility value would decrease from 149% to 136%, a significant drop but not as much as by reducing the number of hospitals.

- # **Reducing personnel by decreasing staff norms.** GOTO the HOSPSTAFF table. Note in row 91 that regional hospitals have the greatest numbers of staff (cells L91-92). If the assumed norm of 60 doctors per hospital (cell L75) were cut in half, what would be the economic feasibility value? (____%) Re-enter 60. What would be the economic feasibility value if you cut in half the nurses per regional hospital (cell L78) from 100 to 50? (____%) Re-enter 100.
- # GOTO the DEMOgraphic table. What would be the economic feasibility value be if a more rapid decline in the demographic growth rate could be attained, assuming 3.0, 2.0, and 1.0 in the three decades instead of 3.0, 2.5, and 2.0? (____%) Re-enter the original values and unsplit the tables with the red slash icon.

From these few Require spreadsheet exercises you have an appreciation of the many variables that can affect public sector costs. As noted above, no one variable would, by itself, make the projection economically feasible, and the political costs of trying to put most of the burden for cost savings on one or several variables might be high. In practice multiple changes would be made, whether the projection scenario is too costly or too low, to find a better balance between costs and funds. Major considerations will be the balance between: the public and private sectors; the different hospital and clinic numbers, types and distributions; high, medium and low income personnel; and the assumptions used regarding average changes in real incomes, available funds, and staffing norms.

Before leaving the Require spreadsheet, GOTO the Utilities page and using the <Tab> or right arrow key, scroll across the page to see the many utility tables that are available to help you with various planning tasks. The HOURS, BEDS, STAFF1-3, VISITS, NORMS, MATERNAL, AND AMBUTARGETS tables will probably be the most useful.

COMPARE: Comparing and combining projections

We shall conclude our tour of the HRH models with a brief review of the Compare spreadsheet. The Compare spreadsheet makes it possible to...

(1) **Compare** one projection for a single geographic area (or health care system) with others for the **same** area (or same system), with each projection based on different planning assumptions, or to...

(2) **Combine** multiple subnational projections, based either on different geographic areas or on different health care systems, in order to produce a national requirements projection.

Open the Compare spreadsheet (*File/Open/Compare*) and if necessary, press the <Home> key to place the cell pointer at the top of the Info page. Note that you did not have to close the Require spreadsheet first and indeed both spreadsheets are now open though only Compare is displayed.

-- GOTO the COMPARisons table. This is an exact copy of the SUMMARY table in the Require spreadsheet. No values are shown since no alternative projections have been made and almost all of the cells are write-protected, thus making it impossible to load a demonstration data set.

-- GOTO the COMBINE table, which combines data from as many different subnational requirements projections as your computer can manage, and calculates the SUMMARY table values for the entire country. When using the combine feature of the model you must be careful to avoid double-counting or omissions. Specifically, the province-by-province totals for base year population, numbers of hospitals and clinics, health workers, services, etc., must exactly equal the estimated base year national total, since otherwise, the target year projection would be over- or underestimated.

-- GOTO the NEEDS table. When combining data sets, this table will show the intermediate and target year distributions and numerical requirements for health personnel in the entire country.

It is now time to exit the program. The easiest way is to click the green door icon in the toolbar. When it asks whether you would like to *Save changes in COMPARE.BWB* and then in *REQUIRE.BWB*, click **No**.# If you clicked *Yes*, you would save the large bwb file with all the data now in it and the only way to be sure of getting back your original file would be to reload it from your master diskette.

Once again, CONGRATULATIONS# You have now reached the end of this step-by-step demonstration of the two models, and it is time to proceed on your own, with your own country data. You should be sure to review in detail Part IV (Validation and Resolving Mismatches) in the full documentation, which has many suggestions regarding ways to detect errors and to bring your own supply and requirements projections into balance.

filename = **M-Info about HRH Scenario Models** --- The models were prepared for the World Health Organization by Thomas L. Hall, MD, DrPH, Dept. of Epidemiology and Biostatistics, Univ. of California School of Medicine, San Francisco, CA, USA – Contact info: 1515 – 16th Ave., San Francisco, CA 94122; e-mail: thall@epi.ucsf.edu; Home: tel: 415/731-7944; fax: 415/731-3132.