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TESTBANK (1.0)
USER'S MANUAL

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JUNE 1991

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This document describes the Testbank program, which is designed to enhance the reliability and efficiency of test development. Testbank accomplishes this goal by maintaining a data base of test items together with reference data for each time the item has been used. A test developer can then query the test database for items that satisfy any number of query parameters. A full range of test editing functions are available to modify and revise the test. Upon completion of a test, the Testbank software will create a ChiWriter document of the test. In order to enhance the reliability of the produced test, the Testbank software will use the reference data from the included items to predict the mean and standard deviation for the produced test.

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The concept and development of the Testbank software is the result of significant collaboration and joint development accomplished by a number of individuals in the Department of Mathematical Sciences at the United States Air Force Academy. Among these many individuals are Col Dan Litwhiler, Lt Col Tuiren Bratina, Lt Col Ron Berdine, Lt Col Bill Kiele, Lt Col Mark Kiemele, Maj Jim Boatner, Maj Steve Capehart, Capt Francine Lockwood, Capt Rob Watkins, and Capt John Tomick.

- Capt Steve Hadfield

1.0 INTRODUCTION

1.1 Purpose. The Testbank program is designed to enhance the reliability and efficiency of test development. Testbank accomplishes this goal by maintaining a data base of test items together with reference data for each time the item has been used. A test developer can then query the test data base for items that satisfy any number of query parameters. A full range of test editing functions are available to modify and revise the test. Upon completion of a test, the Testbank software will create a ChiWriter document of the test. In order to enhance the reliability of the produced test, the Testbank software will use the reference data from the included items to predict the mean and standard deviation for the produced test.

In support of the test development functions, Testbank provides a full range of item maintenance functions. These functions allow items to be entered from either existing files, directly from ChiWriter, or by modifying existing items. Existing items may also be improved with their evolution recorded. The reference data for items may be modified and updated. A number of printed reports are also available for reference.

1.2 Audience. This document is intended for several audiences to include:

- Test Developers: Those building new tests with items from the test data bases.

- Test Item Maintainers: Those putting items and reference data into the test data bases.

- Testbank Administrators: Those overseeing the integrity of the test data bases.

1.3 Hardware Requirements. Testbank requires an IBM PC/XT/AT-compatible or 386 processor with 640K bytes of memory. (If integrated use of ChiWriter is not required, only 384K bytes are needed.) If additional Expanded Memory is available, it will be used to cache overlays and speed up the program. Storage of the test items requires a hard disk with approximately 1M byte of storage for every 100 test items. A color monitor with a 25x80 text screen is also required to support the menu system used by Testbank.

2.0 INSTALLATION PROCEDURES

Testbank runs under a simple directory structure. The software program itself resides in a directory named: "TESTBANK." The three following files must reside in this directory:

TESTBANK.EXE - The main Testbank program.

TESTBANK.OVR - The Testbank overlays.

TESTBANK.PAR - A file of ChiWriter setup commands.

In order to install the Testbank software, you should follow the steps outlined below:

a. From the root directory, create the primary Testbank directory with:

MD TESTBANK <enter>

CD TESTBANK <enter>

b. Now insert the Testbank Installation disk into drive A: (or whichever floppy drive you wish to use) and copy over the required files.

COPY A:TESTBANK.*.* <enter>

c. To start up the Testbank program, type:

TESTBANK <enter>

d. Set the configuration by selecting the Change Configuration option on the Initial Menu. This option allows you to change the device on which the Testbank data bases will be stored ("Testbank Device") and the device where ChiWriter resides ("ChiWriter Device"). Both of these devices are defaulted to the "C:" drive.

NOTE 1: To fully utilize the Testbank functions, you will need a copy of ChiWriter installed on your hard drive. Specific instructions for installing ChiWriter are found in Chapter I of the ChiWriter manual.

NOTE 2: To start up Testbank later on, you will need the following:

CD TESTBANK <enter>

TESTBANK <enter>

Once the Testbank software has been installed, you can use the New Course option on the Initial Menu to create data bases for specific courses. You may also use the Restore Course option of the Misc Menu to copy in an existing course data base. Specifics on these options appear later in this manual.

3.0 GENERAL INFORMATION

Prior to learning the specifics of operating the various Testbank functions, you will find it helpful to understand some of the basic concepts used by the program.

3.1 Screen Layout. In particular, the Testbank software uses a partitioned screen layout with menus and function keys to allow you to access the Testbank capabilities. Figure 3-1 below illustrates the screen layout.

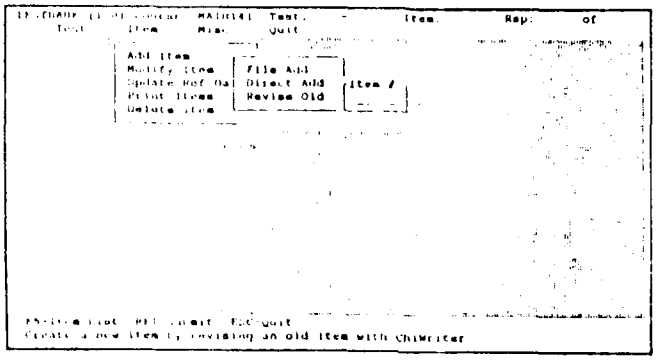

Figure 3-1, Testbank Screen Layout

3.1.1. **Information Line:** This is the top line of the screen and keeps track of your currently selected course, test, item, and (when multiple objects are queued for your review) the current and total number of your responses.

3.1.2. **Main Bar Menu:** Once a course data base has been selected, the second line from the top of the display becomes the Main Menu Bar. This line allows you to access the three primary functional menus. These menus allow you to build and modify tests, maintain items, and perform miscellaneous functions. The Main Bar Menu will normally remain visible to let you know your current functional area.

3.1.3. **Pull-Down Menus:** Each of the three primary functions has its own pull-down menu that activates when you select the function. These menus provide you access to the next level of functions. Pull-down menu options may be selected directly by hitting the appropriated highlighted letter or by arrowing down to the desired function and hitting the ENTER key.

3.1.4. **Secondary Menus:** Some of the pull-down menu options have their own lower level options that appear on a secondary menu. These options are selected in the same fashion as the pull-down menu options.

3.1.5. **Dialog Boxes:** When you need to specify an item number, file name, or other such information, a dialog box will appear with a place for you to enter the information. When entering the information, you will have several standard keys available to you. These include the backspace, delete, home, end, insert, and left/right arrows.

3.1.6. **Forms:** When several items of information need to be specified, a form will be displayed with various fields indicated. Information in the fields can be specified just as in the dialog boxes. In order to warn you about exceeding the field's size, a beep will sound when you enter a character for which there is no room. You may move between fields with the tab, shift-tab, and up/down arrows. The F10 function key will always submit the form for verification and processing, and the escape key will always terminate the form processing.

3.1.7. **Lists:** At times you will need to make a selection out of a predefined set of information. When this occurs, you will be presented with a list of the options. The up and down arrows, together with the page up and page down commands, are available for you to move through the list. A carriage return allows you to select an item from the list.

3.1.8. **Submenu Line:** In addition to the menu system, function keys are often available for your use. The second from the last line of the display is called the submenu line and identifies the currently available function keys and their functions. Throughout the Testbank, you will see that F10 is used to execute a command/process, and the escape key is standard for moving back out of functions.

3.1.9. **Description Line:** The last line of the display is called the description line. This line provides you with a brief description of the currently selected menu function.

3.1.10. **Feedback Area:** The right end of the description line is used as a feedback area. Whenever a process executes for more than a second or so, a message will flash in this area indicating what is currently happening. When a command is completed, this area will either be cleared or a completion message will appear.

3.2 Error Messages Errors encountered during operation of the Testbank are reported in red boxes and a list of error codes is provided in Appendix A to assist you in resolving errors.

3.3 Function Keys. Once a function has been selected via the menu system, most of the lower level commands are accomplished with the use of function keys. The currently available function keys are identified on the submenu line. F10 is consistently used to initiate or confirm an operation. The escape key is typically used to get out of a function. When the escape key is used in a situation that could result in the loss of already accomplished work, you will be prompted to ensure that this is appropriate.

3.4 ChiWriter Interface. The items stored in the Testbank data bases are ChiWriter documents. The Testbank software will normally display these items in an abbreviated format. This abbreviated format does not show all of the symbols that ChiWriter provides, but it is very fast. In order to see the full display of the item as it would appear in a test, Testbank allows you to call up ChiWriter to display the item. This is typically done with the F2 function key. ChiWriter is also used to finalize a completed test document. Once in ChiWriter, all of the normal ChiWriter commands are available. When you exit ChiWriter with an Escape/Quit command sequence, you will be returned to the Testbank processing. For further details on the ChiWriter commands, see Chapter II of the ChiWriter manual.

3.5 Test Item Reference Data. The Testbank uses historical data to provide the reliability and predictability of tests. Each test item will have a reference record associated with it for every time the item has been used in a test. The data in the reference record is used for answering queries for test items and to aid the developer with the selection of appropriate items. In particular, a reference record will include both primary and secondary keywords, item level, item category, the usage, ease, selectivity, test and multiple-choice statistics, a breakout of option selections, and comments.

3.5.1. **Keywords:** Each item has a primary and maybe a secondary keyword associated with it. Only the primary keyword is required by the Testbank. These keywords are very important since they will most likely be used for selecting items for inclusion in tests. Consistent use of keywords is critical. We do not want to use "derivatives" as a keyword if "derivative" has already been used, since this means we would have to use two different queries to retrieve items that test the concept of derivative. In order to facilitate the needed keyword consistency, any time a keyword is to be entered or selected, the F function key will be available to call up a current list of keywords. Furthermore, there is a Print Keyword List option available under the Item menu. This option allows you to write a list of the keywords to the printer or to a file.

3.5.2. **Item Level:** The item level is an assessment of the level and type of effort required to answer the item. It is a required field in the reference form. There are four options for this assessment. They are computation (CT), comprehension (CP), application (AP), and analysis (AN). These options are defined in detail below using definitions taken from E.G. Begle's Critical Variables in Mathematics Education, 1979, p 15.

> COMPUTATION - Items designed to require straight-forward manipulation of problem elements according to rules the subjects presumably have learned. Emphasis is upon performing operations and not upon deciding which operations are appropriate.
>
> COMPREHENSION - Items designed to require either recall of concepts and generalizations or transformation of problem elements from from mode to another. Emphasis is upon demonstrating understanding of concepts and their relationships and not upon using the concepts to produce a solution.
>
> APPLICATION - Items designed to require (1) recall of relevant knowledge, (2) selection of appropriate operations, and (3) performance of the operations. Items are of a routine nature. They require the subject to use concepts in a specific context and in a way presumably already practiced.
>
> ANALYSIS - Items designed to require a nonroutine application of concepts.

3.5.3. **Category:** Category refers to the type of test question; the options are multiple choice (MC), short answer (SA), and work out (WO). This is a required field.

3.5.4. **Usage:** This field is used to indicate the test into which the item was included to produce the associated reference data. The format of this field is tttvsnn where ttt is the test name ('GR1'...'GR5,''FIN'), v is the test version ('A','B,''M'), s is the semester ('F,''S'), and nn is the year.

3.5.5. **Ease:** The ease indicates the percent of those taking the test who correctly answered the item. The average of all the ease statistics associated with an item (weighted by number taking each test) is the number used for satisfying queries for test items and for predicting test statistics.

3.5.6. **Selectivity:** The selectivity is a measure of the how well the item discriminated between the students who mastered the material and those who have not. This statistic is calculated by dividing the population that took the test into three nearly equal size groups. One group contains those that did the best on the considered items. Another group consists of those with the worst scores. These two group are of equal sizes. The third group consists of those remaining in the middle. For example, if the population taking the test were ten, then the high and low groups would each have three and the middle group would have four. The selectivity statistic ranges between -1 and 1 and is calculated with the formula below:

$$SEL = \frac{(\#\text{ in high group correct}) - (\#\text{ in low group correct})}{(\text{Total }\#\text{ in high group})}$$

A value of 1 indicates a high selectivity where all in the high group answered correctly and all in the low group answered incorrectly. A value of -1 indicates that all in the high group got the item wrong and the low group all got it right. With the exception of extremely easy or extremely hard questions, the selectivity value should be greater than 0.2.

WARNING: The selectivity index for an item is sensitive to the quality and number of the other items with which it was given, together with the number of students who took the test. Few accompanying questions, poor quality accompanying questions, misgraded accompanying questions, and small test populations will severely degrade the value of this statistic.

3.5.7. **Test and Multiple-Choice Statistics:** In order to provide some insight into the context in which the item was used, we also include the overall test average, standard deviation, and population size together with the same statistics for the multiple choice portion of the test. The average and standard deviation are given as percents to avoid point biases. The population sizes are later used to weight the ease indicies associated with an item.

3.5.8. **Selection Break-Outs:** Also included in the reference data is a break-out of how many students in each of the three groups (described in 3.5.6) selected each of the multiple choice options. This is useful in determining strong and weak distractors and can help you refine the item.

3.5.9. **Comments:** There is room for 4 lines of 60 characters for comments about the item. The comments could include things like how the item was developed (i.e., reasoning behind distractors, etc.) or specifics regarding its performance that are not reflected or obvious from the other data.

4.0 START-UP INSTRUCTIONS

The Testbank software is executed by the following set of DOS commands that could easily be put into a batch file:

CD TESTBANK <enter>

TESTBANK <enter>

Once initiated, a banner display is shown that includes the copyright and usage restrictions. Hitting any key at that point will take you to the intial menu (see Figure 4-1). The first item(s) on this menu is the course(s) currently available. When you select one of these courses, you will be prompted for a password that is specific to the course and then taken to the main bar menu.

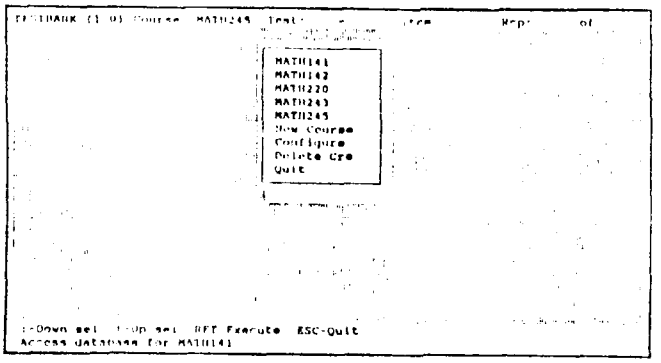

Figure 4-1, Initial Menu

Following are several other options available on the initial menu.

4.1 New Course This option creates a new (empty) data base for a course. This data base will exist in its own subdirectory with the same name as the course. As a result, course-naming restrictions are the same as those for naming DOS subdirectories. When a new course is created, the initial password associated with it will be the same as the course name. This may then be changed by an option on the Misc menu.

4.2 Delete Course This rather drastic command completely erases the data base associated with a particular course. Due to its serious consequences, after selecting this option you will be prompted to ensure that this is really what you want to do.

4.3 Change Configuration The Testbank software allows the actual course data bases to exist on separate disk drives. It also can handle ChiWriter being on a different disk drive. The Change Configuration command provides a submenu that allows you to change either the Testbank drive and/or the ChiWriter drive (see Figure 4-2). You may also display the current drives. Once changed, the drive settings will be permanently saved. If the Testbank drive is changed, the new drive will be checked and the initial menu changed to reflect the newly available courses on that drive.

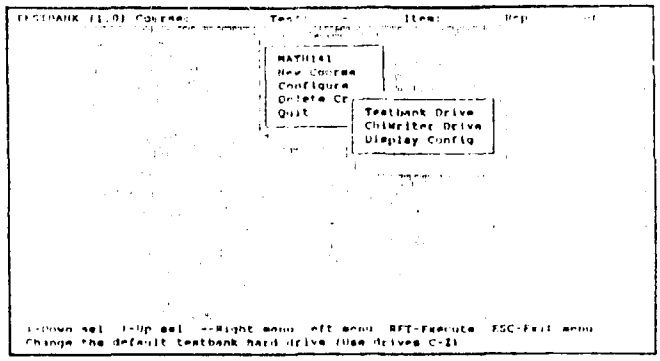

Figure 4-2, Change Configuration Option and Submenu

5.0 TEST GENERATION AND MAINTENANCE

This set of functions allows tests to be created, modified, finalized, and erased. The pull-down menu for this set of functions consists of "Build Test," "List Tests," "Finalize (CHI)," and "Erase Test" (see Figure 5-1). When any option other than List Tests is selected, you will be prompted for a test name. You may either type in the name directly or hit the F5 function key to obtain a list of existing tests for selection. Once a test has been selected, the information line (top line of display) will be updated with that test name.

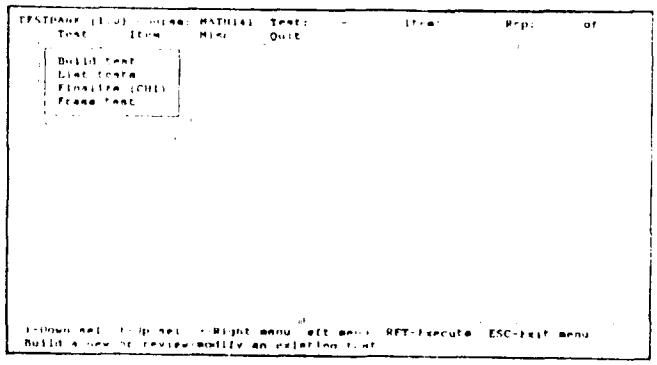

Figure 5-1, Test Pull-Down Menu

5.1 Build Test. This is the primary option that allows tests to be created and modified. Within this option you may also predict the statistics for a created test and display the items included in the test.

When you initially build a new test, an item query form will be displayed for you to select items for inclusion into test. If the test you selected already exists, a summary of the test will be displayed and a number of different options are then available to you.

5.1.1. **Item Queries:** Testbank provides an item query form for selecting items for inclusion in the test (see Fig 5-2). The query form allows any combination of the query parameters. These query parameters include keyword, level, category, ease range (0.0 to 100.0 possible), selectivity range (-1.0 to 1.0), and item number. Items returned for a given query will have to satisfy all of the parameters that you specify. The one exception to this rule is when you specify item number. In this case, the specified item will be returned even if it does not satisfy the other parameters. The F5 function key will provide you with selection lists when specifying either the keyword parameter or the item number.

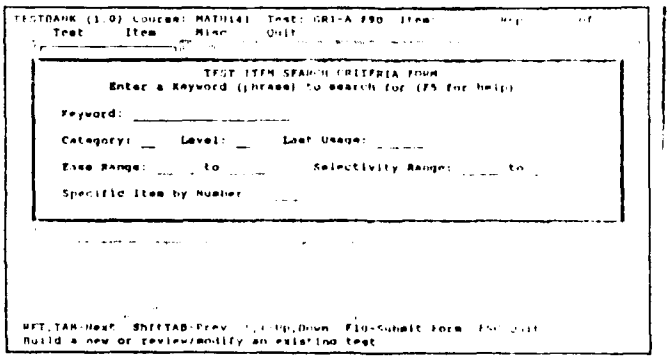

Figure 5-2, Item Query Form

5.1.2. **Query Responses:** Once an error-free query has been submitted via the F10 function key, a search of the data base will be accomplished and a list of responses built. When the search is completed, the first response item will be displayed and the right side of the information line (top line) will report the total number of responses (see Figure 5-3). The F3 and F4 function keys will allow you to move through the list of response items. The F2 key will redisplay your current item using ChiWriter. F6 will display the reference data for your current item, and F7 will display any earlier versions of the item that may have been used in the past and were revised. The escape key will take you back to the query form and get you out of the response review. The F10 function key will select your currently displayed item for inclusion into the test and take you back to the test summary. When an item is selected, you will be prompted for its point value; you must then specify a positive integer value (point value may be changed later). If you attempt to include an item into the test that is already in the test, you will be shown an error message and disallowed the second inclusion.

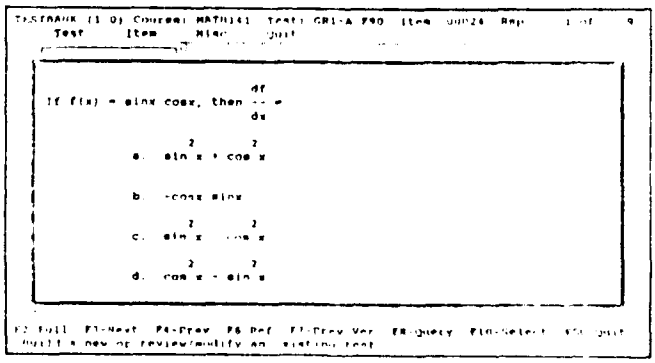

Figure 5-3, Response Review Item Display

5.1.3. **Test Summary Index:** Once your current test has at least one item, a test summary index will be displayed (see Figure 5-4). This index display provides the sequence number, point value, item number, primary keyword, category, level, ease, and selectivity for each item in the test. (The ease and selectivity are actually accumulated figures derived from all uses of the item). The up and down arrows can be used to select items in the test for display, replacement, or deletion. If there are more than 16 items in your test, you can use the page up and page down keys to access the other items. The test summary index is intended to provide a good summary for the test developer to use in assessing test content coverage.

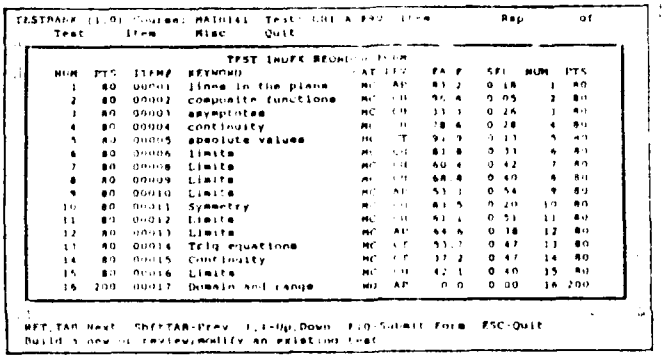

Figure 5-4, Test Summary Index

The Test Summary Index provides access to a number of functions accessible via the following function keys:

a. F1-Display Item: This function will put up a fast display of the item currently selected on the Test Summary Index. Once displayed, you may use F2 to fully display it with the ChiWriter word processor or use F6 to display the reference data associated with this item.

b. F4-Replace Item: This function allows you to replace the currently selected item. The query form used to find the original item will be provided for you to update and submit to find the replacement item.

c. F5-Predict Statistics: When executed, this function provides an estimate of the test's average and standard deviation based on the accumulated reference data for each item in the test that has ease and selectivity data. If one or more items in the test do not have the required reference data, they will not be included in the estimates. See Figure 5-5 for an example of the predicted statistics. The lower bound for standard deviation is based on a variance prediction that assumes independent test items. An actual standard deviation less than the lower bound indicates that there are negative dependencies between the test items; i.e., getting one item correct means you are more likely to get another problem wrong. This would be indicative of a poorly constructed test.

d. F6-Add Item: The add item function brings up the item query form to allow you to find and select another item for inclusion into the test.

e. F7-Reorder Test: This function translates your current page of the Test Summary Index into a form (see Figure 5-6) with the last two fields on each line available for you to modify the sequence number and point value for the item. Sequence numbers can be signed integers, and point values must be positive integers less than 1000. Once submitted, all the items in the test will be sorted by sequence number and resequenced starting at one. With this mechanism, it is easy to put an item at the front of the test by assigning it a large negative sequence number. NOTE: Changing point values can affect the predicted statistics.

f. F8-Delete Item: Hitting the F8 key will cause the currently selected item in the Test Summary Index to be removed from the test. Executing this command will result in a verify prompt to help ensure the wrong item is not deleted.

g. F9-Print Index: This function allows you to either print or write to a file the Test Summary Index with the predicted statistics attached. When you execute this command, you will be prompted for a "PRINTER/FILE NAME" and the default value will show up as "LPT1" which is the standard printer. You may either hit <enter> to print the index on LPT1, or you may type in a file name or other printer device. Anytime during the print procedure you can hit the escape key to terminate the printing and return to the Test Summary Index.

h. F10-Save Test: As usual, F10 allows you retain your work. Hitting F10 will save the Test Summary Index to disk and then let you escape or continue working on the test. Once saved, the test may be called up again later by executing the Build Test option or it may be finalized into a ChiWriter document with the "Finalize (CHI)" option. We recommend hitting F10 frequently during test development so as to not lose your work.

i. Escape Key: The escape key returns you to the Test menu. If you have created a test and not saved it, a prompt will appear to ensure that you wish to abandon your work without saving it.

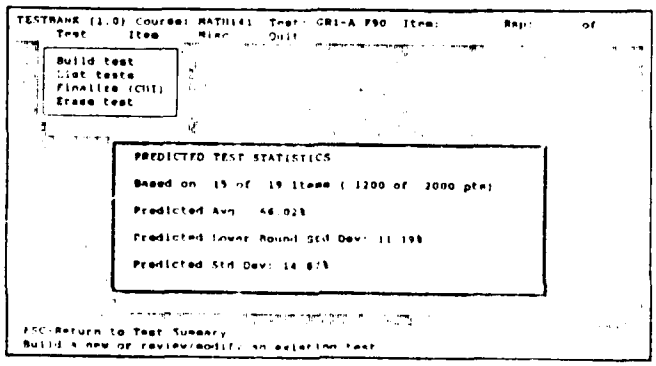

Figure 5-5, Testbank Predicted Statistics

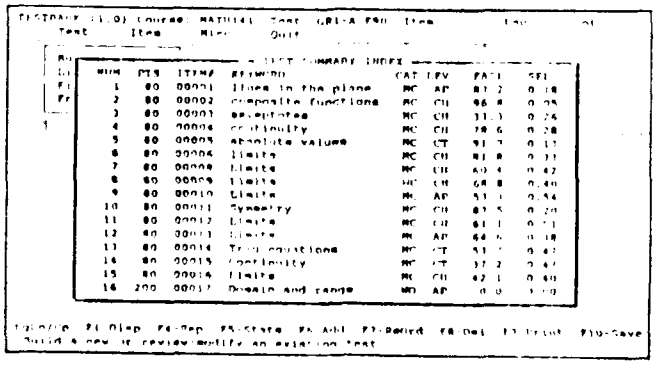

Figure 5-6, Test Summary Index Reorder Form

5.2 List Tests. This Test menu option simply displays a list of the current tests. If there are more tests than can fit on the display, you can use the page-up and page-down commands to see the rest of the tests.

5.3 Finalize (CHI). Selecting this Test menu option prompts you for a test name. The F5 function key will provide a list of current tests. Once a test has been selected, Testbank will merge all of the items in the test into a single ChiWriter document and bring the test up for you in the ChiWriter word processor. Within ChiWriter, you can adjust spacing between items and insert page breaks as necessary. You may also add headers, footers, and cover sheets as required. Specifics on editing with ChiWriter may be found in Chapter II of the ChiWriter manual.

Since ChiWriter will be run while the Testbank program is still in memory, the size of the document that ChiWriter can handle will be limited. You will be notified of your test exceeds this limit and be given the opportunity to copy your test document to another file that you may later edit with ChiWriter after you have exited Testbank and more memory is available.

WARNING: Once you have edited the finalized test, you must write it to a file with a new name. The file created by Testbank during the merge process will be automatically deleted for security reasons. Thus you will need to execute an Escape/Write/Change Name command sequence followed by an Escape/Write/ Document to preserve your ChiWriter edits.

OTHER CONCERNS: During the merge process, Testbank will prefix each test item with the point value and sequence number for that item. These will be put in front of the first nonempty main line of the item's text. When items include extensive use of superscript lines, the point value and sequence number may not be put exactly where you like them but may be editted with ChiWriter. If the first text line of an item is especially long, prefixing the point value and sequence number may cause it to exceed line size and be truncated. If this occurs, you will be warned as ChiWriter is started up.

5.4 Erase Test. The Erase Test option also prompts you for a test name and provides a list of existing tests via the F5 function key. Once a test is selected, Testbank will verify that you wish to delete it to help preclude errors.

6.0 ITEM MAINTENANCE

The Item Maintenance menu is typically used by the Testbank Maintainers and Testbank Adminstrators to build and ensure the integrity of the course data bases. However, some of these functions are also used by Test Developers to insert new items into the data base that they may need to build a test. The Item Maintenance functions are available via the Item pull-down menu (see Figure 6-1).

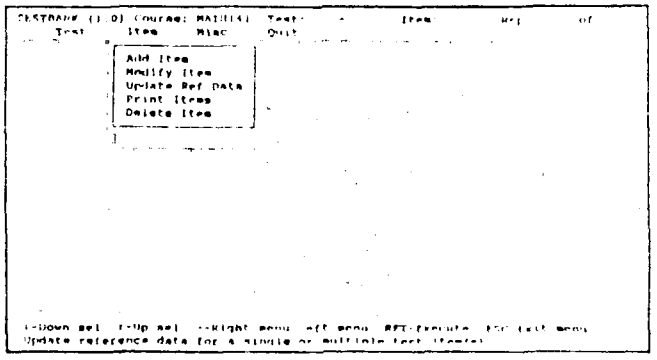

Figure 6-1, Item Pull-Down Menu

6.1 Add Item. Items can be added to a course's data base in one of three ways (see Figure 6-2).

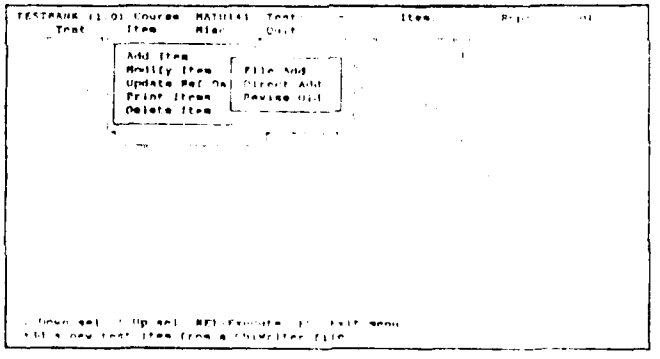

Figure 6-2, Add Item Secondary Menu

6.1.1. File Add Option: The File Add option copies an item that currently exists as a separate ChiWriter document file. Such files can be created with the procedure defined in Appendix B. The procedure involves taking a ChiWriter version of a test and marking/writing each item into a separate file. When executing this function, you will be prompted for a file name and then Testbank will display the new item for you. At this point you may use F10 to save the item, escape to abort the item, or F2 to fully display the item with ChiWriter. The item will not be put into the data base unless the F10 key is depressed. If you do save the item, the Reference Data Form will be provided for you to insert the reference data for the item.

6.1.2. Direct Add Option: Another way to add items to the data base is via the Direct Add option. This functions calls up ChiWriter from Testbank and allows you to create the new item directly from ChiWriter. When using this function, you must remember to execute the Escape/Write/Document ChiWriter

command sequence prior to exiting ChiWriter. Details on the ChiWriter commands are available in Chapter II of the ChiWriter manual. Once the item has been created and you have exited ChiWriter, Testbank will ask for confirmation that you wish to save the item in the data base. After confirmation, the Reference Data Form will be displayed for you to insert reference data for the item.

6.1.3. Revise Old Option: The third way to add an item to the data base is to call up an existing item and revise it using ChiWriter. This Revise Old option will not change the original item. The procedure associated with this option is very similar to the Direct Add option except that you will be prompted for the existing item to revise. At this prompt, you may use the F5 function key to obtain a list of existing items from which to select. Reference data from the old item will NOT be carried forward.

6.2 Modify Item. The Modify Item function is used to correct an existing item when its current version was poor or contained errors. The function allows you to modify the item using ChiWriter; both the new and old versions will be maintained in the data base. However, only the new version will be available for inclusion into tests. When executing this function, you will be prompted for the item number of the item to be modified. You may use the F5 function key at this point to obtain a list of the existing items. ChiWriter will then be called up with the item for you to make the necessary modifications. Details on the ChiWriter commands are available in Chapter II of the ChiWriter manual. Remember to execute the ChiWriter command sequence Escape/Write/Document prior to your exit from ChiWriter. Upon exiting ChiWriter, Testbank will ask you to confirm the modification to the item. F10 will confirm the change and escape will abort it. If confirmed, you will be asked if you wish to enter reference data for the item. If so, you will be provided a Reference Data Form.

NOTE: There is a third (hidden) response option to the confirmation prompt. If you resond with a Shift-F1 at the confirmation prompt, the old version of the item will be overwritten with the modifications that you made. This feature is primarily provided to allow the Testbank Administrator to correct items that are already in the data base.

6.3 Update Reference Data. There are three options available for modifying and updating the reference data associated with an item (see Figure 6-3). Once the reference data for an item has been called up via any of the three options, it may be reviewed, modified, extended, and/or deleted via a standard set of functions.

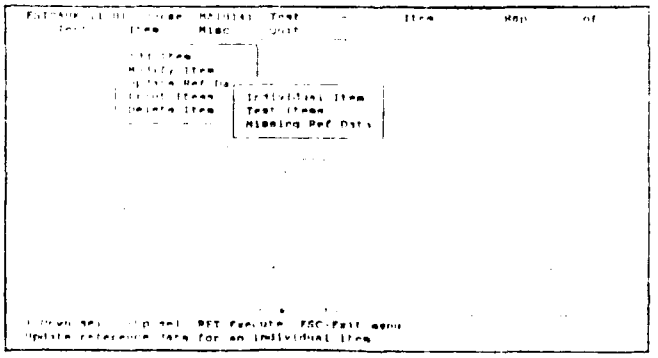

Figure 6-3, Reference Data Update Options

6.3.1. **General Reference Data Updates:** Regardless of the option used to call up the reference data for an item, the same functions are available for actually updating the item (see Figure 6-4). F1 allows you to redisplay the actual item. Since an item will have a separate reference form for each time it was used, F3 is available to move through these forms. F4 will allow you to modify the currently displayed form. To add a new reference data form for an item, hit F6 and a new form will be presented for you to complete and include with the item. F8 can be used to delete the currently displayed reference form. Finally, F10 will permanently record all of the changes that you have made, and escape will abort any changes.

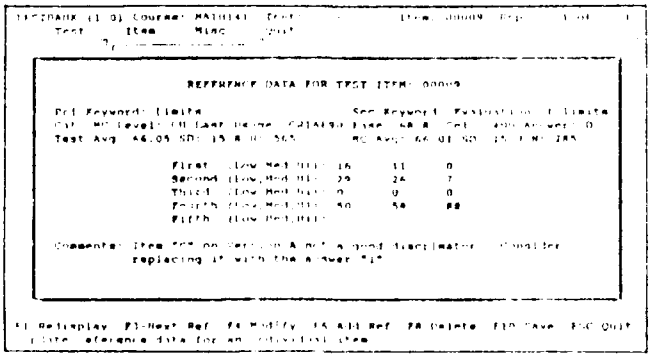

Figure 6-4, Reference Data Update Form

6.3.2. **Individual Item Reference Data Update:** The first option available for calling up the reference data for an item is to do it directly by item number. Executing this option prompts you for an item number. The F5 key is available for obtaining a list of the current items in the data base. Once an item has been selected, its reference data is present for update.

6.3.3. **Test Items Reference Data Update:** To assist with the updating of reference data for all items used in a particular test, the Test Items option is provided. This option displays a list of the existing tests from which you can select. Once a test is selected, a second list of all the item numbers used in that test is provided for your use in selecting items for updates. As each item is updated, you will return to this list of item numbers.

6.3.4. **Missing Reference Data Update:** In order to aid in the preservation of data base integrity, the Missing Ref Data option is provided. This option causes the entire data base to be scanned for items that do not have associated reference data. Any such items are then presented in a list for you to select and update.

6.4 Print Functions. There are four print options available for obtaining hardcopies of data base information (see Figure 6-5). Each of these options allows the information provided to be printed or written to a file for later display or printing.

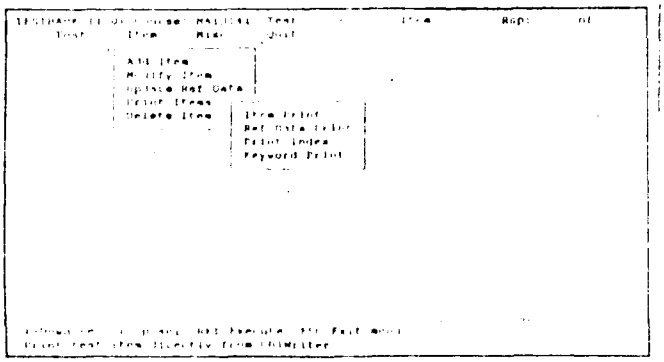

Figure 6-5, Testbank Print Functions

6.4.1. Item Print: The Item Print function prompts for an item number (allowing F5 for a list of items) and then calls up ChiWriter with a copy of the item that may then be printed from ChiWriter.

6.4.2. Reference Data Print: This function again prompts for an item number (F5 also available for listing the items) and then prints out all of the reference data associated with the selected item.

6.4.3. Index Print: The Index Print option provides a summary list of all of the items in the current course's data base.

6.4.4. Keyword Print: The consistent use of keywords is critical to the efficient use of the Testbank data bases. The Keyword Print option provides a list of the current keywords for reference when adding new items.

6.5 Delete Item. The Delete Item function prompts for an item number (F5 available for a list of items) and then deletes the selected item. A confirmation prompt is provided to preclude mistakes. Once an item has been deleted, its number will not be used again. Furthermore, if the deleted item was included in a test, you will not be able to regenerate that entire test.

6.6 Requirement for Back Ups. Every time any of the Item Pull-Down menu functions are used, you should generate a back up of your work with the Back Up Course command available under the Misc menu and described in the next chapter.

7.0 MISCELLANEOUS FUNCTIONS

Testbank provides three miscellaneous functions to assist with the administration and maintenance of the test data bases (see Figure 7-1):

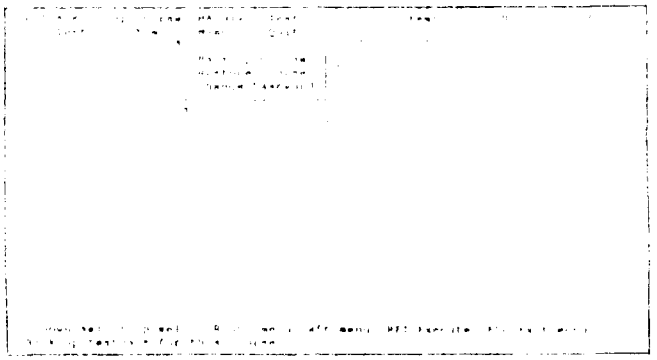

Figure 7-1, Misc Pull-Down Menu

7.1 Back Up Course. The Back Up Course function copies all of the item, reference, and test files from the current course data base to floppy diskette(s). Any testbank information already on the target disks will be automatically deleted prior to the file transfer. However, the back up process will go much faster if you delete all the files from the diskette(s) with a "del *.*" before you use them for the back up process. During the back up process, you will be prompted for a destination disk drive and provided with feedback as the process progresses. This feedback comes in the form of the number of files copied. There are two files for each test item and one for each test. If the floppy diskette becomes full before all the items have been backed up, you will be prompted for a new diskette. Anytime during the back up process you may hit the escape key to abort it.

7.2 Restore Course. The sister function to Back Up Course is Restore Course. The Restore Course function clears your currently active course data base and replaces it with the data base contained on back up diskette(s). Since the current data base is destroyed, you will be prompted to ensure that you wish to pursue this option. The files of the data base will be copied in a fashion very similar to the back up process, and the restore operation may be terminated at any time with the escape key. When a back up diskette has been completely copied, you will be asked if there are any other back up diskettes to be used.

7.3 Change Password. Each course data base will have a specific password associated with it. The password is required to restrict access to the test items and maintain the integrity of the data base. When changing a password, you will be prompted for the old password and then prompted twice for the new password. If all three of your inputs verify, the password will be changed. If any one of your inputs are not correct, the old password will remain in effect.

8.0 TESTBANK ADMINISTRATOR FUNCTIONS

One of the Testbank Administrator's primary duties is to maintain the integrity of the course data bases. There are a number of integrity concerns to be dealt with, and this section describes them. Other areas of responsibility of the Testbank Administrator include the maintenance of back ups and passwords.

8.1 Item Integrity. Item integrity concerns include the format of the items and the elimination of duplicate items. The Testbank Administrator should conduct periodic spot reviews of the course data bases to ensure that newly included items are of a proper format and duplicate items do not exist. An easy way to review items is to create a dummy test using the Build Test option on the Test menu. Use the query form to call up items and check their format. If an item with an improper format exists, call it up with the Modify Item option of the Item menu. Make the necessary corrections, execute the Escape/Write/Document, and then Escape/Quit ChiWriter command sequences. Once you are back in Testbank, respond to the save confirmation prompt with a Shift-F1 (not shown on the display). Your revised version of the item will then replace the errored one.

Things to look for when reviewing an item:

- Removal of point values and sequence numbers.

- First main line of the item should start at the left margin. There should be at least ten blanks at the end of that line and before the right margin. This is required so that sequence numbers and point values may be added to items when they are included into tests.

- Absence of unusual and/or control characters in the text of the item.

- Absence of page breaks in the item.

- A couple of blank lines at the beginning and ending of each item.

The easiest may to look for duplicates is to put your cursor on the Item Number field of the Item Query form (accessed through the Build Test option) and then hit F5. You will be provided a list of the current data base items. Look for items near each other that have identical information, and call them up using the query form. Check to see if they are duplicates. If duplicate items are found, they may be easily deleted using the Delete Item option under the Item menu.

Finally, and perhaps most importantly, the Testbank Administrator should review the quality of items being put into the course data bases. Flawed items, such as those with multiple correct answers, should not be included in the data bases. Other items of questionable quality should either not be included or annotated with appropriate comments in the Comments field of the Reference Data Forms.

8.2 Reference Data Integrity. Another critical area of integrity concerns involves the reference data included with the items. Spotchecks of the reference data can be accomplished in several ways. Items with their reference data may be called up via queries through the Build Test option. Likewise, the reference data for items may be called up directly via the Update Ref Data option of the Item menu.

When reviewing reference data, you should look for the following:

- Consistent use of keywords (printing out a list of the keywords will also help you with this task).

- Appropriate classification of an item's level.

- Correct specification of item statistics as percents.

- Correct ordering of response breakdowns for multiple-choice questions.

- Appropriate and meaningful comments.

Other areas to check regarding reference data include checking that all items have associated reference data and that those items included in already-given tests are updated with the results of the test. Both of these concerns may be handled via the appropriate secondary menu options under the Update Ref Data option.

8.3 Maintenance of Back Ups. In order to ensure that valuable data is not lost due to hardware or operator errors, it is necessary to maintain proper backups of the course data bases. The Testbank Administrator should monitor the Testbank Maintainers to ensure back ups are performed after each session in which they work on a course. The Testbank Administrator should also periodically make a second set of backups and keep them at a different facility. This will preclude losses due to major facility problems.

8.4 Password Maintenance. When a course data base is initially created, its password is initialized to the course name. This password may then be changed via the Misc menu by anyone knowing the current password. If for some reason the password for a course is lost or forgotten, the Testbank Administrator can use the SAVEME program to reset the password to "Testbank." To use the SAVEME program, simply change to the subdirectory for the course and run SAVEME. For example, if Testbank were on my "C" drive and my course was Math 141, I would execute the following commands:

```
C: <enter>
cd testbank <enter>
cd Math141 <enter>
run A:SAVEME <enter>
```

9.0 IMPLEMENTATION SPECIFICS

At times, it may be helpful to know a bit more information about the Testbank software beyond what is provided in Chapter 2. This section provides some of this information. For additional details, consult the Testbank Software Maintainer's Guide and/or the Testbank Software Source Listing.

9.1 Directory Structure. The Testbank software utilizes a simple directory structure to maintain separate course data bases and isolate data from the programs. The top of the structure consists of a TESTBANK directory that resides directly under the disk's root directory. The TESTBANK directory will contain the actual Testbank software and configuration files. Immediately under the TESTBANK directory will be separate subdirectories for each of the course data bases. Figure 9-1 illustrates the structure.

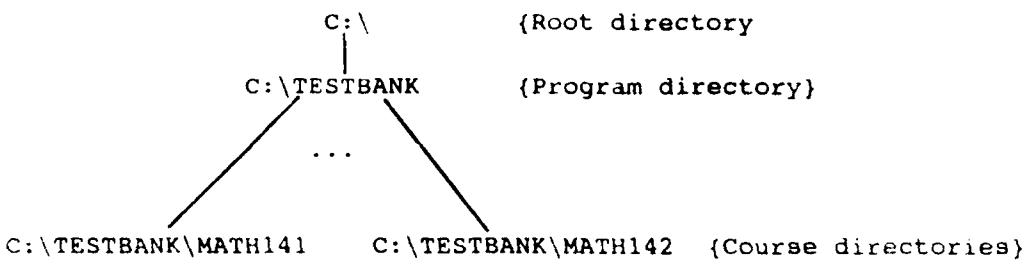

Figure 9-1, Testbank Directory Structure

9.2 File Naming. Within each course directory, the contents of that data base are contained in three types of files. These separate types of files include one type for the items themselves, one type for the reference data, and one type for the test summaries. Notice that built tests exist only in the summary form from which ChiWriter versions are built. This makes it necessary for the Test Developer to write his/her test to a separate file during the Finalize (CHI) option on the Test menu. The names for the three types of files follow the conventions below:

a. Item Files: TInnnnnv.CHI where nnnnn is the item number padded to the left with zeroes and v is the version. The latest version will be "A" and it will be the only version that can be incorporated into tests. Other versions will be named "B," "C,"... and are available only for historical reference purposes. These files are actually encrypted read-only versions of the ChiWriter format items.

b. Reference Files: TInnnnnv.REF where nnnnn is the item number padded to the left with zeroes and v is the version. These files are of a special Testbank software defined format and include one record of data for each time the item was used. When the item is used more than once, a summary record will be included at the end of the file with the accumulated statistics for the item.

c. Test Summary Files: tttvsyy.TST where ttt is the test ID, v is the version (A, B, or M), s is the semester, and yy is the year. An example would be GR1AF90.TST. These files are also of a Testbank software-defined format and include one record for each item included into the test. This record will include the item number, sequence number, point value, and query parameters used to find the item. This file is used as a table of contents for building the actual ChiWriter version of the test.

9.3 Back Up and Restore Functions. The back up and restore functions built into Testbank under the Misc menu are based on copying individual files. While simple and easy to understand, this is not the most efficient means available since DOS limits diskettes to 112 files. A more efficient backup mechanism exists via the DOS BACKUP and RESTORE commands. These commands may be used to back up and restore the contents of the course subdirectories in a more efficient manner.

Appendix A: Error Codes

These error codes are the standard DOS error codes that may also be easily found in the DOS and Turbo Pascal manuals.

DOS ERRORS:

2 - File not found.
3 - Path not found.
4 - Too many files open.
5 - File access denied.
6 - Invalid file handle.
12 - Invalid file access mode.
15 - Invalid drive number.
16 - Cannot remove current directory.
17 - Cannot rename across drives.

INPUT/OUTPUT ERRORS:

100 - Disk read error.
101 - Disk write error.
102 - File not assigned.
103 - File not open.
104 - File not open for input.
105 - File not open for output.
106 - Invalid numeric format.

CRITICAL ERRORS:

150 - Disk is write-protected.
151 - Unknown unit.
152 - Drive not ready.
153 - Unknown command.
154 - CRC error in data.
155 - Bad drive request structure length.
156 - Disk seek error.
157 - Unknown media type.
158 - Sector not found.
159 - Printer out of paper.
160 - Device write fault.
161 - Device read fault.
162 - Hardware failure.

FATAL ERRORS:

200 - Division by zero.
201 - Range check error.
202 - Stack overflow error.
203 - Heap overflow error.
204 - Invalid pointer operation.
205 - Floating point overflow.
206 - Floating point underflow.
207 - Invalid floating point operation.

Appendix B: Item Preparation with ChiWriter

The easiest way to get items for course data bases is by taking them from existing tests created with the ChiWriter word processor. This is done by using ChiWriter to break the test into items and write the items to separate files. This procedure is designed to guide this break out process and create resulting files that may be included into the Testbank data bases without further modification.

1. Start up ChiWriter with the test document (assume the test file to be called: "TEST.CHI" for purposes of illustration).

```
C: <enter>
CD CHI <enter>
CW TEST.CHI <enter>
```

2. Move down to the start of the first item in the test and prepare it for marking. The following critical checks must be done at this point:

a. Ensure there are at least two blank lines (with no page breaks) before and after the item.

b. If the item has a sequence number and/or point value with it, delete the sequence number and point value. This should leave some spaces at the end of this first line. Ensure that there are at least 10 such spaces. (These will be needed when the item is included into a later test so that the new sequence number and point value may be put at the start of the first line without the line growing too long and being truncated.)

c. If the first line of the item contains a lot of super/subscripts, you should consider creating a new first line prior to the current one. This is needed because the Testbank software will prefix the point value and sequence number for an item at the beginning of the first main line of an item. If the item has a lot of supers/subscripts on that line, the point value and sequence number may be put in an inappropriate place.

3. Once step 2 is completed, the item may be marked and written to a file. The following steps should then be observed:

a. Place the cursor at the begining of the two blank lines that precede the item.

b. Execute an Escape/Mark.

c. Move the cursor to the end of the second line after the item and execute an Escape/Write.

d. When prompted for a file name, specify one (to include the device that you wish to write to) and hit <enter>.

e. On an accompanying paper version of the test, write down the file name beside the item for future reference.

4. Repeat steps 2 and 3 for all of the items in the test. If you encounter a matching or similiar question, treat it as a single item.

Appendix C: Modifying Statistic Prediction Coefficients

The formula for predicting the standard deviation of a test built with Testbank includes an experimentally derived coefficient(K). Furthermore, our initial experiments showed that different values for K are needed for graded reviews and for final exams. Within the software, K is set to 0.1571 for graded reviews and 0.2208 for final exams.

These values may be changed by creating a file that contains new values. The file must reside in the Testbank course subdirectory and be named: TBPRED.DAT. (Notice that this mechanism allows each course to have its own new values.)

The TBPRED.DAT file must be a standard ASCII text file with the value for K associated with graded reviews on the first line and the value for the final exam version of K on the second line. Below are examples of the commands needed to create this file for a course named: Math 141 on the C: drive:

```
C:\>COPY CON:\TESTBANK\MATH141\TBPRED.DAT  <Enter>
    0.16  <Enter>
    0.23  <CTRL-Z> <Enter>
```

The K value for graded reviews is now 0.16 and for final exams is now 0.23.

For more information on the statistics prediction formulas, see the Testbank Software Maintenance Guide.